Sustainability & Comfort
Working Group TensiNet

ENVIRONMENTAL PRODUCT DECLARATIONS IN TENSILE ARCHITECTURE

Summary of available EPDs

	EPD or SD	EPD-Number	EPD-Holder	Published by	Validity	Norm	Membrane Material (EPD title)	(kg/m²)
PVC-polyester fabric	EPD 1	EPD-MTX-20130164-IBA1-EN [1]	Mehler Texnologies	IBU	2013-2018	EN15804+A1	PVC-polyester: Valmex FR580	0,58
	EPD 2	EPD-MTX-20130165-IBA1-EN [2]	Mehler Texnologies	IBU	2013-2018	EN15804+A1	PVC-polyester: Valmex FR700	0,70
	EPD 3	EPD-MTX-20130166-IBA1-EN [3]	Mehler Texnologies	IBU	2013-2018	EN15804+A1	PVC-polyester: Valmex FR900	0,90
	EPD 4	EPD-MTX-20130019-IBA1-EN [4]	Mehler Texnologies	IBU	2013-2018	EN15804+A1	PVC-polyester: Valmex FR1000	1,05
	EPD 5	EPD-MTX-20130167-IBA1-EN [5]	Mehler Texnologies	IBU	2013-2018	EN15804+A1	PVC-polyester: Valmex FR1400	1,35
	EPD 6	EPD-MTX-20130168-IBA1-EN [6]	Mehler Texnologies	IBU	2013-2018	EN15804+A1	PVC-polyester: Valmex FR1600	1,55
	EPD 7	4-536:2021 [7]	Serge Ferrari	INIES	2021-2026	EN15804+A1	PVC-polyester: Heavyweight composite membranes 1,144 kg/m2	1,14
	EPD 8	4-535:2021 [8]	Serge Ferrari	INIES	2021-2026	EN15804+A1	PVC-polyester: Lightweight composite membranes 0,564 kg/m2	0,56
	EPD 9	4-534:2021 [9]	Serge Ferrari	INIES	2021-2026	EN15804+A1	PVC-polyester mesh: Tensile composite membranes for interior and exterior applications SOLAR PROTECTION	0,46
	EPD 10	S-P-01441[10]	Serge Ferrari	EPD	2018-2023	EN15804+A1	PVC-polyester mesh: Frontside view 381	0,54
	EPD 11	EPD-SIO-20220324-IBJ1-EN [11]	Sioen Industries NV	IBU	2023-2028	EN15804+A2	PVC-polyester: Technical textile type II	0,90
PTFE-glass fabric	EPD 12	4787277976.101.1 [12]	Saint Gobain, Sheerfill		2017-2023	EN15804+A1	PTFE: Sheerfill II	1,31
	EPD 13	EPD-SER-20240197-IBI1-EN [13]	Verseidag - Serge Ferrari	IBU	2024-2029	EN15804+A2	PTFE: PTFE coated glass fabrics for Tensile Architecture	1,05
	EPD 14	EPD-SER-20240198-IBI1-EN [14]	Verseidag - Serge Ferrari	IBU	2024-2029	EN15804+A2	PTFE mesh: PTFE coated glass fabrics for Tensile Architecture	0,70
ET-Film	SD 15	ETFE-film 0,09mm, 0,157 kg/m², 1744,4 kg/m³ [21]	Nowofol Kunststoffprodukte			EN15804+A1	ETFE: Nowoflon ® - ET Film	0,16
Fluoro-polymer on Poly-arylate mesh	EPD 16	EPD-SER-20230502-IBB2-EN [22]	Serge Ferrari	IBU	2024-2029	EN15804+A2	STFE50: Transparent and structural membrane for tensile architecture	0,85

	EPD or SD	EPD-Number	EPD-Holder	Published by	Validity	Norm	Frame Material for systems	Membrane Material (EPD title)	(kg/m²)
ETFE-cushion system	EPD 17	EPD-VFA-20170121-IBE1-EN [15]	VECTOR FOILTEC	IBU	2018-2023	EN15804+A1	Alu	ETFE: AGC Fluon	4,56
	EPD 18	EPD-DVN-20140043-IBE1-EN [16]	VECTOR FOILTEC	IBU	2014-2019	EN15804+A1	Alu	ETFE: NOWOFLON	5,13
	EPD 19	EPD-TAI-20190092-ICB1-EN [17]	TAIYO	IBU	2019-2024	EN15804+A1	Alu	ETFE: AGC Fluon	3,93
	EPD 20	EPD-NMG-20170152-IBC1-EN [18]	NOVUM	IBU	2017-2023	EN15804+A1	Alu	ETFE: Generic data	4,82
	EPD 21	EPD-DVN-20210122-IBJ2-EN [19]	VECTOR FOILTEC	IBU	2021-2026	EN15804+A2	Alu	ETFE: NOWOFLON	3,89
	EPD 22	EPD-PFE-20220207-IBC2-EN [20]	PFEIFER	IBU	2023-2028	EN15804+A2	Alu	ETFE: Generic data	3,36

This summary was taken from the presentation webinar on LCA introduction. See link to the handouts.

Sustainability & Comfort
Working Group TensiNet

EPD1 – EPD7 Mehler Texnologies

ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Mehler Texnologies GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-MTX-20130164-IBA1-EN
Issue date	05/09/2013
Valid to	05/09/2018

VALMEX® FR 580

Mehler Texnologies GmbH

Institut Bauen und Umwelt e.V.

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

MEHLER TEXNOLOGIES

1. General Information

Mehler Texnologies GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
D-10178 Berlin

Declaration number
EPD-MTX-20130164-IBA1-EN

This Declaration is based on the Product Category Rules:
Technical Textiles, 04-2013
(PCR tested and approved by the independent expert committee)

Issue date
05/09/2013

Valid to
05/09/2018

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

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of SVA)

VALMEX® FR 580

Owner of the Declaration
Mehler Texnologies GmbH
Rheinstraße 11
D-41836 Hückelhoven

Declared product / Declared unit
1m² of VALMEX® FR 580 (7213) technical textile.

Scope:
The declaration covers the product VALMEX® FR 580. The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a polyvinyl fluoride finish. The fully coated fabric weight is 580g/m². The calculations are based on average production data collected during the period 11/2011 to 10/2012.
The producing company is Mehler Texnologies GmbH. The above named products are produced at the production site in Fulda.
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.

Verification

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

Mr Carl-Otto Neven
(Independent tester appointed by SVA)

2. Product

2.1 Product description
The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a Polyvinyl fluoride finish. The base fabric is composed of high tenacity multifilament and low wick treated polyester yarns. The coating mass distribution (CMD) ratio is 3:2 asymmetrically distributed (Topside 3 parts: Reverse side 2 parts). On both sides are at least 4 layers of coating, those include adhesion layer, main coating made out of Polyvinylchloride with several additives, Nano-Titanium dioxide primer and top coat made out of a weldable blend of high concentrated polyvinyl fluoride (PVDF) lacquer. The declared product has a weight of 580 g/m².

2.2 Application
The range of application for those products is mainly tensile architecture. These kinds of structures can be easily integrated into regular buildings, can be very variably shaped and adapted to many forms of construction typologies. These can range from roof coverings, sun-shading elements to façade coverings, interior ceilings and divider elements.
A traditional tensile or lightweight structure performs always under tension instead of compression and bending. The material can be used for permanent or temporary applications. Flexible and harmonic forms are characteristic for this type of architecture. These tensile (or tension) structures can be supported mechanically or pneumatically.

2.3 Technical Data

Constructional data

Name	Value	Unit
Yarn density, /DIN EN 1049-2/ - warp/weft	73/85	Yarn count/dm
Yarn count, /DIN EN ISO 2060/	1100	dtex
Total weight, /DIN EN ISO 2286-1/	580	g/m²
Tensile strength, /DIN EN ISO 1421 V1/ - warp/weft	2900/2700	N/5cm
Tear strength, /DIN 53363/ - warp/weft	300/300	N
Stress/strain behaviour, /CEN TC 248 WG 4/ Draft - warp/weft	4/8	13kN/m in %
Adhesion, internal testing method	16	N/cm
Cold resistance, /DIN EN 1876-1/	-40	°C
Heat resistance, internal testing method	+70	°C
Light fastness, /DIN EN ISO 105 B02/	>6	Grade
Crack resistance, /DIN 53359 A/	100.000 no	Visual

	cracks	assessment
Thermal transmittance, /DIN EN ISO 6946/ - vertical/horizontal	5,7/4,8	W/m²K
Light transmittance, /DIN EN 410/ - solar spectral range	12	%
Light reflection, /DIN EN 410/ - solar spectral range	79	%
Light absorption, /DIN EN 410/ - solar spectral range	9	%

2.4 Placing on the market / Application rules

Tensile architecture applications or technical textiles in general are not regulated completely compared to other standard construction materials and methods. Consequently, the currently valid and available standards or rules for applications and materials may change and vary from country to country.
As indicative basic standards for construction and use of technical textiles the below listed standards and rules may be considered.
1. The International Association for Shell and Spatial Structures (IASS) working groups 6 and 7
2. /DIN 4134/ - Air-supported structures; structure at design, construction and operation, 1983
3. Technical Standards for Specific Membrane Structure Buildings by Membrane Structures Association of Japan, 1996
4. American Society of Civil Engineers (ASCE), SEI/ASCE 37-02 Design Loads on Structures during Construction, 2002
5. The Design of Air Supported Structures by The Institution of Structural Engineers, London 1984
6. Standards Council of Canada (SCC), CAN3-S367-M81: Air Supported Structures, 1981
7. SS UNI U50.00.299.0:1996 Tents, Tensile Structures, Air-supported Structures - Instructions for the Design, Realization, Verification, Use and Maintenance, 1996
8. European Design Guide on Tensile Surface Structures, 2004
9. The latest version of Eurocodes and CEN Technical Committees 248 and 250.

Other common information and accomplishment related to the correct usage of technical textiles for architectural application are collected in the Mehler Guideline for tensile structures available at www.mehler-texnologies.com

2.5 Delivery status

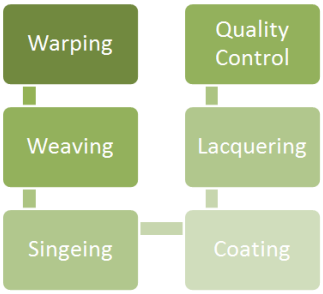
The material is produced as a metre good. The technical textiles are delivered on rolls of different length and width. The amount can be determined by the customer.

2.6 Base materials / Ancillary materials

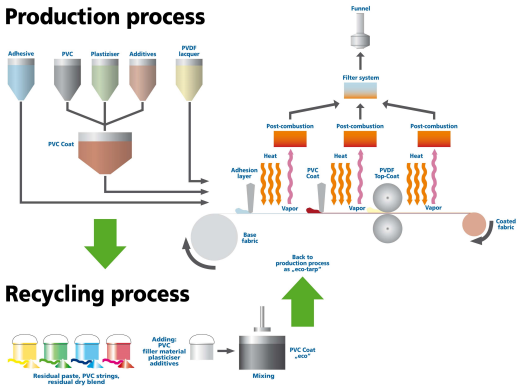
Name	Value	Unit
PVC	35	wt-%
DINP (CAS 28553-12-0)	20	wt-%
PES	30	wt-%
OTHERS including: TiO2 and flame retardants: ATO, ATH	15	wt-%

2.7 Manufacture

During manufacturing the following production steps are processed at Mehler Texnologies GmbH, Fulda.



The quality management system is certified according to /DIN ISO 9001:2008/.
Mehler Texnologies GmbH buys yarns to produce warp beams and weaves fabrics at the weaving mill in Fulda. After weaving, the fabrics undergo a quality control plus a singeing process where minimal fabric irregularities can be corrected as well as defects can be eliminated. Due to the computer controlled coating process a stringent quality control is in place. The products are coated by a knife-coating process. The coating, a PVC plastisol, is brought onto the base fabric and later on dried by infrared emitter. To maintain a good adhesion between fabric and PVC coating an adhesion layer is necessary. Afterwards the PVC coated fabrics are finished by the lacquering process.



The lacquer system is a combination of a primer and a top lacquer. The system contains nano titanium dioxide as well as PVDF. The lacquer is applied on the PVC-polyesters coated base fabric and finally dried by infrared emitters. Thereby the solvents are nearly completely evaporated of the material. The generated vapor is directly treated at post-combustion. Finally, the produced material is inspected and tested according to /DIN ISO 9001:2008/. On customer request a lot certificate and a visual inspection report can be provided.

2.8 Environment and health during manufacturing

The Mehler Texnologies GmbH production sites are subject to the Gefahrstoffverordnung /GefStoffV/, due to its handling of a variety of chemicals.
Furthermore, regular measurements of air quality and noise levels are done. The results are below the compulsory safety value.
In areas where employees are exposed to lacquers, powders etc., prescribed safety clothes and technical safety devices are provided. Regular health checks are mandatory for employees of production sites.

Further regulations and laws which Mehler Texnologies is subject to are:
- Arbeitsschutzgesetz /ArbSchG/
- Betriebssicherheitsverordnung /BetrSichV/
- /Maschinenrichtlinie 2006/42/EG/

2.9 Product processing/Installation

Technical textiles used for architectural application get an interactive functionality with the application performance and need to be handled carefully at several stages, from design to maintenance.

Design:
- Tensile structures are solely subject to tensile stress due to low compressive and bending rigidity. The shape has to be a double curvature to stabilize and distribute the tension, stress and the applied loads on the surface correctly.
- A basic rule in this kind of design is that form follows function
- The structural analysis must be completely integrated into the architectural design. The geometry of the technical textile is established through a "shape generation‘‘(form finding) technique in order to ensure a static equilibrium of the system.
- The pattern of the technical textile is calculated by the deflection finite-element analysis software. During the calculation progressive load deformation is taken into account and consequent compensation or decompensation of the defined fabric pattern geometry is substantial.
- Proper material compensation and application of the biaxial material values are key factors determining project efforts, global costs and long-term performances of the application

Manufacture:
- The production itself can be sub-divided into four phases: intake control and quality inspection of the material, cutting, welding and packing.
- Delivery and quality management consists of practiced good control and re-check of the quality control report. An additional inspection of the material by light tables and seam adhesion tests can be done.
- Once unrolled, the cutting of the patterns can begin. Those are generated using 3D computer models of the whole surface and taking into account the required compensations and the edge corrections for welding seams and edge details. The fabric can be cut by automatic plotting desks or by scissors
- Assembly of the various patterns is done by welding the perimetral edges of the single patterns. Welding is mostly effected by conducting electrical energy in the form of a radio frequency field to the two surfaces that are to be joined together. This stimulates the molecules in the material to move at a speed of approx. 25 million times a second. The friction that arises between the molecules generates the heat that is required to fuse the material layers. A weld seam is thereby created which has the same strength as the surrounding material (tested at 23°C). The fabric can be welded by means of hot air special tools, wherever this operation is mostly chosen for small detail welding processes as corners or on site repairing operation.

Installation:
- The installation of a tensile structure system is a highly specialized field of work requiring experienced staff as well as special and safe access equipment. However the tools and other equipment are standard items used in conventional construction rigging.
- The installation of tensile structures requires reasonable weather conditions. The lightweight of the technical textile, in conjunction with the large surface of exposure, means that work can only proceed at wind speeds of less than 5 m/s. At higher wind speeds lifting operations must be stopped. Installation should also be stopped at temperatures below 10° Celsius.
- The fabric as a secondary structural element is lifted and tied in position by pulling devices and brackets. Afterwards the completed distensile process is secured by linear clamps, steel cables and other permanent fixing devices to the primary structural elements.
- The main task of the technical textile installation team is the approval of the main structure, the installation of the temporary racks, to secure the building site and finally to manage the quality and safety control processes during installation.

Maintenance:
- Regular inspection of the technical textile has to be undertaken as the fabric can be cut, torn or crushed if subjected to high local ‘pinching’ loads, caused by bad design or by inappropriate clamping. If damaged, redistribution of load can result in a concentration of stress that could cause a propagation of tears.
- Fabric Inspection and maintenance manual is provided to the customer with shipment of the goods.

2.10 Packaging

The material is rolled on a cardboard roll core. The finished roll is packed in foil and fixed by PVC tape. Rolls are packed with 3 to 5 rolls on pallets. To guarantee that the rolls are not damaged during transportation, they are covered with cardboard and fastened by steel or plastic strapping.

2.11 Condition of use

There are no changes within the material composition during the use of the product, except extraordinary effects occur (e.g. fire). The long term stability can be measured according to /DIN EN ISO 105 B02/.

2.12 Environment and health during use

Mehler Texnologies GmbH follows a concept that accompanies its products throughout their entire lifecycle, including the incorporation of ecological criteria in the selection of raw materials and the use of environmentally friendly production processes. Mehler Texnologies GmbH only uses substances that suppliers have previously registered as REACH compliant with European Chemicals Agency (ECHA), or that have been approved for the respective use. The products contain no restricted substances in a quantity of more than 0.1 mass percent. None of those substances are persistent, bioaccumulative and toxic according to the criteria set out in Annex XIII to the REACH Regulation (PBT substances). No hidden chemicals are released in the processing (e.g. welding) of the materials and Maximum Allowable Concentrations (MAC) are not exceeded by unregistered substances.

2.13 Reference service life

The documentation of the RSL is not required for the EPD of the company Mehler Texnologies GmbH since not the entire life cycle is declared (without modules B1-B7).

2.14 Extraordinary effects

Fire
/DIN 4102-1: B1/

Water
The declared product is adequate for the outer use. Water has no influence. The product has a good weatherability.

Mechanical destruction
The mechanical destruction of the declared product doesn't lead to a change of the chemical composition.

2.15 Re-use phase
The company Mehler Texnologies GmbH is conscious of its responsibility for acting in an environmentally compatible manner. Therefore, Mehler Texnologies is involved in a range of activities related to recycling and to preserving resources. These activities are participation in external recycling systems like EPcoat, in-house recycling and a sustainable production manner.
Mehler Texnologies GmbH actively supports the commitment of the Vinyl Plus Committee by the overall goal to recycle 800.000t PVC per year by 2020 and furthermore is a member of the Industrieverband Kunststoffbahnen e.V. (IVK Europe). As a consequence Mehler Texnologies is able to use the EPcoat recycling system. The post-consumer PVC coated fabric is recyclable. The material is then shredded and afterwards processed into the recyclate (plastic granulate), which is applied in the production of e.g. windows, pipes and foils. The shredded material is also used in the production of e.g. riding and sport arenas /Schönmackers/.

2.16 Disposal
The waste code of production waste for PVC coated Polyester fabrics is in accordance with the European Waste Index /AVV/ 04 02 09. Within the category of construction waste Technical textiles are not closer specified. Therefore waste code for plastics would apply 17 02 03.

2.17 Further information
Further information about PVC coated Polyester, technical textiles can be found on the companies' homepage.

3. LCA: Calculation rules

3.1 Declared Unit
The functional unit is a production and final treatment of 1 m² of technical textile - product nr **7213** VALMEX® FR 580 with a total weight of 580 g/m².

Declared unit

Name	Value	Unit
Declared unit	1	m²
Conversion factor to 1 kg	1,72413 7931	m²

3.2 System boundary
The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials which are declared in module A1-A3.
In this LCA study scenario of end-of-life (EoL) stage is considered. It is incineration of the technical textiles in the incineration plant which burdens accounted in the module C4.
The collection rate of end-of-life stage is 100%.
In this LCA study the transport of the used product to final disposal was modeled (module C2).
Potential credits for electricity and thermal energy resulting from the waste incineration plant are declared in module D.

3.3 Estimates and assumptions
In this LCA study scenario of end-of-life (EoL) stage is considered. In this case the incineration of the technical textiles has been accounted. The burdens of this process are included in the module C4 (waste incineration plant with R1 < 0,6), but the electricity and energy production – that occurs due to the incineration process – as benefits in the module D.
Even then it has to be mentioned that the post-consumer PVC coated fabrics are recyclable materials (more information in chapter 2.15).
The collection rate of end-of-life stage is 100%.
It has been also assumed that the average transport of post-consumer PVC coated fabrics to the incineration plant is 100 km.

3.4 Cut-off criteria
Several flows (raw materials) were excluded from the LCA study. All excluded flows pass the cut-off criteria: they represent less than 1% and are summing up to less than 5% of the total input (mass) and impact of renewable and non-renewable primary energy usage of mandatory modules (A1-A3).
Machines and facilities required during production are neglected.

3.5 Background data
For life cycle modeling of the considered products, the /GaBi 6 2012 Software System/ for Life Cycle Engineering, developed by PE INTERNATIONAL AG, is used. All relevant background datasets are taken from the GaBi 6 software database. The datasets from the database GaBi used are all PE International datasets and are documented in the online documentation /GaBi 6 2012B/. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

3.6 Data quality
The model for the mandatory modules (A1-A3) was based on primary data (in kg or g per m²) provided by Mehler Texnologies GmbH. Primary data collected covered all the production steps taking place in the production plant: warping, weaving, singeing coating, lacquering, quality control.
All data used in the model is no more than 10 years old.

3.7 Period under review
Data sets are based on 1 year averaged data (time period: November 2011 to October 2012).

3.8 Allocation

The product is produced in one plant. All data were provided by the producer of the product according to 1 m² of technical textile.
The assumptions according EoL of the product are described in the section 3.3.
The modeled thermal utilization of the combustibles in their end-of-life process takes place in a waste-to-energy plant. The allocation is based on a physical classification of the mass flows or calorific values. Benefit and credit for the thermal energy, which is calculated based on country specific "Thermal energy from natural gas" as well as the credit for electricity from the country specific “Power grid mix”, are given in module D.

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.

4. LCA: Scenarios and additional technical information

The following information refer to the declared modules and are the basis for calculations or can be used for further calculations. All indicated values refer to the declared functional unit.

End of life (C1-C4)

Name	Value	Unit
Collected separately	0.58	kg

The collection rate of the post-consumer PVC coated fabrics is 100%. The collected material is incinerated with energy recovery. The average distance to the incineration plant is 100 km.

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² VALMEX® FR 580

Parameter	Unit	A1-A3	C2	C4	D
Global warming potential	[kg CO_2-Eq.]	3.46E+0	2.72E-5	1.46E+0	-9.26E-1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.48E-8	5.68E-16	2.11E-11	-2.80E-10
Acidification potential of land and water	[kg SO_2-Eq.]	1.11E-2	1.23E-7	3.54E-4	-1.28E-3
Eutrophication potential	[kg $(PO_4)^{3-}$ Eq.]	1.31E-3	2.98E-8	2.76E-5	-1.44E-4
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	1.87E-3	-4.23E-8	2.00E-5	-1.18E-4
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	9.19E-3	1.25E-12	2.10E-7	-9.58E-8
Abiotic depletion potential for fossil resources	[MJ]	6.43E+1	3.72E-4	6.88E-1	-1.22E+1

RESULTS OF THE LCA - RESOURCE USE: 1 m² VALMEX® FR 580

Parameter	Unit	A1-A3	C2	C4	D
Renewable primary energy as energy carrier	[MJ]	3.65E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	3.65E+0	2.21E-5	6.57E-2	-1.35E+0
Non renewable primary energy as energy carrier	[MJ]	6.15E+1	IND	IND	IND
Non renewable primary energy as material utilization	[MJ]	7.37E+0	IND	IND	IND
Total use of non renewable primary energy resources	[MJ]	6.89E+1	3.73E-4	7.79E-1	-1.41E+1
Use of secondary material	[kg]	0.00E+0	IND	IND	IND
Use of renewable secondary fuels	[MJ]	1.70E-3	2.78E-9	9.62E-6	-2.04E-4
Use of non renewable secondary fuels	[MJ]	1.77E-2	2.90E-8	1.01E-4	-2.14E-3
Use of net fresh water	[m³]	3.71E-2	2.13E-8	3.60E-3	-2.10E-3

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² VALMEX® FR 580

Parameter	Unit	A1-A3	C2	C4	D
Hazardous waste disposed	[kg]	1.65E-2	0.00E+0	1.48E-1	0.00E+0
Non hazardous waste disposed	[kg]	9.61E-2	7.38E-8	2.99E-4	-5.30E-3
Radioactive waste disposed	[kg]	1.85E-3	5.35E-10	3.77E-5	-8.04E-4
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	2.83E+0	IND
Exported thermal energy	[MJ]	IND	IND	6.79E+0	IND

6. LCA: Interpretation

Primary energy demand

The total use of renewable primary energy resources as well as the total use of non-renewable primary energy is dominated by the mandatory modules (A1-A3), within which the raw material supply (A1) plays the most significant role. The production site (A3) has the second highest contribution to both.
The share of module D in the total use of renewable primary energy resources (PERT) value is due to the energy production via incineration of the technical textiles.

Global warming potential (GWP)

GWP is dominated by the supply chain (A1) due to production of raw materials especially PET, DINP, antimony, and PVC. The supply chain makes more than 71% of the GWP for the mandatory modules, where the production (A3) makes more than 28%. The end-of-life stage contributes in about 30% into the summed value of GWP. At the same time thanks to combustion of the technical textiles there is a decline in the total GWP in around 19%.

Formation potential of tropospheric ozone photochemical oxidants (POCP)

POCP is dominated by the supply of basic materials (PET, DINP, epoxised soy bean oil, PVC, antimony) and the production (A3). Transportation has a minor

but visible impact on the product. The main emissions contributing to this impact category are NMVOCs, benzene, butane, sulfur dioxide, butane, carbon dioxide, and nitrogen oxides. The high benzene emissions, which occur during production of epoxised soy bean oil, make an important contribution into the total POCP value.

Acidification potential (AP)

AP is dominated by the supply of basic materials (e.g. antimony, PET) and the production stage due to the nitrogen dioxide emissions that occur during the lacquering process. Mostly the impact refers to emissions to air: ca. 56% comes from sulfur dioxide and 19% from nitrogen oxides.

Eutrophication potential (EP)

EP is influenced by the supply of basic materials, their transport and the production stage. The nitrogen dioxide emissions from the lacquering process have also a significant contribution to the total EP. Mostly the impact refers to emissions to air (mainly nitrogen oxide and dioxide).

Abiotic depletion potential (ADP)

The ADP **for non fossil resources** is significantly dominated by production of antimony trioxides.
The ADP **for fossil element** is mainly dominated by the supply of basic materials (A1). The contribution of the benefits and loads due to incineration of post-consumer PVC coated fabrics in the end-of-life stage in the total ADP fossil value is around 19%. The energy consumption plays a crucial rule in the ADP fossil element value. The most important energy sources are lignite, hard coal, and natural gas.

Depletion potential of the stratospheric ozone layer (ODP)

The ODP is most notably influenced the supply of basic materials and mainly the production of the polyvinylidene fluoride (PVDF). This results mainly from the upstream supply chain due to production of dichloro-1-fluoroethane that is used for the PVDF. The relevant emissions are trichloroethane and R141b.

7. Requisite evidence

Environmental information of used chemicals from “Material Safety Data Sheets”.

During the application of the lacquer on the PVC-polyesters the generated vapor is directly treated at post-combustion and emitted emissions verified according BImSchV /TÜV SAAR and BImSchV/.

7.1 VOC emissions
The information of the formaldehyde and VOC emissions by /AgBB schema/ AgBB are not relevant for the product because it is applied outside.

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DIN EN ISO 2286-1: Rubber- or plastics-coated fabrics - Determination of roll characteristics - Part 1: Method for determination of the length, width and net mass (ISO 2286-1:1998)

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DIN EN ISO 6946: Building components and building elements - Thermal resistance and thermal transmittance - Calculation method (ISO 6946:2007)

DIN EN ISO 9001
DIN EN ISO 9001:2008: Quality management systems - Requirements

DIN ISO 2060
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EN 1049-2
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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Mehler Texnologies GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-MTX-20130165-IBA1-EN
Issue date	05/09/2013
Valid to	04/09/2018

VALMEX® FR 700

Mehler Texnologies GmbH

Institut Bauen und Umwelt e.V.

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

MEHLER TEXNOLOGIES

1. General Information

Mehler Texnologies GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
D-10178 Berlin

Declaration number
EPD-MTX-20130165-IBA1-EN

This Declaration is based on the Product Category Rules:
Technical Textiles, 04-2013
(PCR tested and approved by the independent expert committee)

Issue date
05/09/2013

Valid to
04/09/2018

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

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of SVA)

VALMEX® FR 700

Owner of the Declaration
Mehler Texnologies GmbH
Rheinstraße 11
D-41836 Hückelhoven

Declared product / Declared unit
1m² of VALMEX® FR 700 (7205) technical textile.

Scope:
The declaration covers the product VALMEX® FR 700. The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a polyvinyl fluoride finish. The fully coated fabric weight is 700g/m². The calculations are based on average production data collected during the period 11/2011 to 10/2012.
The producing company is Mehler Texnologies GmbH. The above named products are produced at the production site in Fulda.
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.

Verification

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

Mr Carl-Otto Neven
(Independent tester appointed by SVA)

2. Product

2.1 Product description
The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a Polyvinyl fluoride finish. The base fabric is composed of high tenacity multifilament and low wick treated polyester yarns. The coating mass distribution (CMD) ratio is 3:2 asymmetrically distributed (Topside 3 parts: Reverse side 2 parts). On both sides are at least 4 layers of coating, those include adhesion layer, main coating made out of Polyvinylchloride with several additives, Nano-Titanium dioxide primer and top coat made out of a weldable blend of high concentrated polyvinyl fluoride (PVDF) lacquer. The declared product has a weight of 700 g/m².

2.2 Application
The range of application for those products is mainly tensile architecture. These kinds of structures can be easily integrated into regular buildings, can be very variably shaped and adapted to many forms of construction typologies. These can range from roof coverings, sun-shading elements to façade coverings, interior ceilings and divider elements.
A traditional tensile or lightweight structure performs always under tension instead of compression and bending. The material can be used for permanent or temporary applications. Flexible and harmonic forms are characteristic for this type of architecture. These tensile (or tension) structures can be supported mechanically or pneumatically.

2.3 Technical Data

Constructional data

Name	Value	Unit
Yarn density, /DIN EN 1049-2/ - warp/weft	83/88	Yarn count/dm
Yarn count, /DIN EN ISO 2060/	1100	dtex
Total weight, /DIN EN ISO 2286-1/	700	g/m²
Tensile strength, /DIN EN ISO 1421 V1/ - warp/weft	3000/3000	N/5cm
Tear strength, /DIN 53363/ - warp/weft	300/300	N
Stress/strain behaviour, /CEN TC 248 WG 4/ Draft - warp/weft	5/11	13kN/m in %
Adhesion, internal testing method	20	N/cm
Cold resistance, /DIN EN 1876-1/	-40	°C
Heat resistance, internal testing method	+70	°C
Light fastness, /DIN EN ISO 105 B02/	>6	Grade
Crack resistance, /DIN 53359 A/	100.000 no	Visual

	cracks	assessment
Thermal transmittance, /DIN EN ISO 6946/ - vertical/horizontal	5,7/4,8	W/m²K
Light transmittance, /DIN EN 410/ - solar spectral range	9	%
Light reflection, /DIN EN 410/ - solar spectral range	81	%
Light absorption, /DIN EN 410/ - solar spectral range	10	%

2.4 Placing on the market / Application rules

Tensile architecture applications or technical textiles in general are not regulated completely compared to other standard construction materials and methods. Consequently, the currently valid and available standards or rules for applications and materials may change and vary from country to country.
As indicative basic standards for construction and use of technical textiles the below listed standards and rules may be considered.
1. The International Association for Shell and Spatial Structures (IASS) working groups 6 and 7
2. /DIN 4134/ - Air-supported structures; structure at design, construction and operation, 1983
3. Technical Standards for Specific Membrane Structure Buildings by Membrane Structures Association of Japan, 1996
4. American Society of Civil Engineers (ASCE), SEI/ASCE 37-02 Design Loads on Structures during Construction, 2002
5. The Design of Air Supported Structures by The Institution of Structural Engineers, London 1984
6. Standards Council of Canada (SCC), CAN3-S367-M81: Air Supported Structures, 1981
7. SS UNI U50.00.299.0:1996 Tents, Tensile Structures, Air-supported Structures - Instructions for the Design, Realization, Verification, Use and Maintenance, 1996
8. European Design Guide on Tensile Surface Structures, 2004
9. The latest version of Eurocodes and CEN Technical Committees 248 and 250.

Other common information and accomplishment related to the correct usage of technical textiles for architectural application are collected in the Mehler Guideline for tensile structures available at www.mehler-texnologies.com

2.5 Delivery status

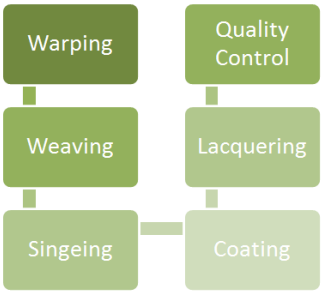
The material is produced as a metre good. The technical textiles are delivered on rolls of different length and width. The amount can be determined by the customer.

2.6 Base materials / Ancillary materials

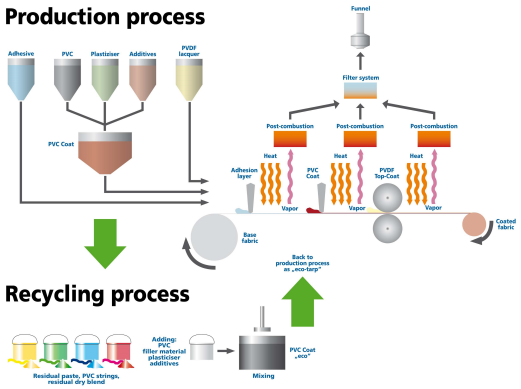
Name	Value	Unit
PVC	35	wt-%
DINP (CAS 28553-12-0)	20	wt-%
PES	30	wt-%
OTHERS including: TiO2 and flame retardants: ATO, ATH	15	wt-%

2.7 Manufacture

During manufacturing the following production steps are processed at Mehler Texnologies GmbH, Fulda.



The quality management system is certified according to /DIN ISO 9001:2008/.
Mehler Texnologies GmbH buys yarns to produce warp beams and weaves fabrics at the weaving mill in Fulda. After weaving, the fabrics undergo a quality control plus a singeing process where minimal fabric irregularities can be corrected as well as defects can be eliminated. Due to the computer controlled coating process a stringent quality control is in place. The products are coated by a knife-coating process. The coating, a PVC plastisol, is brought onto the base fabric and later on dried by infrared emitter. To maintain a good adhesion between fabric and PVC coating an adhesion layer is necessary. Afterwards the PVC coated fabrics are finished by the lacquering process.



The lacquer system is a combination of a primer and a top lacquer. The system contains nano titanium dioxide as well as PVDF. The lacquer is applied on the PVC-polyesters coated base fabric and finally dried by infrared emitters. Thereby the solvents are nearly completely evaporated of the material. The generated vapor is directly treated at post-combustion. Finally, the produced material is inspected and tested according to /DIN ISO 9001:2008/. On customer request a lot certificate and a visual inspection report can be provided.

2.8 Environment and health during manufacturing

The Mehler Texnologies GmbH production sites are subject to the Gefahrstoffverordnung /GefStoffV/, due to its handling of a variety of chemicals.
Furthermore, regular measurements of air quality and noise levels are done. The results are below the compulsory safety value.
In areas where employees are exposed to lacquers, powders etc., prescribed safety clothes and technical safety devices are provided. Regular health checks are mandatory for employees of production sites.

Further regulations and laws which Mehler Texnologies is subject to are:
- Arbeitsschutzgesetz /ArbSchG/
- Betriebssicherheitsverordnung /BetrSichV/
- /Maschinenrichtlinie 2006/42/EG/

2.9 Product processing/Installation

Technical textiles used for architectural application get an interactive functionality with the application performance and need to be handled carefully at several stages, from design to maintenance.

Design:
- Tensile structures are solely subject to tensile stress due to low compressive and bending rigidity. The shape has to be a double curvature to stabilize and distribute the tension, stress and the applied loads on the surface correctly.
- A basic rule in this kind of design is that form follows function
- The structural analysis must be completely integrated into the architectural design. The geometry of the technical textile is established through a "shape generation‘‘(form finding) technique in order to ensure a static equilibrium of the system.
- The pattern of the technical textile is calculated by the deflection finite-element analysis software. During the calculation progressive load deformation is taken into account and consequent compensation or decompensation of the defined fabric pattern geometry is substantial.
- Proper material compensation and application of the biaxial material values are key factors determining project efforts, global costs and long-term performances of the application

Manufacture:
- The production itself can be sub-divided into four phases: intake control and quality inspection of the material, cutting, welding and packing.
- Delivery and quality management consists of practiced good control and re-check of the quality control report. An additional inspection of the material by light tables and seam adhesion tests can be done.
- Once unrolled, the cutting of the patterns can begin. Those are generated using 3D computer models of the whole surface and taking into account the required compensations and the edge corrections for welding seams and edge details.The fabric can be cut by automatic plotting desks or by scissors
- Assembly of the various patterns is done by welding the perimetral edges of the single patterns. Welding is mostly effected by conducting electrical energy in the form of a radio frequency field to the two surfaces that are to be joined together. This stimulates the molecules in the material to move at a speed of approx. 25 million times a second. The friction that arises between the molecules generates the heat that is required to fuse the material layers. A weld seam is thereby created which has the same strength as the surrounding material (tested at 23°C). The fabric can be welded by means of hot air special tools, wherever this operation is mostly chosen for small detail welding processes as corners or on site repairing operation.

Installation:
- The installation of a tensile structure system is a highly specialized field of work requiring experienced staff as well as special and safe access equipment. However the tools and other equipment are standard items used in conventional construction rigging.
- The installation of tensile structures requires reasonable weather conditions. The lightweight of the technical textile, in conjunction with the large surface of exposure, means that work can only proceed at wind speeds of less than 5 m/s. At higher wind speeds lifting operations must be stopped. Installation should also be stopped at temperatures below 10° Celsius.
- The fabric as a secondary structural element is lifted and tied in position by pulling devices and brackets. Afterwards the completed distensile process is secured by linear clamps, steel cables and other permanent fixing devices to the primary structural elements.
- The main task of the technical textile installation team is the approval of the main structure, the installation of the temporary racks, to secure the building site and finally to manage the quality and safety control processes during installation.

Maintenance:
- Regular inspection of the technical textile has to be undertaken as the fabric can be cut, torn or crushed if subjected to high local ‘pinching’ loads, caused by bad design or by inappropriate clamping. If damaged, redistribution of load can result in a concentration of stress that could cause a propagation of tears.
- Fabric Inspection and maintenance manual is provided to the customer with shipment of the goods.

2.10 Packaging

The material is rolled on a cardboard roll core. The finished roll is packed in foil and fixed by PVC tape. Rolls are packed with 3 to 5 rolls on pallets. To guarantee that the rolls are not damaged during transportation, they are covered with cardboard and fastened by steel or plastic strapping.

2.11 Condition of use

There are no changes within the material composition during the use of the product, except extraordinary effects occur (e.g. fire). The long term stability can be measured according to /DIN EN ISO 105 B02/.

2.12 Environment and health during use

Mehler Texnologies GmbH follows a concept that accompanies its products throughout their entire lifecycle, including the incorporation of ecological criteria in the selection of raw materials and the use of environmentally friendly production processes.
Mehler Texnologies GmbH only uses substances that suppliers have previously registered as REACH compliant with European Chemicals Agency (ECHA), or that have been approved for the respective use. The products contain no restricted substances in a quantity of more than 0.1 mass percent. None of those substances are persistent, bioaccumulative and toxic according to the criteria set out in Annex XIII to the REACH Regulation (PBT substances). No hidden chemicals are released in the processing (e.g. welding) of the materials and Maximum Allowable Concentrations (MAC) are not exceeded by unregistered substances.

2.13 Reference service life

The documentation of the RSL is not required for the EPD of the company Mehler Texnologies GmbH since not the entire life cycle is declared (without modules B1-B7).
Nevertheless, the producer specifies that an average applicability of PES-PVC fabrics for textile architecture are 20-25 years /Australian Story/. Products service life

may vary due to application, grade of user know-how, location and maintenance.

2.14 Extraordinary effects

Fire
/DIN 4102-1: B1/

Fire protection

Name	Value
Building material class /EN 13501-1/	B
Smoke gas development EN 13501-1	S2
Burning droplets EN 13501-1	D0

Water
The declared product is adequate for the outer use. Water has no influence. The product has a good weatherability.

Mechanical destruction
The mechanical destruction of the declared product doesn't lead to a change of the chemical composition.

2.15 Re-use phase
The company Mehler Texnologies GmbH is conscious of its responsibility for acting in an environmentally compatible manner. Therefore, Mehler Texnologies is involved in a range of activities related to recycling and to preserving resources. These activities are participation in external recycling systems like EPcoat, in-house recycling and a sustainable production manner.
Mehler Texnologies GmbH actively supports the commitment of the Vinyl Plus Committee by the overall goal to recycle 800.000t PVC per year by 2020 and furthermore is a member of the Industrieverband Kunststoffbahnen e.V. (IVK Europe). As a consequence Mehler Texnologies is able to use the EPcoat recycling system. The post-consumer PVC coated fabric is recyclable. The material is then shredded and afterwards processed into the recyclate (plastic granulate), which is applied in the production of e.g. windows, pipes and foils. The shredded material is also used in the production of e.g. riding and sport arenas /Schönmackers/.

2.16 Disposal
The waste code of production waste for PVC coated Polyester fabrics is in accordance with the European Waste Index /AVV/ 04 02 09. Within the category of construction waste Technical textiles are not closer specified. Therefore waste code for plastics would apply 17 02 03.

2.17 Further information
Further information about PVC coated Polyester, technical textiles can be found on the companies' homepage.

3. LCA: Calculation rules

3.1 Declared Unit
The functional unit is a production and final treatment of 1 m² of technical textile - product nr **7205** VALMEX® FR 700 with a total weight of 700 g/m².

Declared unit

Name	Value	Unit
Declared unit	1	m²
Conversion factor to 1 kg	1,42857 1429	m²

3.2 System boundary
The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials which are declared in module A1-A3.
In this LCA study scenario of end-of-life (EoL) stage is considered. It is incineration of the technical textiles in the incineration plant which burdens accounted in the module C4.
The collection rate of end-of-life stage is 100%.
In this LCA study the transport of the used product to final disposal was modeled (module C2).
Potential credits for electricity and thermal energy resulting from the waste incineration plant are declared in module D.

3.3 Estimates and assumptions
In this LCA study scenario of end-of-life (EoL) stage is considered. In this case the incineration of the technical textiles has been accounted. The burdens of this process are included in the module C4 (waste incineration plant with R1 < 0,6), but the electricity and energy production – that occurs due to the incineration process – as benefits in the module D.
Even then it has to be mentioned that the post-consumer PVC coated fabrics are recyclable materials (more information in chapter 2.15).
The collection rate of end-of-life stage is 100%.
It has been also assumed that the average transport of post-consumer PVC coated fabrics to the incineration plant is 100 km.

3.4 Cut-off criteria
Several flows (raw materials) were excluded from the LCA study. All excluded flows pass the cut-off criteria: they represent less than 1% and are summing up to less than 5% of the total input (mass) and impact of renewable and non-renewable primary energy usage of mandatory modules (A1-A3).
Machines and facilities required during production are neglected.

3.5 Background data
For life cycle modeling of the considered products, the /GaBi 6 2012 Software System/ for Life Cycle Engineering, developed by PE INTERNATIONAL AG, is used. All relevant background datasets are taken from the GaBi 6 software database. The datasets from the database GaBi used are all PE International datasets and are documented in the online documentation /GaBi 6 2012B/. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

3.6 Data quality
The model for the mandatory modules (A1-A3) was based on primary data (in kg or g per m²) provided by Mehler Texnologies GmbH. Primary data collected covered all the production steps taking place in the

production plant: warping, weaving, singeing coating, lacquering, quality control.
All data used in the model is no more than 10 years old.

3.7 Period under review

Data sets are based on 1 year averaged data (time period: November 2011 to October 2012).

3.8 Allocation

The product is produced in one plant. All data were provided by the producer of the product according to 1 m² of technical textile.
The assumptions according EoL of the product are described in the section 3.3.

The modeled thermal utilization of the combustibles in their end-of-life process takes place in a waste-to-energy plant. The allocation is based on a physical classification of the mass flows or calorific values. Benefit and credit for the thermal energy, which is calculated based on country specific "Thermal energy from natural gas" as well as the credit for electricity from the country specific “Power grid mix”, are given in module D.

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.

4. LCA: Scenarios and additional technical information

The following information refer to the declared modules and are the basis for calculations or can be used for further calculations. All indicated values refer to the declared functional unit.

End of life (C1-C4)

Name	Value	Unit
Collected separately	0.7	kg

The collection rate of the post-consumer PVC coated fabrics is 100%. The collected material is incinerated with energy recovery. The average distance to the incineration plant is 100 km.

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² VALMEX® FR 700

Parameter	Unit	A1-A3	C2	C4	D
Global warming potential	[kg CO_2-Eq.]	4.00E+0	3.28E-5	1.77E+0	-1.12E+0
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	5.22E-8	6.86E-16	2.55E-11	-3.38E-10
Acidification potential of land and water	[kg SO_2-Eq.]	1.38E-2	1.49E-7	4.28E-4	-1.55E-3
Eutrophication potential	[kg $(PO_4)^{3-}$ Eq.]	1.68E-3	3.60E-8	3.33E-5	-1.74E-4
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	2.32E-3	-5.11E-8	2.42E-5	-1.42E-4
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	1.21E-2	1.51E-12	2.53E-7	-1.16E-7
Abiotic depletion potential for fossil resources	[MJ]	7.54E+1	4.49E-4	8.30E-1	-1.47E+1

RESULTS OF THE LCA - RESOURCE USE: 1 m² VALMEX® FR 700

Parameter	Unit	A1-A3	C2	C4	D
Renewable primary energy as energy carrier	[MJ]	4.15E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	4.15E+0	2.67E-5	7.93E-2	-1.63E+0
Non renewable primary energy as energy carrier	[MJ]	7.16E+1	IND	IND	IND
Non renewable primary energy as material utilization	[MJ]	8.72E+0	IND	IND	IND
Total use of non renewable primary energy resources	[MJ]	8.03E+1	4.50E-4	9.41E-1	-1.71E+1
Use of secondary material	[kg]	0.00E+0	IND	IND	IND
Use of renewable secondary fuels	[MJ]	2.08E-3	3.35E-9	1.16E-5	-2.46E-4
Use of non renewable secondary fuels	[MJ]	2.16E-2	3.50E-8	1.22E-4	-2.58E-3
Use of net fresh water	[m³]	4.65E-2	2.57E-8	4.35E-3	-2.53E-3

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² VALMEX® FR 700

Parameter	Unit	A1-A3	C2	C4	D
Hazardous waste disposed	[kg]	1.76E-2	0.00E+0	1.78E-1	0.00E+0
Non hazardous waste disposed	[kg]	1.22E-1	8.91E-8	3.61E-4	-6.39E-3
Radioactive waste disposed	[kg]	2.04E-3	6.46E-10	4.55E-5	-9.70E-4
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	3.41E+0	IND
Exported thermal energy	[MJ]	IND	IND	8.20E+0	IND

6. LCA: Interpretation

Primary energy demand

The total use of renewable primary energy resources as well as the total use of non-renewable primary energy is dominated by the mandatory modules (A1-A3), within which the raw material supply (A1) plays the most significant role. The production site (A3) has the second highest contribution to both.
The share of module D in the total use of renewable primary energy resources (PERT) value is due to the energy production via incineration of the technical textiles.

Global warming potential (GWP)

GWP is dominated by the supply chain (A1) due to production of raw materials especially PET, DINP, antimony, and PVC. The supply chain makes almost 82% of the GWP for the mandatory modules, where the production (A3) makes less than 18%. The end-of-life stage contributes in about 31% into the summed value of GWP. At the same time thanks to combustion of the technical textiles there is a decline in the total GWP in around 19%.

Formation potential of tropospheric ozone photochemical oxidants (POCP)

POCP is dominated by the supply of basic materials (PET, DINP, epoxised soy bean oil, PVC, antimony) and the production (A3). Transportation has a minor

but visible impact on the product. The main emissions contributing to this impact category are NMVOCs, benzene, butane, sulfur dioxide, butane, carbon dioxide, and nitrogen oxides. The high benzene emissions, which occur during production of epoxised soy bean oil, make an important contribution into the total POCP value.

Acidification potential (AP)

AP is dominated by the supply of basic materials (e.g. antimony, PET) and the production stage due to the nitrogen dioxide emissions that occur during the lacquering process. Mostly the impact refers to emissions to air: ca. 55% comes from sulfur dioxide and 18% from nitrogen oxides.

Eutrophication potential (EP)

EP is influenced by the supply of basic materials, their transport and the production stage. The nitrogen dioxide emissions from the lacquering process have also a significant contribution to the total EP. Mostly the impact refers to emissions to air (mainly nitrogen oxide and dioxide).

Abiotic depletion potential (ADP)

The ADP **for non fossil resources** is significantly dominated by production of antimony trioxides.
The ADP **for fossil element** is mainly dominated by the supply of basic materials (A1). The contribution of the benefits and loads due to incineration of post-consumer PVC coated fabrics in the end-of-life stage in the total ADP fossil value is around 19%. The energy consumption plays a crucial rule in the ADP fossil element value. The most important energy sources are lignite, hard coal, and natural gas.

Depletion potential of the stratospheric ozone layer (ODP)

The ODP is most notably influenced the supply of basic materials and mainly the production of the polyvinylidene fluoride (PVDF). This results mainly from the upstream supply chain due to production of dichloro-1-fluoroethane that is used for the PVDF. The relevant emissions are trichloroethane and R141b.

7. Requisite evidence

Environmental information of used chemicals from “Material Safety Data Sheets”.

During the application of the lacquer on the PVC-polyesters the generated vapor is directly treated at post-combustion and emitted emissions verified according BImSchV /TÜV SAAR and BImSchV/.

7.1 VOC emissions

The information of the formaldehyde and VOC emissions by /AgBB schema/ AgBB are not relevant for the product because it is applied outside.

8. References

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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Mehler Texnologies GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-MTX-20130166-IBA1-EN
Issue date	05/09/2013
Valid to	04/09/2018

VALMEX® FR 900

Mehler Texnologies GmbH

Institut Bauen und Umwelt e.V.

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

MEHLER TEXNOLOGIES

1. General Information

Mehler Texnologies GmbH

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IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
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Declaration number
EPD-MTX-20130166-IBA1-EN

This Declaration is based on the Product Category Rules:
Technical Textiles, 04-2013
(PCR tested and approved by the independent expert committee)

Issue date
05/09/2013

Valid to
04/09/2018

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

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of SVA)

VALMEX® FR 900

Owner of the Declaration
Mehler Texnologies GmbH
Rheinstraße 11
D-41836 Hückelhoven

Declared product / Declared unit
1m² of VALMEX® FR 900 (7211) technical textile.

Scope:
The declaration covers the product VALMEX® FR 900. The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a polyvinyl fluoride finish. The fully coated fabric weight is 900g/m². The calculations are based on average production data collected during the period 11/2011 to 10/2012.
The producing company is Mehler Texnologies GmbH. The above named products are produced at the production site in Fulda.
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.

Verification

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

Mr Carl-Otto Neven
(Independent tester appointed by SVA)

2. Product

2.1 Product description
The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a Polyvinyl fluoride finish. The base fabric is composed of high tenacity multifilament and low wick treated polyester yarns. The coating mass distribution (CMD) ratio is 3:2 asymmetrically distributed (Topside 3 parts: Reverse side 2 parts). On both sides are at least 4 layers of coating, those include adhesion layer, main coating made out of Polyvinylchloride with several additives, Nano-Titanium dioxide primer and top coat made out of a weldable blend of high concentrated polyvinyl fluoride (PVDF) lacquer. The declared product has a weight of 900 g/m².

2.2 Application
The range of application for those products is mainly tensile architecture. These kinds of structures can be easily integrated into regular buildings, can be very variably shaped and adapted to many forms of construction typologies. These can range from roof coverings, sun-shading elements to façade coverings, interior ceilings and divider elements.
A traditional tensile or lightweight structure performs always under tension instead of compression and bending. The material can be used for permanent or temporary applications. Flexible and harmonic forms are characteristic for this type of architecture. These tensile (or tension) structures can be supported mechanically or pneumatically.

2.3 Technical Data

Constructional data

Name	Value	Unit
Yarn density, /DIN EN 1049-2/ - warp/weft	110/125	Yarn count/dm
Yarn count, /DIN EN ISO 2060/	1100	dtex
Total weight, /DIN EN ISO 2286-1/	900	g/m²
Tensile strength, /DIN EN ISO 1421 V1/ - warp/weft	4300/4200	N/5cm
Tear strength, /DIN 53363/ - warp/weft	500/500	N
Stress/strain behaviour, /CEN TC 248 WG 4/ Draft - warp/weft	7/10	20kN/m in %
Adhesion, internal testing method	25	N/cm
Cold resistance, /DIN EN 1876-1/	-40	°C
Heat resistance, internal testing method	+70	°C
Light fastness, /DIN EN ISO 105 B02/	>6	Grade
Crack resistance, /DIN 53359 A/	100.000 no	Visual

	cracks	assessment
Thermal transmittance, /DIN EN ISO 6946/ - vertical/horizontal	5,7/4,8	W/m²K
Light transmittance, /DIN EN 410/ - solar spectral range	7	%
Light reflection, /DIN EN 410/ - solar spectral range	82	%
Light absorption, /DIN EN 410/ - solar spectral range	11	%

2.4 Placing on the market / Application rules

Tensile architecture applications or technical textiles in general are not regulated completely compared to other standard construction materials and methods. Consequently, the currently valid and available standards or rules for applications and materials may change and vary from country to country.
As indicative basic standards for construction and use of technical textiles the below listed standards and rules may be considered.
1. The International Association for Shell and Spatial Structures (IASS) working groups 6 and 7
2. /DIN 4134/ - Air-supported structures; structure at design, construction and operation, 1983
3. Technical Standards for Specific Membrane Structure Buildings by Membrane Structures Association of Japan, 1996
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8. European Design Guide on Tensile Surface Structures, 2004
9. The latest version of Eurocodes and CEN Technical Committees 248 and 250.

Other common information and accomplishment related to the correct usage of technical textiles for architectural application are collected in the Mehler Guideline for tensile structures available at www.mehler-texnologies.com

2.5 Delivery status

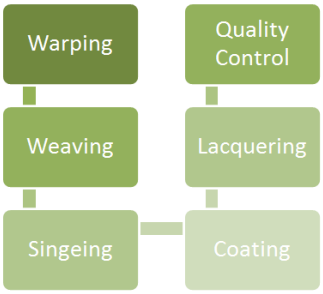
The material is produced as a metre good. The technical textiles are delivered on rolls of different length and width. The amount can be determined by the customer.

2.6 Base materials / Ancillary materials

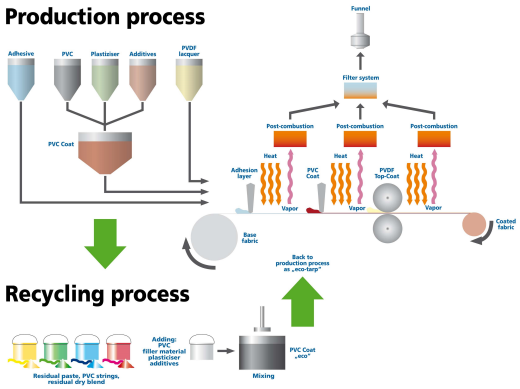
Name	Value	Unit
PVC	35	wt-%
DINP (CAS 28553-12-0)	20	wt-%
PES	30	wt-%
OTHERS including: TiO2 and flame retardants: ATO, ATH	15	wt-%

2.7 Manufacture

During manufacturing the following production steps are processed at Mehler Texnologies GmbH, Fulda.



The quality management system is certified according to /DIN ISO 9001:2008/.
Mehler Texnologies GmbH buys yarns to produce warp beams and weaves fabrics at the weaving mill in Fulda. After weaving, the fabrics undergo a quality control plus a singeing process where minimal fabric irregularities can be corrected as well as defects can be eliminated. Due to the computer controlled coating process a stringent quality control is in place. The products are coated by a knife-coating process. The coating, a PVC plastisol, is brought onto the base fabric and later on dried by infrared emitter. To maintain a good adhesion between fabric and PVC coating an adhesion layer is necessary. Afterwards the PVC coated fabrics are finished by the lacquering process.



The lacquer system is a combination of a primer and a top lacquer. The system contains nano titanium dioxide as well as PVDF. The lacquer is applied on the PVC-polyesters coated base fabric and finally dried by infrared emitters. Thereby the solvents are nearly completely evaporated of the material. The generated vapor is directly treated at post-combustion. Finally, the produced material is inspected and tested according to /DIN ISO 9001:2008/. On customer request a lot certificate and a visual inspection report can be provided.

2.8 Environment and health during manufacturing

The Mehler Texnologies GmbH production sites are subject to the Gefahrstoffverordnung /GefStoffV/, due to its handling of a variety of chemicals.
Furthermore, regular measurements of air quality and noise levels are done. The results are below the compulsory safety value.
In areas where employees are exposed to lacquers, powders etc., prescribed safety clothes and technical safety devices are provided. Regular health checks are mandatory for employees of production sites.

Further regulations and laws which Mehler Texnologies is subject to are:
- Arbeitsschutzgesetz /ArbSchG/
- Betriebssicherheitsverordnung /BetrSichV/
- /Maschinenrichtlinie 2006/42/EG/

2.9 Product processing/Installation

Technical textiles used for architectural application get an interactive functionality with the application performance and need to be handled carefully at several stages, from design to maintenance.

Design:
- Tensile structures are solely subject to tensile stress due to low compressive and bending rigidity. The shape has to be a double curvature to stabilize and distribute the tension, stress and the applied loads on the surface correctly.
- A basic rule in this kind of design is that form follows function
- The structural analysis must be completely integrated into the architectural design. The geometry of the technical textile is established through a "shape generation‘‘(form finding) technique in order to ensure a static equilibrium of the system.
- The pattern of the technical textile is calculated by the deflection finite-element analysis software. During the calculation progressive load deformation is taken into account and consequent compensation or decompensation of the defined fabric pattern geometry is substantial.
- Proper material compensation and application of the biaxial material values are key factors determining project efforts, global costs and long-term performances of the application

Manufacture:
- The production itself can be sub-divided into four phases: intake control and quality inspection of the material, cutting, welding and packing.
- Delivery and quality management consists of practiced good control and re-check of the quality control report. An additional inspection of the material by light tables and seam adhesion tests can be done.
- Once unrolled, the cutting of the patterns can begin. Those are generated using 3D computer models of the whole surface and taking into account the required compensations and the edge corrections for welding seams and edge details.The fabric can be cut by automatic plotting desks or by scissors
- Assembly of the various patterns is done by welding the perimetral edges of the single patterns. Welding is mostly effected by conducting electrical energy in the form of a radio frequency field to the two surfaces that are to be joined together. This stimulates the molecules in the material to move at a speed of approx. 25 million times a second. The friction that arises between the molecules generates the heat that is required to fuse the material layers. A weld seam is thereby created which has the same strength as the surrounding material (tested at 23°C). The fabric can be welded by means of hot air special tools, wherever this operation is mostly chosen for small detail welding processes as corners or on site repairing operation.

Installation:
- The installation of a tensile structure system is a highly specialized field of work requiring experienced staff as well as special and safe access equipment. However the tools and other equipment are standard items used in conventional construction rigging.
- The installation of tensile structures requires reasonable weather conditions. The lightweight of the technical textile, in conjunction with the large surface of exposure, means that work can only proceed at wind speeds of less than 5 m/s. At higher wind speeds lifting operations must be stopped. Installation should also be stopped at temperatures below 10° Celsius.
- The fabric as a secondary structural element is lifted and tied in position by pulling devices and brackets. Afterwards the completed distensile process is secured by linear clamps, steel cables and other permanent fixing devices to the primary structural elements.
- The main task of the technical textile installation team is the approval of the main structure, the installation of the temporary racks, to secure the building site and finally to manage the quality and safety control processes during installation.

Maintenance:
- Regular inspection of the technical textile has to be undertaken as the fabric can be cut, torn or crushed if subjected to high local ‘pinching’ loads, caused by bad design or by inappropriate clamping. If damaged, redistribution of load can result in a concentration of stress that could cause a propagation of tears.
- Fabric Inspection and maintenance manual is provided to the customer with shipment of the goods.

2.10 Packaging

The material is rolled on a cardboard roll core. The finished roll is packed in foil and fixed by PVC tape. Rolls are packed with 3 to 5 rolls on pallets. To guarantee that the rolls are not damaged during transportation, they are covered with cardboard and fastened by steel or plastic strapping.

2.11 Condition of use

There are no changes within the material composition during the use of the product, except extraordinary effects occur (e.g. fire). The long term stability can be measured according to /DIN EN ISO 105 B02/.

2.12 Environment and health during use

Mehler Texnologies GmbH follows a concept that accompanies its products throughout their entire lifecycle, including the incorporation of ecological criteria in the selection of raw materials and the use of environmentally friendly production processes.
Mehler Texnologies GmbH only uses substances that suppliers have previously registered as REACH compliant with European Chemicals Agency (ECHA), or that have been approved for the respective use. The products contain no restricted substances in a quantity of more than 0.1 mass percent. None of those substances are persistent, bioaccumulative and toxic according to the criteria set out in Annex XIII to the REACH Regulation (PBT substances). No hidden chemicals are released in the processing (e.g. welding) of the materials and Maximum Allowable Concentrations (MAC) are not exceeded by unregistered substances.

2.13 Reference service life

The documentation of the RSL is not required for the EPD of the company Mehler Texnologies GmbH since not the entire life cycle is declared (without modules B1-B7).
Nevertheless, the producer specifies that an average applicability of PES-PVC fabrics for textile architecture are 20-25 years /Australian Story/. Products service life

may vary due to application, grade of user know-how, location and maintenance.

2.14 Extraordinary effects

Fire
/DIN 4102-1: B1/

Fire protection

Name	Value
Building material class /EN 13501-1/	B
Smoke gas development EN 13501-1	S2
Burning droplets EN 13501-1	D0

Water
The declared product is adequate for the outer use. Water has no influence. The product has a good weatherability.

Mechanical destruction
The mechanical destruction of the declared product doesn't lead to a change of the chemical composition.

2.15 Re-use phase
The company Mehler Texnologies GmbH is conscious of its responsibility for acting in an environmentally compatible manner. Therefore, Mehler Texnologies is involved in a range of activities related to recycling and to preserving resources. These activities are participation in external recycling systems like EPcoat, in-house recycling and a sustainable production manner.
Mehler Texnologies GmbH actively supports the commitment of the Vinyl Plus Committee by the overall goal to recycle 800.000t PVC per year by 2020 and furthermore is a member of the Industrieverband Kunststoffbahnen e.V. (IVK Europe). As a consequence Mehler Texnologies is able to use the EPcoat recycling system. The post-consumer PVC coated fabric is recyclable. The material is then shredded and afterwards processed into the recyclate (plastic granulate), which is applied in the production of e.g. windows, pipes and foils. The shredded material is also used in the production of e.g. riding and sport arenas /Schönmackers/.

2.16 Disposal
The waste code of production waste for PVC coated Polyester fabrics is in accordance with the European Waste Index /AVV/ 04 02 09. Within the category of construction waste Technical textiles are not closer specified. Therefore waste code for plastics would apply 17 02 03.

2.17 Further information
Further information about PVC coated Polyester, technical textiles can be found on the companies' homepage.

3. LCA: Calculation rules

3.1 Declared Unit
The functional unit is a production and final treatment of 1 m² of technical textile - product nr **7211** VALMEX® FR 900 with a total weight of 900 g/m².

Declared unit

Name	Value	Unit
Declared unit	1	m²
Conversion factor to 1 kg	1,11111 1111	m²

3.2 System boundary
The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials which are declared in module A1-A3.
In this LCA study scenario of end-of-life (EoL) stage is considered. It is incineration of the technical textiles in the incineration plant which burdens accounted in the module C4.
The collection rate of end-of-life stage is 100%.
In this LCA study the transport of the used product to final disposal was modeled (module C2).
Potential credits for electricity and thermal energy resulting from the waste incineration plant are declared in module D.

3.3 Estimates and assumptions
In this LCA study scenario of end-of-life (EoL) stage is considered. In this case the incineration of the technical textiles has been accounted. The burdens of this process are included in the module C4 (waste incineration plant with R1 < 0,6), but the electricity and energy production – that occurs due to the incineration process – as benefits in the module D.
Even then it has to be mentioned that the post-consumer PVC coated fabrics are recyclable materials (more information in chapter 2.15).
The collection rate of end-of-life stage is 100%.
It has been also assumed that the average transport of post-consumer PVC coated fabrics to the incineration plant is 100 km.

3.4 Cut-off criteria
Several flows (raw materials) were excluded from the LCA study. All excluded flows pass the cut-off criteria: they represent less than 1% and are summing up to less than 5% of the total input (mass) and impact of renewable and non-renewable primary energy usage of mandatory modules (A1-A3).
Machines and facilities required during production are neglected.

3.5 Background data
For life cycle modeling of the considered products, the /GaBi 6 2012 Software System/ for Life Cycle Engineering, developed by PE INTERNATIONAL AG, is used. All relevant background datasets are taken from the GaBi 6 software database. The datasets from the database GaBi used are all PE International datasets and are documented in the online documentation /GaBi 6 2012B/. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

3.6 Data quality
The model for the mandatory modules (A1-A3) was based on primary data (in kg or g per m²) provided by Mehler Texnologies GmbH. Primary data collected covered all the production steps taking place in the

production plant: warping, weaving, singeing coating, lacquering, quality control.
All data used in the model is no more than 10 years old.

3.7 Period under review

Data sets are based on 1 year averaged data (time period: November 2011 to October 2012).

3.8 Allocation

The product is produced in one plant. All data were provided by the producer of the product according to 1 m² of technical textile.
The assumptions according EoL of the product are described in the section 3.3.

The modeled thermal utilization of the combustibles in their end-of-life process takes place in a waste-to-energy plant. The allocation is based on a physical classification of the mass flows or calorific values. Benefit and credit for the thermal energy, which is calculated based on country specific "Thermal energy from natural gas" as well as the credit for electricity from the country specific “Power grid mix”, are given in module D.

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.

4. LCA: Scenarios and additional technical information

The following information refer to the declared modules and are the basis for calculations or can be used for further calculations. All indicated values refer to the declared functional unit.

End of life (C1-C4)

Name	Value	Unit
Collected separately	0.9	kg

The collection rate of the post-consumer PVC coated fabrics is 100%. The collected material is incinerated with energy recovery. The average distance to the incineration plant is 100 km.

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² VALMEX® FR 900

Parameter	Unit	A1-A3	C2	C4	D
Global warming potential	[kg CO_2-Eq.]	4.72E+0	4.22E-5	2.27E+0	-1.44E+0
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	7.60E-8	8.81E-16	3.28E-11	-4.35E-10
Acidification potential of land and water	[kg SO_2-Eq.]	1.63E-2	1.91E-7	5.50E-4	-1.99E-3
Eutrophication potential	[kg $(PO_4)^{3-}$ Eq.]	1.91E-3	4.62E-8	4.28E-5	-2.24E-4
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	2.78E-3	-6.57E-8	3.11E-5	-1.83E-4
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	1.46E-2	1.95E-12	3.26E-7	-1.49E-7
Abiotic depletion potential for fossil resources	[MJ]	8.99E+1	5.77E-4	1.07E+0	-1.89E+1

RESULTS OF THE LCA - RESOURCE USE: 1 m² VALMEX® FR 900

Parameter	Unit	A1-A3	C2	C4	D
Renewable primary energy as energy carrier	[MJ]	4.98E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	4.98E+0	3.43E-5	1.02E-1	-2.09E+0
Non renewable primary energy as energy carrier	[MJ]	8.47E+1	IND	IND	IND
Non renewable primary energy as material utilization	[MJ]	1.11E+1	IND	IND	IND
Total use of non renewable primary energy resources	[MJ]	9.58E+1	5.79E-4	1.21E+0	-2.19E+1
Use of secondary material	[kg]	0.00E+0	IND	IND	IND
Use of renewable secondary fuels	[MJ]	2.54E-3	4.31E-9	1.49E-5	-3.17E-4
Use of non renewable secondary fuels	[MJ]	2.64E-2	4.50E-8	1.56E-4	-3.32E-3
Use of net fresh water	[m³]	5.60E-2	3.30E-8	5.59E-3	-3.26E-3

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² VALMEX® FR 900

Parameter	Unit	A1-A3	C2	C4	D
Hazardous waste disposed	[kg]	1.96E-2	0.00E+0	2.29E-1	0.00E+0
Non hazardous waste disposed	[kg]	1.51E-1	1.15E-7	4.64E-4	-8.22E-3
Radioactive waste disposed	[kg]	2.44E-3	8.31E-10	5.85E-5	-1.25E-3
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	4.38E+0	IND
Exported thermal energy	[MJ]	IND	IND	1.05E+1	IND

6. LCA: Interpretation

Primary energy demand

The total use of renewable primary energy resources as well as the total use of non-renewable primary energy is dominated by the mandatory modules (A1-A3), within which the raw material supply (A1) plays the most significant role. The production site (A3) has the second highest contribution to both.
The share of module D in the total use of renewable primary energy resources (PERT) value is due to the energy production via incineration of the technical textiles.

Global warming potential (GWP)

GWP is dominated by the supply chain (A1) due to production of raw materials especially PET, DINP, antimony, and PVC. The supply chain makes almost 82% of the GWP for the mandatory modules, where the production (A3) makes less than 18%. The end-of-life stage contributes in about 32% into the summed value of GWP. At the same time thanks to combustion of the technical textiles there is a decline in the total GWP in around 21%.

Formation potential of tropospheric ozone photochemical oxidants (POCP)

POCP is dominated by the supply of basic materials (PET, DINP, epoxised soy bean oil, PVC, antimony) and the production (A3). Transportation has a minor

but visible impact on the product. The main emissions contributing to this impact category are NMVOCs, benzene, butane, sulfur dioxide, butane, carbon dioxide, and nitrogen oxides. The high benzene emissions, which occur during production of epoxised soy bean oil, make an important contribution into the total POCP value.

Acidification potential (AP)

AP is dominated by the supply of basic materials (e.g. antimony, PET) and the production stage due to the nitrogen dioxide emissions that occur during the lacquering process. Mostly the impact refers to emissions to air: ca. 56% comes from sulfur dioxide and 18% from nitrogen oxides.

Eutrophication potential (EP)

EP is influenced by the supply of basic materials, their transport and the production stage. The nitrogen dioxide emissions from the lacquering process have also a significant contribution to the total EP. Mostly the impact refers to emissions to air (mainly nitrogen oxide and dioxide).

Abiotic depletion potential (ADP)

The ADP **for non fossil resources** is significantly dominated by production of antimony trioxides.
The ADP **for fossil element** is mainly dominated by the supply of basic materials (A1). The contribution of the benefits and loads due to incineration of post-consumer PVC coated fabrics in the end-of-life stage in the total ADP fossil value is around 21%. The energy consumption plays a crucial rule in the ADP fossil element value. The most important energy sources are lignite, hard coal, and natural gas.

Depletion potential of the stratospheric ozone layer (ODP)

The ODP is most notably influenced the supply of basic materials and mainly the production of the polyvinylidene fluoride (PVDF). This results mainly from the upstream supply chain due to production of dichloro-1-fluoroethane that is used for the PVDF. The relevant emissions are trichloroethane and R141b.

7. Requisite evidence

Environmental information of used chemicals from “Material Safety Data Sheets”.

During the application of the lacquer on the PVC-polyesters the generated vapor is directly treated at post-combustion and emitted emissions verified according BImSchV /TÜV SAAR and BImSchV/.

7.1 VOC emissions
The information of the formaldehyde and VOC emissions by /AgBB schema/ AgBB are not relevant for the product because it is applied outside.

8. References

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DIN ISO 2060
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European Design Guide on Tensile Surface Structures, 2004. http://www.tensinet.com

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GaBi 6: Documentation of GaBi 6-Datasets for life cycle engineering. LBP University of Stuttgart and PE INTERNATIONAL AG, 2012. http://documentation.gabi-software.com

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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Mehler Texnologies GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-MTX-20130019-IBA1-EN
Issue date	17/07/2013
Valid to	16/07/2018

VALMEX® FR 1000

Mehler Texnologies GmbH

Institut Bauen und Umwelt e.V.

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

MEHLER TEXNOLOGIES

1. General Information

Mehler Texnologies GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Rheinufer 108
D-53639 Königswinter

Declaration number
EPD-MTX-20130019-IBA1-EN

This Declaration is based on the Product Category Rules:
Technical Textiles, 04-2013
(PCR tested and approved by the independent expert committee)

Issue date
17/07/2013

Valid to
16/07/2018

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

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of SVA)

VALMEX® FR 1000

Owner of the Declaration
Mehler Texnologies GmbH
Rheinstraße 11
D-41836 Hückelhoven

Declared product / Declared unit
1m² of VALMEX® FR 1000 (7269) technical textile.

Scope:
The declaration covers the product VALMEX® FR 1000. The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a polyvinyl fluoride finish. The fully coated fabric weight is 1050g/m². The calculations are based on average production data collected during the period 11/2011 to 10/2012.
The producing company is Mehler Texnologies GmbH. The above named products are produced at the production site in Fulda.
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.

Verification

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

Mr Carl-Otto Neven
(Independent tester appointed by SVA)

2. Product

2.1 Product description
The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a Polyvinyl fluoride finish. The base fabric is composed of high tenacity multifilament and low wick treated polyester yarns. The coating mass distribution (CMD) ratio is 3:2 asymmetrically distributed (Topside 3 parts: Reverse side 2 parts). On both sides are at least 4 layers of coating, those include adhesion layer, main coating made out of Polyvinylchloride with several additives, Nano-Titanium dioxide primer and top coat made out of a weldable blend of high concentrated polyvinyl fluoride (PVDF) lacquer. The declared product has a weight of 1050 g/m².

2.2 Application
The range of application for those products is mainly tensile architecture. These kinds of structures can be easily integrated into regular buildings, can be very variably shaped and adapted to many forms of construction typologies. These can range from roof coverings, sun-shading elements to façade coverings, interior ceilings and divider elements.
A traditional tensile or lightweight structure performs always under tension instead of compression and bending. The material can be used for permanent or temporary applications. Flexible and harmonic forms are characteristic for this type of architecture. These tensile (or tension) structures can be supported mechanically or pneumatically.

2.3 Technical Data

Constructional data

Name	Value	Unit
Yarn density, DIN EN 1049-2 - warp/weft	105/105	Yarn count/dm
Yarn count, DIN EN ISO 2060	1670	dtex
Total weight, DIN EN ISO 2286-1	1050	g/m²
Tensile strength, DIN EN ISO 1421 V1 - warp/weft	6000/5500	N/5cm
Tear strength, DIN 53363 - warp/weft	900/800	N
Stress/strain behaviour, CEN TC 248 WG 4 Draft - warp/weft	5/10	27kN/m in %
Adhesion, internal testing method	25	N/cm
Cold resistance, DIN EN 1876-1	-40	°C
Heat resistance, internal testing method	+70	°C
Light fastness, DIN EN ISO 105 B02	>6	Grade
Crack resistance, DIN 53359 A	100.000 no	Visual

	cracks	assessment
Thermal transmittance, DIN EN ISO 6946 - vertical/horizontal	5,7/4,8	W/m²K
Light transmittance, DIN EN 410 - solar spectral range	6	%
Light reflection, DIN EN 410 - solar spectral range	82	%
Light absorption, DIN EN 410 - solar spectral range	12	%

2.4 Placing on the market / Application rules

Tensile architecture applications or technical textiles in general are not regulated completely compared to other standard construction materials and methods. Consequently, the currently valid and available standards or rules for applications and materials may change and vary from country to country.
As indicative basic standards for construction and use of technical textiles the below listed standards and rules may be considered.
1. The International Association for Shell and Spatial Structures (IASS) working groups 6 and 7
2. DIN 4134 - Air-supported structures; structure at design, construction and operation, 1983
3. Technical Standards for Specific Membrane Structure Buildings by Membrane Structures Association of Japan, 1996
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7. SS UNI U50.00.299.0:1996 Tents, Tensile Structures, Air-supported Structures - Instructions for the Design, Realization, Verification, Use and Maintenance, 1996
8. European Design Guide on Tensile Surface Structures, 2004
9. The latest version of Eurocodes and CEN Technical Committees 248 and 250.

Other common information and accomplishment related to the correct usage of technical textiles for architectural application are collected in the Mehler Guideline for tensile structures available at www.mehler-texnologies.com

2.5 Delivery status

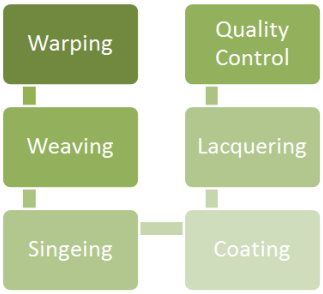
The material is produced as a metre good. The technical textiles are delivered on rolls of different length and width. The amount can be determined by the customer.

2.6 Base materials / Ancillary materials

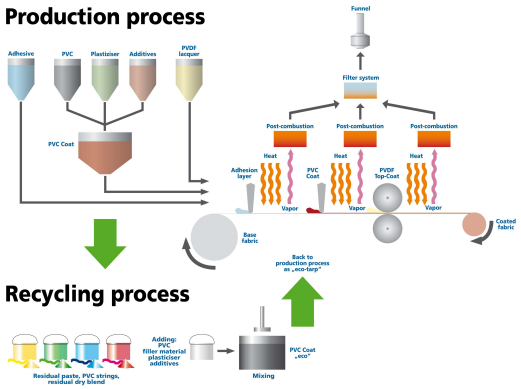
Name	Value	Unit
PVC	30	wt-%
DINP CAS 28553-12-0	20	wt-%
PES	35	wt-%
OTHERS including: TiO2 and Flame retardants: ATO, ATH	15	wt-%

2.7 Manufacture

During manufacturing the following production steps are processed at Mehler Texnologies GmbH, Fulda.



The quality management system is certified according to DIN ISO 9001:2008.
Mehler Texnologies GmbH buys yarns to produce warp beams and weaves fabrics at the weaving mill in Fulda. After weaving, the fabrics undergo a quality control plus a singeing process where minimal fabric irregularities can be corrected as well as defects can be eliminated. Due to the computer controlled coating process a stringent quality control is in place. The products are coated by a knife-coating process. The coating, a PVC plastisol, is brought onto the base fabric and later on dried by infrared emitter. To maintain a good adhesion between fabric and PVC coating an adhesion layer is necessary. Afterwards the PVC coated fabrics are finished by the lacquering process.



The lacquer system is a combination of a primer and a top lacquer. The system contains nano titanium dioxide as well as PVDF. The lacquer is applied on the PVC-polyesters coated base fabric and finally dried by infrared emitters. Thereby the solvents are nearly completely evaporated of the material. The generated vapor is directly treated at post-combustion. Finally, the produced material is inspected and tested according to /DIN ISO 9001:2008/. On customer request a lot certificate and a visual inspection report can be provided.

2.8 Environment and health during manufacturing

The Mehler Texnologies GmbH production sites are subject to the Gefahrstoffverordnung /GefStoffV/, due to its handling of a variety of chemicals.
Furthermore, regular measurements of air quality and noise levels are done. The results are below the compulsory safety value.
In areas where employees are exposed to lacquers, powders etc., prescribed safety clothes and technical safety devices are provided. Regular health checks are mandatory for employees of production sites.

Further regulations and laws which Mehler Texnologies is subject to are:
- Arbeitsschutzgesetz /ArbSchG/
- Betriebssicherheitsverordnung /BetrSichV/
- /Maschinenrichtlinie 2006/42/EG/

2.9 Product processing/Installation

Technical textiles used for architectural application becomes an interactive functionality with the application performance and needs to be handled carefully at several stages, from design to maintenance.

Design:
- Tensile structures are solely subject to tensile stress due to low compressive and bending rigidity. The shape has to be a double curvature to stabilize and distribute the tension, stress and the applied loads on the surface correctly.
- A basic rule in this kind of design is that form follows function
- The structural analysis must be completely integrated into the architectural design. The geometry of the technical textile is established through a "shape generation‘‘(form finding) technique in order to ensure a static equilibrium of the system.
- The pattern of the technical textile is calculated by the deflection finite-element analysis software. During the calculation progressive load deformation is taken into account and consequent compensation or decompensation of the defined fabric pattern geometry is substantial.
- Proper material compensation and application of the biaxial material values are key factors determining project efforts, global costs and long-term performances of the application

Manufacture:
- The production itself can be sub-divided into four phases: intake control and quality inspection of the material, cutting, welding and packing.
- Delivery and quality management consists of practiced good control and re-check of the quality control report. An additional inspection of the material by light tables and seam adhesion tests can be done.
- Once unrolled, the cutting of the patterns can begin. Those are generated using 3D computer models of the whole surface and taking into account the required compensations and the edge corrections for welding seams and edge details.The fabric can be cut by automatic plotting desks or by scissors
- Assembly of the various patterns is done by welding the perimetral edges of the single patterns. Welding is mostly effected by conducting electrical energy in the form of a radio frequency field to the two surfaces that are to be joined together. This stimulates the molecules in the material to move at a speed of approx. 25 million times a second. The friction that arises between the molecules generates the heat that is required to fuse the material layers. A weld seam is thereby created which has the same strength as the surrounding material (tested at 23°C). The fabric can be welded by means of hot air special tools, wherever this operation is mostly chosen for small detail welding processes as corners or on site repairing operation.

Installation:
- The installation of a tensile structure system is a highly specialized field of work requiring experienced staff as well as special and safe access equipment. However the tools and other equipment are standard items used in conventional construction rigging.
- The installation of tensile structures requires reasonable weather conditions. The lightweight of the technical textile, in conjunction with the large surface of exposure, means that work can only proceed at wind speeds of less than 5 m/s. At higher wind speeds lifting operations must be stopped. Installation should also be stopped at temperatures below 10° Celsius.
- The fabric as a secondary structural element is lifted and tied in position by pulling devices and brackets. Afterwards the completed distensile process is secured by linear clamps, steel cables and other permanent fixing devices to the primary structural elements.
- The main task of the technical textile installation team is the approval of the main structure, the installation of the temporary racks, to secure the building site and finally to manage the quality and safety control processes during installation.

Maintenance:
- Regular inspection of the technical textile has to be undertaken as the fabric can be cut, torn or crushed if subjected to high local ‘pinching’ loads, caused by bad design or by inappropriate clamping. If damaged, redistribution of load can result in a concentration of stress that could cause a propagation of tears.
- Fabric Inspection and maintenance manual is provided to the customer with shipment of the goods.

2.10 Packaging

The material is rolled on a cardboard roll core. The finished roll is packed in foil and fixed by PVC tape. Rolls are packed with 3 to 5 rolls on pallets. To guarantee that the rolls are not damaged during transportation, they are covered with cardboard and fastened by steel or plastic strapping.

2.11 Condition of use

There are no changes within the material composition during the use of the product, except extraordinary effects occur (e.g. fire). The long term stability can be measured according to /DIN EN ISO 105 B02/.

2.12 Environment and health during use

Mehler Texnologies GmbH follows a concept that accompanies its products throughout their entire lifecycle, including the incorporation of ecological criteria in the selection of raw materials and the use of environmentally friendly production processes.
Mehler Texnologies GmbH only uses substances that suppliers have previously registered as REACH compliant with European Chemicals Agency (ECHA), or that have been approved for the respective use. The products contain no restricted substances in a quantity of more than 0.1 mass percent. None of those substances are persistent, bioaccumulative and toxic according to the criteria set out in Annex XIII to the REACH Regulation (PBT substances). No hidden chemicals are released in the processing (e.g. welding) of the materials and Maximum Allowable Concentrations (MAC) are not exceeded by unregistered substances.

2.13 Reference service life

The documentation of the RSL is not required for the EPD of the company Mehler Texnologies GmbH since not the entire life cycle is declared (without modules B1-B7).
Nevertheless, the producer specifies that an average applicability of PES-PVC fabrics for textile architecture

are 20-25 years /Australian Story/. Products service life may vary due to application, grade of user know-how, location and maintenance.

2.14 Extraordinary effects

Fire
/DIN 4102-1: B1/

Fire protection

Name	Value
Building material class /EN 13501-1/	B
Smoke gas development EN 13501-1	S2
Burning droplets EN 13501-1	D0

Water
The declared product is adequate for the outer use. Water has no influence. The product has a good weatherability.

Mechanical destruction
The mechanical destruction of the declared product doesn't lead to a change of the chemical composition.

2.15 Re-use phase
The company Mehler Texnologies GmbH is conscious of its responsibility for acting in an environmentally compatible manner. Therefore, Mehler Texnologies is involved in a range of activities related to recycling and to preserving resources. These activities are participation in external recycling systems like EPcoat, in-house recycling and a sustainable production manner.
Mehler Texnologies GmbH actively supports the commitment of the Vinyl Plus Committee by the overall goal to recycle 800.000t PVC per year by 2020 and furthermore is a member of the Industrieverband Kunststoffbahnen e.V. (IVK Europe). As a consequence Mehler Texnologies is able to use the EPcoat recycling system. The post-consumer PVC coated fabric is recyclable. The material is then shredded and afterwards processed into the recyclate (plastic granulate), which is applied in the production of e.g. windows, pipes and foils. The shredded material is also used in the production of e.g. riding and sport arenas /Schönmackers/.

2.16 Disposal
The waste code of production waste for PVC coated Polyester fabrics is in accordance with the European Waste Index /AVV/ 04 02 09. Within the category of construction waste Technical textiles are not closer specified. Therefore waste code for plastics would apply 17 02 03.

2.17 Further information
Further information about PVC coated Polyester, technical textiles can be found on the companies' homepage.

3. LCA: Calculation rules

3.1 Declared Unit
The functional unit is a production and final treatment of 1 m² of technical textile - product nr **7269** VALMEX® FR 1000 with a total weight of 1050 g/m².

Declared unit

Name	Value	Unit
Declared unit	1	m²
Conversion factor to 1 kg	0,95238 0952	m²

3.2 System boundary
The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials which are declared in module A1-A3.
In this LCA study scenario of end-of-life (EoL) stage is considered. It is incineration of the technical textiles in the incineration plant which burdens accounted in the module C4.
The collection rate of end-of-life stage is 100%.
In this LCA study the transport of the used product to final disposal was modeled (module C2).
Potential credits for electricity and thermal energy resulting from the waste incineration plant are declared in module D.

3.3 Estimates and assumptions
In this LCA study scenario of end-of-life (EoL) stage is considered. In this case the incineration of the technical textiles has been accounted. The burdens of this process are included in the module C4 (waste incineration plant with R1 < 0,6), but the electricity and energy production – that occurs due to the incineration process – as benefits in the module D.
Even then it has to be mentioned that the post-consumer PVC coated fabrics are recyclable materials (more information in chapter 2.15).
The collection rate of end-of-life stage is 100%.
It has been also assumed that the average transport of post-consumer PVC coated fabrics to the incineration plant is 100 km.

3.4 Cut-off criteria
Several flows (raw materials) were excluded from the LCA study. All excluded flows pass the cut-off criteria: they represent less than 1% and are summing up to less than 5% of the total input (mass) and impact of renewable and non-renewable primary energy usage of mandatory modules (A1-A3).
Machines and facilities required during production are neglected.

3.5 Background data
For life cycle modeling of the considered products, the /GaBi 6 2012 Software System/ for Life Cycle Engineering, developed by PE INTERNATIONAL AG, is used. All relevant background datasets are taken from the GaBi 6 software database. The datasets from the database GaBi used are all PE International datasets and are documented in the online documentation /GaBi 6 2012B/. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

3.6 Data quality
The model for the mandatory modules (A1-A3) was based on primary data (in kg or g per m²) provided by Mehler Texnologies GmbH. Primary data collected covered all the production steps taking place in the

production plant: warping, weaving, singeing coating, lacquering, quality control.
All data used in the model is no more than 10 years old.

3.7 Period under review

Data sets are based on 1 year averaged data (time period: November 2011 to October 2012).

3.8 Allocation

The product is produced in one plant. All data were provided by the producer of the product according to 1 m² of technical textile.
The assumptions according EoL of the product are described in the section 3.3.

The modeled thermal utilization of the combustibles in their end-of-life process takes place in a waste-to-energy plant. The allocation is based on a physical classification of the mass flows or calorific values. Benefit and credit for the thermal energy, which is calculated based on country specific "Thermal energy from natural gas" as well as the credit for electricity from the country specific “Power grid mix”, are given in module D.

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.

4. LCA: Scenarios and additional technical information

The following information refer to the declared modules and are the basis for calculations or can be used for further calculations. All indicated values refer to the declared functional unit.

End of life (C1-C4)

Name	Value	Unit
Collected separately	1.05	kg

The collection rate of the post-consumer PVC coated fabrics is 100%. The collected material is incinerated with energy recovery. The average distance to the incineration plant is 100 km.

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² VALMEX® FR 1000

Parameter	Unit	A1-A3	C2	C4	D
Global warming potential	[kg CO_2-Eq.]	5.34E+0	4.93E-5	2.65E+0	-1.68E+0
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	7.81E-8	1.03E-15	3.82E-11	-5.07E-10
Acidification potential of land and water	[kg SO_2-Eq.]	1.79E-2	2.23E-7	6.41E-4	-2.32E-3
Eutrophication potential	[kg $(PO_4)^{3-}$ Eq.]	2.08E-3	5.39E-8	4.99E-5	-2.61E-4
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	3.14E-3	-7.66E-8	3.63E-5	-2.13E-4
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	1.57E-2	2.27E-12	3.80E-7	-1.74E-7
Abiotic depletion potential for fossil resources	[MJ]	1.03E+2	6.73E-4	1.25E+0	-2.21E+1

RESULTS OF THE LCA - RESOURCE USE: 1 m² VALMEX® FR 1000

Parameter	Unit	A1-A3	C2	C4	D
Renewable primary energy as energy carrier	[MJ]	5.64E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	5.64E+0	4.00E-5	1.19E-1	-2.44E+0
Non renewable primary energy as energy carrier	[MJ]	9.57E+1	IND	IND	IND
Non renewable primary energy as material utilization	[MJ]	1.37E+1	IND	IND	IND
Total use of non renewable primary energy resources	[MJ]	1.09E+2	6.76E-4	1.41E+0	-2.56E+1
Use of secondary material	[kg]	0.00E+0	IND	IND	IND
Use of renewable secondary fuels	[MJ]	2.88E-3	5.02E-9	1.74E-5	-3.70E-4
Use of non renewable secondary fuels	[MJ]	3.00E-2	5.25E-8	1.82E-4	-3.87E-3
Use of net fresh water	[m³]	6.15E-2	3.86E-8	6.52E-3	-3.80E-3

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² VALMEX® FR 1000

Parameter	Unit	A1-A3	C2	C4	D
Hazardous waste disposed	[kg]	2.15E-2	0.00E+0	2.67E-1	0.00E+0
Non hazardous waste disposed	[kg]	1.65E-1	1.34E-7	5.42E-4	-9.59E-3
Radioactive waste disposed	[kg]	2.79E-3	9.69E-10	6.82E-5	-1.46E-3
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	5.11E+0	IND
Exported thermal energy	[MJ]	IND	IND	1.23E+1	IND

6. LCA: Interpretation

Primary energy demand

The total use of renewable primary energy resources as well as the total use of non-renewable primary energy is dominated by the mandatory modules (A1-A3), within which the raw material supply (A1) plays the most significant role. The production site (A3) has the second highest contribution to both.
The share of module D in the total use of renewable primary energy resources (PERT) value is due to the energy production via incineration of the technical textiles.

Global warming potential (GWP)

GWP is dominated by the supply chain (A1) due to production of raw materials especially PET, DINP, antimony, and PVC. The supply chain makes almost 82% of the GWP for the mandatory modules, where the production (A3) makes less than 18%. The end-of-life stage contributes in about 33% into the summed value of GWP. At the same time thanks to combustion of the technical textiles there is a decline in the total GWP in around 21%.

Formation potential of tropospheric ozone photochemical oxidants (POCP)

POCP is dominated by the supply of basic materials (PET, DINP, epoxised soy bean oil, PVC, antimony) and the production (A3). Transportation has a minor

but visible impact on the product. The main emissions contributing to this impact category are NMVOCs, benzene, butane, sulfur dioxide, butane, carbon dioxide, and nitrogen oxides. The high benzene emissions, which occur during production of epoxised soy bean oil, make an important contribution into the total POCP value.

Acidification potential (AP)

AP is dominated by the supply of basic materials (e.g. antimony, PET) and the production stage due to the nitrogen dioxide emissions that occur during the lacquering process. Mostly the impact refers to emissions to air: ca. 55% comes from sulfur dioxide and 20% from nitrogen oxides.

Eutrophication potential (EP)

EP is influenced by the supply of basic materials, their transport and the production stage. The nitrogen dioxide emissions from the lacquering process have also a significant contribution to the total EP. Mostly the impact refers to emissions to air (mainly nitrogen oxide and dioxide).

Abiotic depletion potential (ADP)

The ADP **for non fossil resources** is significantly dominated by production of antimony trioxides.
The ADP **for fossil element** is mainly dominated by the supply of basic materials (A1). The contribution of the end-of-life stage in the total ADP fossil value is around 21%. The energy consumption plays a crucial rule in the ADP fossil element value. The most important energy sources are lignite, hard coal, and natural gas.

Depletion potential of the stratospheric ozone layer (ODP)

The ODP is most notably influenced the supply of basic materials and mainly the production of the polyvinylidene fluoride (PVDF). This results mainly from the upstream supply chain due to production of dichloro-1-fluoroethane that is used for the PVDF. The relevant emissions are trichloroethane and R141b.

7. Requisite evidence

Environmental information of used chemicals from “Material Safety Data Sheets”.

During the application of the lacquer on the PVC-polyesters the generated vapor is directly treated at post-combustion and emitted emissions verified according BImSchV /TÜV SAAR and BImSchV/.

7.1 VOC emissions

The information of the formaldehyde and VOC emissions by /AgBB schema/ AgBB are not relevant for the product because it is applied outside.

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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Mehler Texnologies GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-MTX-20130167-IBA1-EN
Issue date	05/09/2013
Valid to	04/09/2018

VALMEX® FR 1400

Mehler Texnologies GmbH

Institut Bauen und Umwelt e.V.

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

MEHLER TEXNOLOGIES

1. General Information

Mehler Texnologies GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
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Declaration number
EPD-MTX-20130167-IBA1-EN

This Declaration is based on the Product Category Rules:
Technical Textiles, 04-2013
(PCR tested and approved by the independent expert committee)

Issue date
05/09/2013

Valid to
04/09/2018

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

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of SVA)

VALMEX® FR 1400

Owner of the Declaration
Mehler Texnologies GmbH
Rheinstraße 11
D-41836 Hückelhoven

Declared product / Declared unit
1m² of VALMEX® FR 1400 (7270) technical textile.

Scope:
The declaration covers the product VALMEX® FR 1400. The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a polyvinyl fluoride finish. The fully coated fabric weight is 1350g/m². The calculations are based on average production data collected during the period 11/2011 to 10/2012.
The producing company is Mehler Texnologies GmbH. The above named products are produced at the production site in Fulda.
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.

Verification

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

Mr Carl-Otto Neven
(Independent tester appointed by SVA)

2. Product

2.1 Product description
The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a Polyvinyl fluoride finish. The base fabric is composed of high tenacity multifilament and low wick treated polyester yarns. The coating mass distribution (CMD) ratio is 3:2 asymmetrically distributed (Topside 3 parts: Reverse side 2 parts). On both sides are at least 4 layers of coating, those include adhesion layer, main coating made out of Polyvinylchloride with several additives, Nano-Titanium dioxide primer and top coat made out of a weldable blend of high concentrated polyvinyl fluoride (PVDF) lacquer. The declared product has a weight of 1350 g/m².

2.2 Application
The range of application for those products is mainly tensile architecture. These kinds of structures can be easily integrated into regular buildings, can be very variably shaped and adapted to many forms of construction typologies. These can range from roof coverings, sun-shading elements to façade coverings, interior ceilings and divider elements.
A traditional tensile or lightweight structure performs always under tension instead of compression and bending. The material can be used for permanent or temporary applications. Flexible and harmonic forms are characteristic for this type of architecture. These tensile (or tension) structures can be supported mechanically or pneumatically.

2.3 Technical Data

Constructional data

Name	Value	Unit
Yarn density, /DIN EN 1049-2/ - warp/weft	137/145	Yarn count/dm
Yarn count, /DIN EN ISO 2060/	1670	dtex
Total weight, /DIN EN ISO 2286-1/	1350	g/m²
Tensile strength, /DIN EN ISO 1421 V1/ - warp/weft	8000/7000	N/5cm
Tear strength, /DIN 53363/ - warp/weft	1200/1200	N
Stress/strain behaviour, /CEN TC 248 WG 4/ Draft - warp/weft	5/11	33kN/m in %
Adhesion, internal testing method	26	N/cm
Cold resistance, /DIN EN 1876-1/	-40	°C
Heat resistance, internal testing method	+70	°C
Light fastness, /DIN EN ISO 105 B02/	>6	Grade
Crack resistance, /DIN 53359 A/	100.000 no	Visual

	cracks	assessment
Thermal transmittance, /DIN EN ISO 6946/ - vertical/horizontal	5,6/4,8	W/m²K
Light transmittance, /DIN EN 410/ - solar spectral range	5	%
Light reflection, /DIN EN 410/ - solar spectral range	84	%
Light absorption, /DIN EN 410/ - solar spectral range	11	%

2.4 Placing on the market / Application rules

Tensile architecture applications or technical textiles in general are not regulated completely compared to other standard construction materials and methods. Consequently, the currently valid and available standards or rules for applications and materials may change and vary from country to country.
As indicative basic standards for construction and use of technical textiles the below listed standards and rules may be considered.
1. The International Association for Shell and Spatial Structures (IASS) working groups 6 and 7
2. /DIN 4134/ - Air-supported structures; structure at design, construction and operation, 1983
3. Technical Standards for Specific Membrane Structure Buildings by Membrane Structures Association of Japan, 1996
4. American Society of Civil Engineers (ASCE), SEI/ASCE 37-02 Design Loads on Structures during Construction, 2002
5. The Design of Air Supported Structures by The Institution of Structural Engineers, London 1984
6. Standards Council of Canada (SCC), CAN3-S367-M81: Air Supported Structures, 1981
7. SS UNI U50.00.299.0:1996 Tents, Tensile Structures, Air-supported Structures - Instructions for the Design, Realization, Verification, Use and Maintenance, 1996
8. European Design Guide on Tensile Surface Structures, 2004
9. The latest version of Eurocodes and CEN Technical Committees 248 and 250.

Other common information and accomplishment related to the correct usage of technical textiles for architectural application are collected in the Mehler Guideline for tensile structures available at www.mehler-texnologies.com

2.5 Delivery status

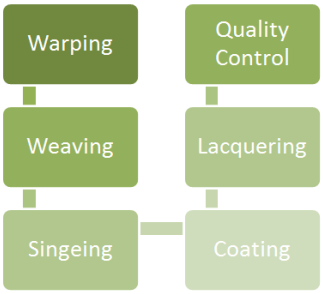
The material is produced as a metre good. The technical textiles are delivered on rolls of different length and width. The amount can be determined by the customer.

2.6 Base materials / Ancillary materials

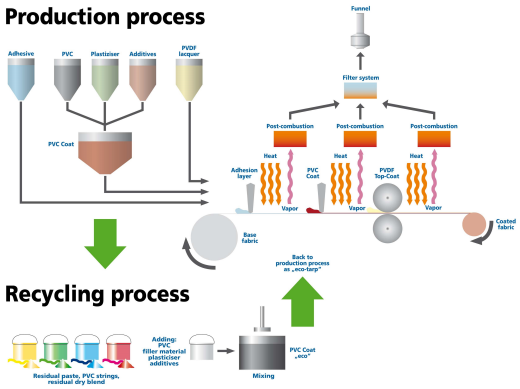
Name	Value	Unit
PVC	30	wt-%
DINP (CAS 28553-12-0)	20	wt-%
PES	35	wt-%
OTHERS including: TiO2 and flame retardants: ATO, ATH	15	wt-%

2.7 Manufacture

During manufacturing the following production steps are processed at Mehler Texnologies GmbH, Fulda.



The quality management system is certified according to /DIN ISO 9001:2008/.
Mehler Texnologies GmbH buys yarns to produce warp beams and weaves fabrics at the weaving mill in Fulda. After weaving, the fabrics undergo a quality control plus a singeing process where minimal fabric irregularities can be corrected as well as defects can be eliminated. Due to the computer controlled coating process a stringent quality control is in place. The products are coated by a knife-coating process. The coating, a PVC plastisol, is brought onto the base fabric and later on dried by infrared emitter. To maintain a good adhesion between fabric and PVC coating an adhesion layer is necessary. Afterwards the PVC coated fabrics are finished by the lacquering process.



The lacquer system is a combination of a primer and a top lacquer. The system contains nano titanium dioxide as well as PVDF. The lacquer is applied on the PVC-polyesters coated base fabric and finally dried by infrared emitters. Thereby the solvents are nearly completely evaporated of the material. The generated vapor is directly treated at post-combustion. Finally, the produced material is inspected and tested according to /DIN ISO 9001:2008/. On customer request a lot certificate and a visual inspection report can be provided.

2.8 Environment and health during manufacturing

The Mehler Texnologies GmbH production sites are subject to the Gefahrstoffverordnung /GefStoffV/, due to its handling of a variety of chemicals.
Furthermore, regular measurements of air quality and noise levels are done. The results are below the compulsory safety value.
In areas where employees are exposed to lacquers, powders etc., prescribed safety clothes and technical safety devices are provided. Regular health checks are mandatory for employees of production sites.

Further regulations and laws which Mehler Texnologies is subject to are:
- Arbeitsschutzgesetz /ArbSchG/
- Betriebssicherheitsverordnung /BetrSichV/
- /Maschinenrichtlinie 2006/42/EG/

2.9 Product processing/Installation

Technical textiles used for architectural application get an interactive functionality with the application performance and need to be handled carefully at several stages, from design to maintenance.

Design:
- Tensile structures are solely subject to tensile stress due to low compressive and bending rigidity. The shape has to be a double curvature to stabilize and distribute the tension, stress and the applied loads on the surface correctly.
- A basic rule in this kind of design is that form follows function
- The structural analysis must be completely integrated into the architectural design. The geometry of the technical textile is established through a "shape generation‘‘(form finding) technique in order to ensure a static equilibrium of the system.
- The pattern of the technical textile is calculated by the deflection finite-element analysis software. During the calculation progressive load deformation is taken into account and consequent compensation or decompensation of the defined fabric pattern geometry is substantial.
- Proper material compensation and application of the biaxial material values are key factors determining project efforts, global costs and long-term performances of the application

Manufacture:
- The production itself can be sub-divided into four phases: intake control and quality inspection of the material, cutting, welding and packing.
- Delivery and quality management consists of practiced good control and re-check of the quality control report. An additional inspection of the material by light tables and seam adhesion tests can be done.
- Once unrolled, the cutting of the patterns can begin. Those are generated using 3D computer models of the whole surface and taking into account the required compensations and the edge corrections for welding seams and edge details.The fabric can be cut by automatic plotting desks or by scissors
- Assembly of the various patterns is done by welding the perimetral edges of the single patterns. Welding is mostly effected by conducting electrical energy in the form of a radio frequency field to the two surfaces that are to be joined together. This stimulates the molecules in the material to move at a speed of approx. 25 million times a second. The friction that arises between the molecules generates the heat that is required to fuse the material layers. A weld seam is thereby created which has the same strength as the surrounding material (tested at 23°C). The fabric can be welded by means of hot air special tools, wherever this operation is mostly chosen for small detail welding processes as corners or on site repairing operation.

Installation:
- The installation of a tensile structure system is a highly specialized field of work requiring experienced staff as well as special and safe access equipment. However the tools and other equipment are standard items used in conventional construction rigging.
- The installation of tensile structures requires reasonable weather conditions. The lightweight of the technical textile, in conjunction with the large surface of exposure, means that work can only proceed at wind speeds of less than 5 m/s. At higher wind speeds lifting operations must be stopped. Installation should also be stopped at temperatures below 10° Celsius.
- The fabric as a secondary structural element is lifted and tied in position by pulling devices and brackets. Afterwards the completed distensile process is secured by linear clamps, steel cables and other permanent fixing devices to the primary structural elements.
- The main task of the technical textile installation team is the approval of the main structure, the installation of the temporary racks, to secure the building site and finally to manage the quality and safety control processes during installation.

Maintenance:
- Regular inspection of the technical textile has to be undertaken as the fabric can be cut, torn or crushed if subjected to high local ‘pinching’ loads, caused by bad design or by inappropriate clamping. If damaged, redistribution of load can result in a concentration of stress that could cause a propagation of tears.
- Fabric Inspection and maintenance manual is provided to the customer with shipment of the goods.

2.10 Packaging

The material is rolled on a cardboard roll core. The finished roll is packed in foil and fixed by PVC tape. Rolls are packed with 3 to 5 rolls on pallets. To guarantee that the rolls are not damaged during transportation, they are covered with cardboard and fastened by steel or plastic strapping.

2.11 Condition of use

There are no changes within the material composition during the use of the product, except extraordinary effects occur (e.g. fire). The long term stability can be measured according to /DIN EN ISO 105 B02/.

2.12 Environment and health during use

Mehler Texnologies GmbH follows a concept that accompanies its products throughout their entire lifecycle, including the incorporation of ecological criteria in the selection of raw materials and the use of environmentally friendly production processes.
Mehler Texnologies GmbH only uses substances that suppliers have previously registered as REACH compliant with European Chemicals Agency (ECHA), or that have been approved for the respective use. The products contain no restricted substances in a quantity of more than 0.1 mass percent. None of those substances are persistent, bioaccumulative and toxic according to the criteria set out in Annex XIII to the REACH Regulation (PBT substances). No hidden chemicals are released in the processing (e.g. welding) of the materials and Maximum Allowable Concentrations (MAC) are not exceeded by unregistered substances.

2.13 Reference service life

The documentation of the RSL is not required for the EPD of the company Mehler Texnologies GmbH since not the entire life cycle is declared (without modules B1-B7).
Nevertheless, the producer specifies that an average applicability of PES-PVC fabrics for textile architecture are 20-25 years /Australian Story/. Products service life

may vary due to application, grade of user know-how, location and maintenance.

2.14 Extraordinary effects

Fire
/DIN 4102-1: B1/

Fire protection

Name	Value
Building material class /EN 13501-1/	B
Smoke gas development EN 13501-1	S3
Burning droplets EN 13501-1	D0

Water
The declared product is adequate for the outer use. Water has no influence. The product has a good weatherability.

Mechanical destruction
The mechanical destruction of the declared product doesn't lead to a change of the chemical composition.

2.15 Re-use phase
The company Mehler Texnologies GmbH is conscious of its responsibility for acting in an environmentally compatible manner. Therefore, Mehler Texnologies is involved in a range of activities related to recycling and to preserving resources. These activities are participation in external recycling systems like EPcoat, in-house recycling and a sustainable production manner.
Mehler Texnologies GmbH actively supports the commitment of the Vinyl Plus Committee by the overall goal to recycle 800.000t PVC per year by 2020 and furthermore is a member of the Industrieverband Kunststoffbahnen e.V. (IVK Europe). As a consequence Mehler Texnologies is able to use the EPcoat recycling system. The post-consumer PVC coated fabric is recyclable. The material is then shredded and afterwards processed into the recyclate (plastic granulate), which is applied in the production of e.g. windows, pipes and foils. The shredded material is also used in the production of e.g. riding and sport arenas /Schönmackers/.

2.16 Disposal
The waste code of production waste for PVC coated Polyester fabrics is in accordance with the European Waste Index /AVV/ 04 02 09. Within the category of construction waste Technical textiles are not closer specified. Therefore waste code for plastics would apply 17 02 03.

2.17 Further information
Further information about PVC coated Polyester, technical textiles can be found on the companies' homepage.

3. LCA: Calculation rules

3.1 Declared Unit
The functional unit is a production and final treatment of 1 m² of technical textile - product nr **7270** VALMEX® FR 1400 with a total weight of 1350 g/m².

Declared unit

Name	Value	Unit
Declared unit	1	m²
Conversion factor to 1 kg	0,74074074	m²

3.2 System boundary
The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials which are declared in module A1-A3.
In this LCA study scenario of end-of-life (EoL) stage is considered. It is incineration of the technical textiles in the incineration plant which burdens accounted in the module C4.
The collection rate of end-of-life stage is 100%.
In this LCA study the transport of the used product to final disposal was modeled (module C2).
Potential credits for electricity and thermal energy resulting from the waste incineration plant are declared in module D.

3.3 Estimates and assumptions
In this LCA study scenario of end-of-life (EoL) stage is considered. In this case the incineration of the technical textiles has been accounted. The burdens of this process are included in the module C4 (waste incineration plant with R1 < 0,6), but the electricity and energy production – that occurs due to the incineration process – as benefits in the module D.
Even then it has to be mentioned that the post-consumer PVC coated fabrics are recyclable materials (more information in chapter 2.15).
The collection rate of end-of-life stage is 100%.
It has been also assumed that the average transport of post-consumer PVC coated fabrics to the incineration plant is 100 km.

3.4 Cut-off criteria
Several flows (raw materials) were excluded from the LCA study. All excluded flows pass the cut-off criteria: they represent less than 1% and are summing up to less than 5% of the total input (mass) and impact of renewable and non-renewable primary energy usage of mandatory modules (A1-A3).
Machines and facilities required during production are neglected.

3.5 Background data
For life cycle modeling of the considered products, the /GaBi 6 2012 Software System/ for Life Cycle Engineering, developed by PE INTERNATIONAL AG, is used. All relevant background datasets are taken from the GaBi 6 software database. The datasets from the database GaBi used are all PE International datasets and are documented in the online documentation /GaBi 6 2012B/. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

3.6 Data quality
The model for the mandatory modules (A1-A3) was based on primary data (in kg or g per m²) provided by Mehler Texnologies GmbH. Primary data collected covered all the production steps taking place in the

production plant: warping, weaving, singeing coating, lacquering, quality control.
All data used in the model is no more than 10 years old.

3.7 Period under review

Data sets are based on 1 year averaged data (time period: November 2011 to October 2012).

3.8 Allocation

The product is produced in one plant. All data were provided by the producer of the product according to 1 m² of technical textile.
The assumptions according EoL of the product are described in the section 3.3.

The modeled thermal utilization of the combustibles in their end-of-life process takes place in a waste-to-energy plant. The allocation is based on a physical classification of the mass flows or calorific values. Benefit and credit for the thermal energy, which is calculated based on country specific "Thermal energy from natural gas" as well as the credit for electricity from the country specific “Power grid mix”, are given in module D.

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.

4. LCA: Scenarios and additional technical information

The following information refer to the declared modules and are the basis for calculations or can be used for further calculations. All indicated values refer to the declared functional unit.

End of life (C1-C4)

Name	Value	Unit
Collected separately	1.35	kg

The collection rate of the post-consumer PVC coated fabrics is 100%. The collected material is incinerated with energy recovery. The average distance to the incineration plant is 100 km.

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² VALMEX® FR 1400

Parameter	Unit	A1-A3	C2	C4	D
Global warming potential	[kg CO_2-Eq.]	6.50E+0	6.33E-5	3.41E+0	-2.16E+0
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	8.22E-8	1.32E-15	4.92E-11	-6.52E-10
Acidification potential of land and water	[kg SO_2-Eq.]	2.20E-2	2.87E-7	8.25E-4	-2.99E-3
Eutrophication potential	[kg $(PO_4)^{3-}$ Eq.]	2.57E-3	6.93E-8	6.42E-5	-3.35E-4
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	3.90E-3	-9.85E-8	4.66E-5	-2.74E-4
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	1.94E-2	2.92E-12	4.88E-7	-2.23E-7
Abiotic depletion potential for fossil resources	[MJ]	1.26E+2	8.66E-4	1.60E+0	-2.84E+1

RESULTS OF THE LCA - RESOURCE USE: 1 m² VALMEX® FR 1400

Parameter	Unit	A1-A3	C2	C4	D
Renewable primary energy as energy carrier	[MJ]	6.97E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	6.97E+0	5.14E-5	1.53E-1	-3.14E+0
Non renewable primary energy as energy carrier	[MJ]	1.17E+2	IND	IND	IND
Non renewable primary energy as material utilization	[MJ]	1.79E+1	IND	IND	IND
Total use of non renewable primary energy resources	[MJ]	1.34E+2	8.69E-4	1.81E+0	-3.29E+1
Use of secondary material	[kg]	0.00E+0	IND	IND	IND
Use of renewable secondary fuels	[MJ]	3.59E-3	6.46E-9	2.24E-5	-4.75E-4
Use of non renewable secondary fuels	[MJ]	3.73E-2	6.76E-8	2.34E-4	-4.98E-3
Use of net fresh water	[m³]	7.58E-2	4.96E-8	8.38E-3	-4.88E-3

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² VALMEX® FR 1400

Parameter	Unit	A1-A3	C2	C4	D
Hazardous waste disposed	[kg]	2.48E-2	0.00E+0	3.44E-1	0.00E+0
Non hazardous waste disposed	[kg]	2.02E-1	1.72E-7	6.97E-4	-1.23E-2
Radioactive waste disposed	[kg]	3.43E-3	1.25E-9	8.77E-5	-1.87E-3
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	6.58E+0	IND
Exported thermal energy	[MJ]	IND	IND	1.58E+1	IND

6. LCA: Interpretation

Primary energy demand

The total use of renewable primary energy resources as well as the total use of non-renewable primary energy is dominated by the mandatory modules (A1-A3), within which the raw material supply (A1) plays the most significant role. The production site (A3) has the second highest contribution to both.
The share of module D in the total use of renewable primary energy resources (PERT) value is due to the energy production via incineration of the technical textiles.

Global warming potential (GWP)

GWP is dominated by the supply chain (A1) due to production of raw materials especially PET, DINP, antimony, and PVC. The supply chain makes almost 82% of the GWP for the mandatory modules, where the production (A3) makes less than 18%. The end-of-life stage contributes in about 34% into the summed value of GWP. At the same time thanks to combustion of the technical textiles there is a decline in the total GWP in around 22%.

Formation potential of tropospheric ozone photochemical oxidants (POCP)

POCP is dominated by the supply of basic materials (PET, DINP, epoxised soy bean oil, PVC, antimony) and the production (A3). Transportation has a minor

but visible impact on the product. The main emissions contributing to this impact category are NMVOCs, benzene, butane, sulfur dioxide, butane, carbon dioxide, and nitrogen oxides. The high benzene emissions, which occur during production of epoxised soy bean oil, make an important contribution into the total POCP value.

Acidification potential (AP)

AP is dominated by the supply of basic materials (e.g. antimony, PET) and the production stage due to the nitrogen dioxide emissions that occur during the lacquering process. Mostly the impact refers to emissions to air: ca. 59% comes from sulfur dioxide and 19% from nitrogen oxides.

Eutrophication potential (EP)

EP is influenced by the supply of basic materials, their transport and the production stage. The nitrogen dioxide emissions from the lacquering process have also a significant contribution to the total EP. Mostly the impact refers to emissions to air (mainly nitrogen oxide and dioxide).

Abiotic depletion potential (ADP)

The ADP **for non fossil resources** is significantly dominated by production of antimony trioxides.
The ADP **for fossil element** is mainly dominated by the supply of basic materials (A1). The contribution of the benefits and loads due to incineration of post-consumer PVC coated fabrics of the benefits and loads due to incineration of post-consumer PVC coated fabrics in the end-of-life stage in the total ADP fossil value is around 22%. The energy consumption plays a crucial rule in the ADP fossil element value. The most important energy sources are lignite, hard coal, and natural gas.

Depletion potential of the stratospheric ozone layer (ODP)

The ODP is most notably influenced the supply of basic materials and mainly the production of the polyvinylidene fluoride (PVDF). This results mainly from the upstream supply chain due to production of dichloro-1-fluoroethane that is used for the PVDF. The relevant emissions are trichloroethane and R141b.

7. Requisite evidence

Environmental information of used chemicals from “Material Safety Data Sheets”.

During the application of the lacquer on the PVC-polyesters the generated vapor is directly treated at post-combustion and emitted emissions verified according BImSchV /TÜV SAAR and BImSchV/.

7.1 VOC emissions

The information of the formaldehyde and VOC emissions by /AgBB schema/ AgBB are not relevant for the product because it is applied outside.

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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Mehler Texnologies GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-MTX-20130168-IBA1-EN
Issue date	05/09/2013
Valid to	04/09/2018

VALMEX® FR 1600

Mehler Texnologies GmbH

Institut Bauen und Umwelt e.V.

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

MEHLER TEXNOLOGIES

1. General Information

Mehler Texnologies GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
D-10178 Berlin

Declaration number
EPD-MTX-20130168-IBA1-EN

This Declaration is based on the Product Category Rules:
Technical Textiles, 04-2013
(PCR tested and approved by the independent expert committee)

Issue date
05/09/2013

Valid to
04/09/2018

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

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of SVA)

VALMEX® FR 1600

Owner of the Declaration
Mehler Texnologies GmbH
Rheinstraße 11
D-41836 Hückelhoven

Declared product / Declared unit
1m² of VALMEX® FR 1600 (7274) technical textile.

Scope:
The declaration covers the product VALMEX® FR 1600. The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a polyvinyl fluoride finish. The fully coated fabric weight is 1550g/m². The calculations are based on average production data collected during the period 11/2011 to 10/2012.
The producing company is Mehler Texnologies GmbH. The above named products are produced at the production site in Fulda.
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.

Verification

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

Mr Carl-Otto Neven
(Independent tester appointed by SVA)

2. Product

2.1 Product description
The product is a technical textile made out of a combination of Polyester and Polyvinylchloride with a Polyvinyl fluoride finish. The base fabric is composed of high tenacity multifilament and low wick treated polyester yarns. The coating mass distribution (CMD) ratio is 3:2 asymmetrically distributed (Topside 3 parts: Reverse side 2 parts). On both sides are at least 4 layers of coating, those include adhesion layer, main coating made out of Polyvinylchloride with several additives, Nano-Titanium dioxide primer and top coat made out of a weldable blend of high concentrated polyvinyl fluoride (PVDF) lacquer. The declared product has a weight of 1550 g/m².

2.2 Application
The range of application for those products is mainly tensile architecture. These kinds of structures can be easily integrated into regular buildings, can be very variably shaped and adapted to many forms of construction typologies. These can range from roof coverings, sun-shading elements to façade coverings, interior ceilings and divider elements.
A traditional tensile or lightweight structure performs always under tension instead of compression and bending. The material can be used for permanent or temporary applications. Flexible and harmonic forms are characteristic for this type of architecture. These tensile (or tension) structures can be supported mechanically or pneumatically.

2.3 Technical Data

Constructional data

Name	Value	Unit
Yarn density, /DIN EN 1049-2/ - warp/weft	155/145	Yarn count/dm
Yarn count, /DIN EN ISO 2060/	2200	dtex
Total weight, /DIN EN ISO 2286-1/	1550	g/m²
Tensile strength, /DIN EN ISO 1421 V1/ - warp/weft	10000/9000	N/5cm
Tear strength, /DIN 53363/ - warp/weft	2000/2000	N
Stress/strain behaviour, /CEN TC 248 WG 4/ Draft - warp/weft	5/10	44kN/m in %
Adhesion, internal testing method	30	N/cm
Cold resistance, /DIN EN 1876-1/	-40	°C
Heat resistance, internal testing method	+70	°C
Light fastness, /DIN EN ISO 105 B02/	>6	Grade
Crack resistance, /DIN 53359 A/	100.000 no	Visual

	cracks	assessment
Thermal transmittance, /DIN EN ISO 6946/ - vertical/horizontal	5,6/4,8	W/m²K
Light transmittance, /DIN EN 410/ - solar spectral range	3	%
Light reflection, /DIN EN 410/ - solar spectral range	84	%
Light absorption, /DIN EN 410/ - solar spectral range	13	%

2.4 Placing on the market / Application rules

Tensile architecture applications or technical textiles in general are not regulated completely compared to other standard construction materials and methods. Consequently, the currently valid and available standards or rules for applications and materials may change and vary from country to country.
As indicative basic standards for construction and use of technical textiles the below listed standards and rules may be considered.
1. The International Association for Shell and Spatial Structures (IASS) working groups 6 and 7
2. /DIN 4134/ - Air-supported structures; structure at design, construction and operation, 1983
3. Technical Standards for Specific Membrane Structure Buildings by Membrane Structures Association of Japan, 1996
4. American Society of Civil Engineers (ASCE), SEI/ASCE 37-02 Design Loads on Structures during Construction, 2002
5. The Design of Air Supported Structures by The Institution of Structural Engineers, London 1984
6. Standards Council of Canada (SCC), CAN3-S367-M81: Air Supported Structures, 1981
7. SS UNI U50.00.299.0:1996 Tents, Tensile Structures, Air-supported Structures - Instructions for the Design, Realization, Verification, Use and Maintenance, 1996
8. European Design Guide on Tensile Surface Structures, 2004
9. The latest version of Eurocodes and CEN Technical Committees 248 and 250.

Other common information and accomplishment related to the correct usage of technical textiles for architectural application are collected in the Mehler Guideline for tensile structures available at www.mehler-texnologies.com

2.5 Delivery status

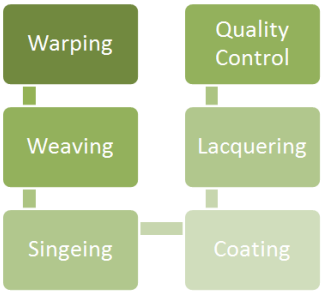
The material is produced as a metre good. The technical textiles are delivered on rolls of different length and width. The amount can be determined by the customer.

2.6 Base materials / Ancillary materials

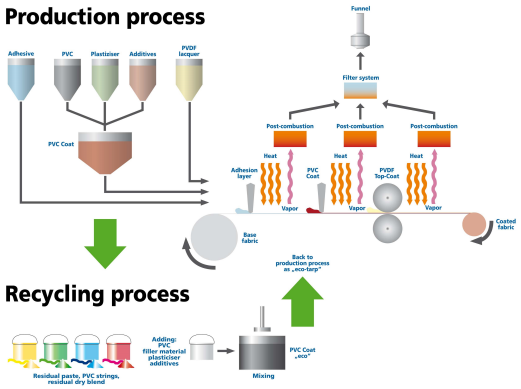
Name	Value	Unit
PVC	25	wt-%
DINP (CAS 28553-12-0)	15	wt-%
PES	45	wt-%
OTHERS including: TiO2 and flame retardant: ATO	15	wt-%

2.7 Manufacture

During manufacturing the following production steps are processed at Mehler Texnologies GmbH, Fulda.



The quality management system is certified according to /DIN ISO 9001:2008/.
Mehler Texnologies GmbH buys yarns to produce warp beams and weaves fabrics at the weaving mill in Fulda. After weaving, the fabrics undergo a quality control plus a singeing process where minimal fabric irregularities can be corrected as well as defects can be eliminated. Due to the computer controlled coating process a stringent quality control is in place. The products are coated by a knife-coating process. The coating, a PVC plastisol, is brought onto the base fabric and later on dried by infrared emitter. To maintain a good adhesion between fabric and PVC coating an adhesion layer is necessary. Afterwards the PVC coated fabrics are finished by the lacquering process.



The lacquer system is a combination of a primer and a top lacquer. The system contains nano titanium dioxide as well as PVDF. The lacquer is applied on the PVC-polyesters coated base fabric and finally dried by infrared emitters. Thereby the solvents are nearly completely evaporated of the material. The generated vapor is directly treated at post-combustion. Finally, the produced material is inspected and tested according to /DIN ISO 9001:2008/. On customer request a lot certificate and a visual inspection report can be provided.

2.8 Environment and health during manufacturing

The Mehler Texnologies GmbH production sites are subject to the Gefahrstoffverordnung /GefStoffV/, due to its handling of a variety of chemicals.
Furthermore, regular measurements of air quality and noise levels are done. The results are below the compulsory safety value.
In areas where employees are exposed to lacquers, powders etc., prescribed safety clothes and technical safety devices are provided. Regular health checks are mandatory for employees of production sites.

Further regulations and laws which Mehler Texnologies is subject to are:
- Arbeitsschutzgesetz /ArbSchG/
- Betriebssicherheitsverordnung /BetrSichV/
- /Maschinenrichtlinie 2006/42/EG/

2.9 Product processing/Installation

Technical textiles used for architectural application get an interactive functionality with the application performance and need to be handled carefully at several stages, from design to maintenance.

Design:
- Tensile structures are solely subject to tensile stress due to low compressive and bending rigidity. The shape has to be a double curvature to stabilize and distribute the tension, stress and the applied loads on the surface correctly.
- A basic rule in this kind of design is that form follows function
- The structural analysis must be completely integrated into the architectural design. The geometry of the technical textile is established through a "shape generation‘‘(form finding) technique in order to ensure a static equilibrium of the system.
- The pattern of the technical textile is calculated by the deflection finite-element analysis software. During the calculation progressive load deformation is taken into account and consequent compensation or decompensation of the defined fabric pattern geometry is substantial.
- Proper material compensation and application of the biaxial material values are key factors determining project efforts, global costs and long-term performances of the application

Manufacture:
- The production itself can be sub-divided into four phases: intake control and quality inspection of the material, cutting, welding and packing.
- Delivery and quality management consists of practiced good control and re-check of the quality control report. An additional inspection of the material by light tables and seam adhesion tests can be done.
- Once unrolled, the cutting of the patterns can begin. Those are generated using 3D computer models of the whole surface and taking into account the required compensations and the edge corrections for welding seams and edge details.The fabric can be cut by automatic plotting desks or by scissors
- Assembly of the various patterns is done by welding the perimetral edges of the single patterns. Welding is mostly effected by conducting electrical energy in the form of a radio frequency field to the two surfaces that are to be joined together. This stimulates the molecules in the material to move at a speed of approx. 25 million times a second. The friction that arises between the molecules generates the heat that is required to fuse the material layers. A weld seam is thereby created which has the same strength as the surrounding material (tested at 23°C). The fabric can be welded by means of hot air special tools, wherever this operation is mostly chosen for small detail welding processes as corners or on site repairing operation.

Installation:
- The installation of a tensile structure system is a highly specialized field of work requiring experienced staff as well as special and safe access equipment. However the tools and other equipment are standard items used in conventional construction rigging.
- The installation of tensile structures requires reasonable weather conditions. The lightweight of the technical textile, in conjunction with the large surface of exposure, means that work can only proceed at wind speeds of less than 5 m/s. At higher wind speeds lifting operations must be stopped. Installation should also be stopped at temperatures below 10° Celsius.
- The fabric as a secondary structural element is lifted and tied in position by pulling devices and brackets. Afterwards the completed distensile process is secured by linear clamps, steel cables and other permanent fixing devices to the primary structural elements.
- The main task of the technical textile installation team is the approval of the main structure, the installation of the temporary racks, to secure the building site and finally to manage the quality and safety control processes during installation.

Maintenance:
- Regular inspection of the technical textile has to be undertaken as the fabric can be cut, torn or crushed if subjected to high local ‘pinching’ loads, caused by bad design or by inappropriate clamping. If damaged, redistribution of load can result in a concentration of stress that could cause a propagation of tears.
- Fabric Inspection and maintenance manual is provided to the customer with shipment of the goods.

2.10 Packaging

The material is rolled on a cardboard roll core. The finished roll is packed in foil and fixed by PVC tape. Rolls are packed with 3 to 5 rolls on pallets. To guarantee that the rolls are not damaged during transportation, they are covered with cardboard and fastened by steel or plastic strapping.

2.11 Condition of use

There are no changes within the material composition during the use of the product, except extraordinary effects occur (e.g. fire). The long term stability can be measured according to /DIN EN ISO 105 B02/.

2.12 Environment and health during use

Mehler Texnologies GmbH follows a concept that accompanies its products throughout their entire lifecycle, including the incorporation of ecological criteria in the selection of raw materials and the use of environmentally friendly production processes.
Mehler Texnologies GmbH only uses substances that suppliers have previously registered as REACH compliant with European Chemicals Agency (ECHA), or that have been approved for the respective use. The products contain no restricted substances in a quantity of more than 0.1 mass percent. None of those substances are persistent, bioaccumulative and toxic according to the criteria set out in Annex XIII to the REACH Regulation (PBT substances). No hidden chemicals are released in the processing (e.g. welding) of the materials and Maximum Allowable Concentrations (MAC) are not exceeded by unregistered substances.

2.13 Reference service life

The documentation of the RSL is not required for the EPD of the company Mehler Texnologies GmbH since not the entire life cycle is declared (without modules B1-B7).
Nevertheless, the producer specifies that an average applicability of PES-PVC fabrics for textile architecture are 20-25 years /Australian Story/. Products service life

may vary due to application, grade of user know-how, location and maintenance.

2.14 Extraordinary effects

Fire
/DIN 4102-1: B1/

Fire protection

Name	Value
Building material class /EN 13501-1/	B
Smoke gas development EN 13501-1	S2
Burning droplets EN 13501-1	D0

Water
The declared product is adequate for the outer use. Water has no influence. The product has a good weatherability.

Mechanical destruction
The mechanical destruction of the declared product doesn't lead to a change of the chemical composition.

2.15 Re-use phase
The company Mehler Texnologies GmbH is conscious of its responsibility for acting in an environmentally compatible manner. Therefore, Mehler Texnologies is involved in a range of activities related to recycling and to preserving resources. These activities are participation in external recycling systems like EPcoat, in-house recycling and a sustainable production manner.
Mehler Texnologies GmbH actively supports the commitment of the Vinyl Plus Committee by the overall goal to recycle 800.000t PVC per year by 2020 and furthermore is a member of the Industrieverband Kunststoffbahnen e.V. (IVK Europe). As a consequence Mehler Texnologies is able to use the EPcoat recycling system. The post-consumer PVC coated fabric is recyclable. The material is then shredded and afterwards processed into the recyclate (plastic granulate), which is applied in the production of e.g. windows, pipes and foils. The shredded material is also used in the production of e.g. riding and sport arenas /Schönmackers/.

2.16 Disposal
The waste code of production waste for PVC coated Polyester fabrics is in accordance with the European Waste Index /AVV/ 04 02 09. Within the category of construction waste Technical textiles are not closer specified. Therefore waste code for plastics would apply 17 02 03.

2.17 Further information
Further information about PVC coated Polyester, technical textiles can be found on the companies' homepage.

3. LCA: Calculation rules

3.1 Declared Unit
The functional unit is a production and final treatment of 1 m² of technical textile - product nr **7274** VALMEX® FR 1600 with a total weight of 1550 g/m².

Declared unit

Name	Value	Unit
Declared unit	1	m²
Conversion factor to 1 kg	0,64516 129	m²

3.2 System boundary
The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials which are declared in module A1-A3.
In this LCA study scenario of end-of-life (EoL) stage is considered. It is incineration of the technical textiles in the incineration plant which burdens accounted in the module C4.
The collection rate of end-of-life stage is 100%.
In this LCA study the transport of the used product to final disposal was modeled (module C2).
Potential credits for electricity and thermal energy resulting from the waste incineration plant are declared in module D.

3.3 Estimates and assumptions
In this LCA study scenario of end-of-life (EoL) stage is considered. In this case the incineration of the technical textiles has been accounted. The burdens of this process are included in the module C4 (waste incineration plant with R1 < 0,6), but the electricity and energy production – that occurs due to the incineration process – as benefits in the module D.
Even then it has to be mentioned that the post-consumer PVC coated fabrics are recyclable materials (more information in chapter 2.15).
The collection rate of end-of-life stage is 100%.
It has been also assumed that the average transport of post-consumer PVC coated fabrics to the incineration plant is 100 km.

3.4 Cut-off criteria
Several flows (raw materials) were excluded from the LCA study. All excluded flows pass the cut-off criteria: they represent less than 1% and are summing up to less than 5% of the total input (mass) and impact of renewable and non-renewable primary energy usage of mandatory modules (A1-A3).
Machines and facilities required during production are neglected.

3.5 Background data
For life cycle modeling of the considered products, the /GaBi 6 2012 Software System/ for Life Cycle Engineering, developed by PE INTERNATIONAL AG, is used. All relevant background datasets are taken from the GaBi 6 software database. The datasets from the database GaBi used are all PE International datasets and are documented in the online documentation /GaBi 6 2012B/. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

3.6 Data quality
The model for the mandatory modules (A1-A3) was based on primary data (in kg or g per m²) provided by Mehler Texnologies GmbH. Primary data collected covered all the production steps taking place in the

production plant: warping, weaving, singeing coating, lacquering, quality control.
All data used in the model is no more than 10 years old.

3.7 Period under review

Data sets are based on 1 year averaged data (time period: November 2011 to October 2012).

3.8 Allocation

The product is produced in one plant. All data were provided by the producer of the product according to 1 m² of technical textile.
The assumptions according EoL of the product are described in the section 3.3.

The modeled thermal utilization of the combustibles in their end-of-life process takes place in a waste-to-energy plant. The allocation is based on a physical classification of the mass flows or calorific values. Benefit and credit for the thermal energy, which is calculated based on country specific "Thermal energy from natural gas" as well as the credit for electricity from the country specific “Power grid mix”, are given in module D.

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.

4. LCA: Scenarios and additional technical information

The following information refer to the declared modules and are the basis for calculations or can be used for further calculations. All indicated values refer to the declared functional unit.

End of life (C1-C4)

Name	Value	Unit
Collected separately	1.55	kg

The collection rate of the post-consumer PVC coated fabrics is 100%. The collected material is incinerated with energy recovery. The average distance to the incineration plant is 100 km.

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² VALMEX® FR 1600

Parameter	Unit	A1-A3	C2	C4	D
Global warming potential	[kg CO_2-Eq.]	8.36E+0	7.27E-5	3.91E+0	-2.47E+0
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	8.68E-8	1.52E-15	5.64E-11	-7.49E-10
Acidification potential of land and water	[kg SO_2-Eq.]	2.83E-2	3.29E-7	9.47E-4	-3.43E-3
Eutrophication potential	[kg $(PO_4)^{3-}$ Eq.]	3.06E-3	7.96E-8	7.37E-5	-3.85E-4
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	4.48E-3	-1.13E-7	5.35E-5	-3.14E-4
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	3.26E-2	3.35E-12	5.61E-7	-2.56E-7
Abiotic depletion potential for fossil resources	[MJ]	1.54E+2	9.94E-4	1.84E+0	-3.26E+1

RESULTS OF THE LCA - RESOURCE USE: 1 m² VALMEX® FR 1600

Parameter	Unit	A1-A3	C2	C4	D
Renewable primary energy as energy carrier	[MJ]	8.59E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	8.59E+0	5.90E-5	1.76E-1	-3.60E+0
Non renewable primary energy as energy carrier	[MJ]	1.43E+2	IND	IND	IND
Non renewable primary energy as material utilization	[MJ]	2.24E+1	IND	IND	IND
Total use of non renewable primary energy resources	[MJ]	1.66E+2	9.97E-4	2.08E+0	-3.78E+1
Use of secondary material	[kg]	0.00E+0	IND	IND	IND
Use of renewable secondary fuels	[MJ]	4.67E-3	7.42E-9	2.57E-5	-5.45E-4
Use of non renewable secondary fuels	[MJ]	4.86E-2	7.76E-8	2.69E-4	-5.71E-3
Use of net fresh water	[m³]	1.11E-1	5.69E-8	9.63E-3	-5.61E-3

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² VALMEX® FR 1600

Parameter	Unit	A1-A3	C2	C4	D
Hazardous waste disposed	[kg]	3.01E-2	0.00E+0	3.95E-1	0.00E+0
Non hazardous waste disposed	[kg]	1.98E-1	1.97E-7	8.00E-4	-1.42E-2
Radioactive waste disposed	[kg]	4.59E-3	1.43E-9	1.01E-4	-2.15E-3
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	7.55E+0	IND
Exported thermal energy	[MJ]	IND	IND	1.82E+1	IND

6. LCA: Interpretation

Primary energy demand

The total use of renewable primary energy resources as well as the total use of non-renewable primary energy is dominated by the mandatory modules (A1-A3), within which the raw material supply (A1) plays the most significant role. The production site (A3) has the second highest contribution to both.
The share of module D in the total use of renewable primary energy resources (PERT) value is due to the energy production via incineration of the technical textiles.

Global warming potential (GWP)

GWP is dominated by the supply chain (A1) due to production of raw materials especially PET, DINP, antimony, and PVC. The supply chain makes almost 82% of the GWP for the mandatory modules, where the production (A3) makes less than 18%. The end-of-life stage contributes in about 32% into the summed value of GWP. At the same time thanks to combustion of the technical textiles there is a decline in the total GWP in around 20%.

Formation potential of tropospheric ozone photochemical oxidants (POCP)

POCP is dominated by the supply of basic materials (PET, DINP, epoxised soy bean oil, PVC, antimony) and the production (A3). Transportation has a minor

but visible impact on the product. The main emissions contributing to this impact category are NMVOCs, benzene, butane, sulfur dioxide, butane, carbon dioxide, and nitrogen oxides. The high benzene emissions, which occur during production of epoxised soy bean oil, make an important contribution into the total POCP value.

Acidification potential (AP)

AP is dominated by the supply of basic materials (e.g. antimony, PET) and the production stage due to the nitrogen dioxide emissions that occur during the lacquering process. Mostly the impact refers to emissions to air: ca. 60% comes from sulfur dioxide and 20% from nitrogen oxides.

Eutrophication potential (EP)

EP is influenced by the supply of basic materials, their transport and the production stage. The nitrogen dioxide emissions from the lacquering process have also a significant contribution to the total EP. Mostly the impact refers to emissions to air (mainly nitrogen oxide and dioxide).

Abiotic depletion potential (ADP)

The ADP **for non fossil resources** is significantly dominated by production of antimony trioxides.
The ADP **for fossil element** is mainly dominated by the supply of basic materials (A1). The contribution of the benefits and loads due to incineration of post-consumer PVC coated fabrics in the end-of-life stage in the total ADP fossil value is around 21%. The energy consumption plays a crucial rule in the ADP fossil element value. The most important energy sources are lignite, hard coal, and natural gas.

Depletion potential of the stratospheric ozone layer (ODP)

The ODP is most notably influenced the supply of basic materials and mainly the production of the polyvinylidene fluoride (PVDF). This results mainly from the upstream supply chain due to production of dichloro-1-fluoroethane that is used for the PVDF. The relevant emissions are trichloroethane and R141b.

7. Requisite evidence

Environmental information of used chemicals from “Material Safety Data Sheets”.

During the application of the lacquer on the PVC-polyesters the generated vapor is directly treated at post-combustion and emitted emissions verified according BImSchV /TÜV SAAR and BImSchV/.

7.1 VOC emissions
The information of the formaldehyde and VOC emissions by /AgBB schema/ AgBB are not relevant for the product because it is applied outside.

8. References

AgBB
Ausschuss zur gesundheitlichen Bewertung von Bauprodukten: Vorgehensweise bei der gesundheitlichen Bewertung der Emissionen von flüchtigen organischen Verbindungen (VOC) aus Bauprodukten

ArbSchG
Arbeitsschutzgesetz: Gesetz über die Durchführung von Maßnahmen des Arbeitsschutzes zur Verbesserung der Sicherheit und des Gesundheitsschutzes der Beschäftigten bei der Arbeit

Australian Story
Enduring architectural fabrics for the world. Mehler Texnologies, 2007

AVV
Abfallverzeichnis-Verordnung: Verordnung über das Europäische Abfallverzeichnis 10. Dezember 2011 (BGBl. I S.3379)

BetrSichV
Verordnung über Sicherheit und Gesundheitsschutz bei der Bereitstellung von Arbeitsmitteln und deren Benutzung bei der Arbeit, über Sicherheit beim Betrieb überwachungsbedürftiger Anlagen und über die Organisation des betrieblichen Arbeitsschutzes

BImSchV
Bundes-Immissionsschutzverordnungen (Federal Emission Control Act)

CAN3-S367-M81
CAN3-S367-M81: Air Supported Structures, 1981

CEN TC 248 WG 4 - Draft
CEN TC 248 WG 4: Coated fabrics, http://www.cen.eu

CEN TC 250 WG 5 - Draft
CEN TC 250 WG 5: Membrane structures, http://www.cen.eu

DIN 4102-1
DIN EN 4102-1: Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests

DIN 4134
DIN 4134:1983 Air-supported structures; structure at design, construction and operation

DIN 53359
DIN 53359 A : Testing of artificial leather and similar sheet materials - Flex cracking test

DIN 53363
DIN 53363: Testing of plastic films - Tear test using trapezoidal test specimen with incision

DIN EN 410
DIN EN 410: Glass in building - Determination of luminous and solar characteristics of glazing

DIN EN 1876-1
DIN EN 1876-1: Rubber or plastics coated fabrics - Low temperatures tests - Part 1: Bending test

DIN EN ISO 105 B02
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Sustainability & Comfort
Working Group Tensinet

EPD8 – EPD10 Serge Ferrari

FICHE DE DECLARATION ENVIRONNEMENTALE ET SANITAIRE

Membranes composites tendue en application intérieure ou extérieure

ARCHITECTURE TENDUE

(hors accessoires de pose)

En conformité avec la norme NF EN 15804+A1 et son complément national NF EN 15804/CN

Avertissement

Les informations contenues dans cette déclaration sont fournies sous la responsabilité de SERGE FERRARI (producteur de la FDES) selon la NF EN 15804+A1 et le complément national NF EN 15804/CN.

Toute exploitation, totale ou partielle, des informations fournies dans ce document doit au minimum être accompagnée de la référence complète à la FDES d'origine ainsi qu'à son producteur qui pourra remettre un exemplaire complet.

GUIDE DE LECTURE

L'affichage des données d'inventaire respecte les exigences de la norme NF EN 15804+A1.

Dans les tableaux suivants 2,53E-06 doit être lu : 2,53x10 -6 (écriture scientifique).

Les unités utilisées dans les tableaux sont :

- Le kilogramme « kg »,
- Le gramme « g »,
- Le litre « L »
- Le kilowattheure « kWh »,
- Le mégajoule « MJ ».

ACV : Analyse du Cycle de Vie
DVR : Durée de Vie de Référence
UF : Unité Fonctionnelle
FDES: Fiche de Déclaration Environnementale et Sanitaire des Produits de la Construction

PRECAUTION D'UTILISATION DE LA FDES POUR LA COMPARAISON DES PRODUITS

Les FDES de produits de construction peuvent ne pas être comparables si elles ne sont pas conformes à la norme NF EN 15804+A1.

La norme NF EN 15804+A1 définie au *§ 5.3 Comparabilité des DEP* pour les produits de construction*, les conditions dans lesquelles les produits de construction peuvent être comparés, sur la base des informations fournies par la FDES :

« Une comparaison de la performance environnementale des produits de construction en utilisant les informations des DEP doit être basée sur l'usage des produits et leurs impacts sur le bâtiment, et doit prendre en compte la totalité du cycle de vie (tous les modules d'information) »

* La note 1 de l'avant-propos du complément national définit *« la traduction littérale en français de EPD (Environmental Product Declaration) est DEP (Déclaration Environnementale de Produit). Toutefois, en France, on utilise couramment le terme de FDES (Fiche de Déclaration Environnementale et Sanitaire) qui regroupe à la fois la Déclaration Environnementale et des informations Sanitaires pour le produit faisant l'objet de cette FDES.*
La FDES est donc bien une ''DEP'' complétée par des informations sanitaires. »

• INFORMATION GENERALE

Nom et adresse des fabricants	**Références commerciales des produits**
SERGE FERRARI Zone industrielle – 246 Rue des Sétives 38110 ST JEAN DE SOUDAIN France	902 ; 1002 ; 1002 Opaque ; 1202 * ; 1302 * ; 1502 * ; 1402 * ; TX30-II ; TX30-III ; TX30-IV ; TX30-V ; 912 ; 1212 ; 702 ; 702 Opaque ; 782 Opaque ; 832 ; 942 ; 392 ; 492 ; B702 *Les versions translucides et opaques de ces références sont couvertes par cette FDES.
Type de FDES	**Circuit de distribution**
- "du berceau à la porte de l'usine, avec options" - individuelle	BtoB
Coordonnées du contact du déclarant	**Nom du vérificateur**
julien.lance@sergeferrari.com	Cécile Beaudard (Solinnen)
Date de publication	**Date de fin de validité**
Avril 2021	Avril 2026
Programme de vérification :	
Programme FDES-INIES http://www.inies.fr/ Association HQE 4, avenue du Recteur Poincaré 75016 PARIS FRANCE	
La norme EN 15804 et son complément national NF EN 15804/CN servent de RCP de référence. Vérification par tierce-partie indépendante en accord avec ISO 14025 et EN 15804 ainsi que les RCP spécifiques citées ci-dessus: ☐ Interne ☒ Externe Numéro d'enregistrement : 4-536:2021	

DESCRIPTION DE L'UNITE FONCTIONNELLE ET DU PRODUIT

UNITE FONCTIONNELLE

«Assurer une fonction de 1m² de couverture en membrane composite tendue en application intérieure ou extérieure pendant 15 ans »

DESCRIPTION DU PRODUIT

Les produits couverts par cette FDES sont des membranes composites lourdes, pleines ou ajourées, de la société SERGE FERRARI fabriquées sur son site à La Tour du Pin.

Le produit de référence sur lequel porte l'étude est une moyenne arithmétique des produits de la gamme.

Les références commerciales couvertes par cette FDES sont cités ci-dessus. Tous les produits de cette famille sont fabriqués sur le site de La Tour du Pin avec les mêmes matières premières, les mêmes procédés de fabrication et ont les mêmes applications. Seul le design des produits diffère. La variabilité est présentée ci-après.

Tous les calculs sont rapportés à l'unité fonctionnelle, c'est-à-dire à 1m² de produit.

USAGE DU PRODUIT (DOMAINE D'APPLICATION)

Les produits sont utilisés dans la fabrication de produits finis destinés à l'Architecture Tendue.

PERFORMANCE PRINCIPALE DE L'UNITE FONCTIONNELLE

Assurer une fonction de 1m² de couverture en membrane composite tendue en application intérieure ou extérieure

CARACTERISTIQUES TECHNIQUES

Paramètre		
Masse produit moyen	1,035	kg
Masse l'emballage moyen	0,109	kg
Masse totale moyenne	**1,144**	**kg**

Le produit de référence est un produit fictif, dont l'ensemble des valeurs ont été calculées à partir de la moyenne arithmétique de tous les produits de la gamme.

DESCRIPTION DES PRINCIPAUX COMPOSANTS ET/OU MATERIAUX DU PRODUIT

Tissu Polyester, PVC, vernis acrylique.

COMPOSITION / SUBSTANCES REACH

Les membranes SERGE FERRARI respectent la réglementation REACH. Elles ne contiennent aucune substance de la liste SHVC (liste mise à jour le 19/01/2021) à un taux supérieur à 0,1% massique.

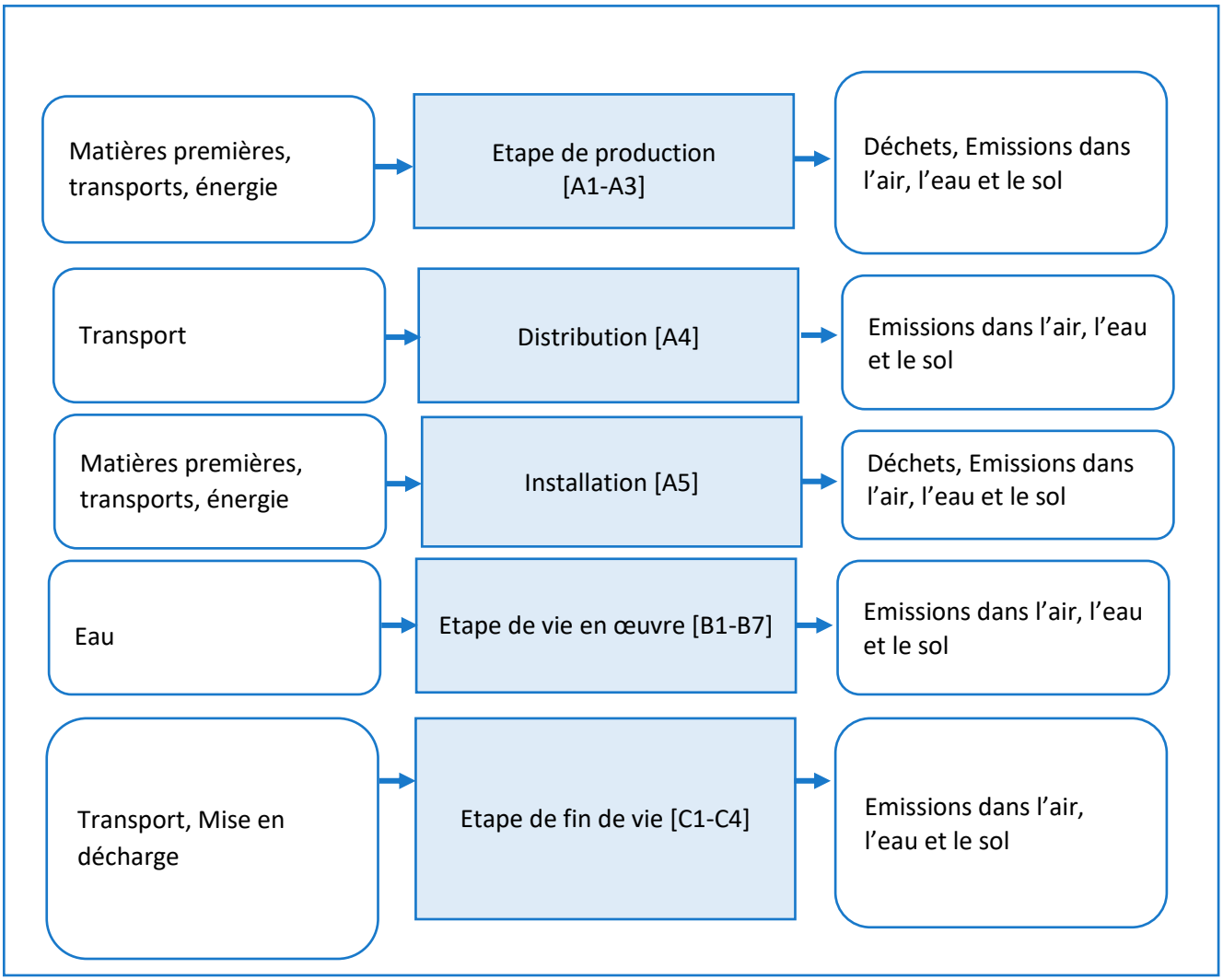
DUREE DE VIE DE REFERENCE

Paramètre	Valeur
Durée de vie de référence	15 ans (minimum). Certains produits de la gamme ont des durées de vie pouvant dépasser les 15 ans. Cf tableau ci-dessous.
Propriétés déclarées du produit (à la sortie de l'usine) et finitions, etc.	Membrane tendue pour réaliser l'enveloppe du bâtiment (toiture et/ou façade)
Paramètres théoriques d'application (s'ils sont imposés par le fabricant), y compris les références aux pratiques appropriées	Membrane tendue sur une structure généralement métallique ou bois
Qualité présumée des travaux, lorsque l'installation est conforme aux instructions du fabricant	Respect des règles de conception pour l'architecture tendue, des règles neige et vent et des Eurocodes Structure
Environnement extérieur (pour les applications en extérieur), par exemple intempéries, polluants, exposition aux UV et au vent, orientation du bâtiment, ombrage, température	Résistance en extérieur contre les UV et les intempéries (pluie, neige, vent). Cf fiche technique.
Environnement intérieur (pour les applications en intérieur), par exemple température, humidité, exposition à des produits chimiques	Résistance à l'humidité, aux ambiances chlorées ou salines. Cf fiche technique. Résistance à des températures inférieures à 50°C en continu et 70°C ponctuellement. Cf fiche technique.
Conditions d'utilisation, par exemple fréquence d'utilisation, exposition mécanique	Non concernés
Maintenance, par exemple fréquence exigée, type et qualité et remplacement des composants remplaçables	Une fois installés, les produits ne requièrent pas de maintenance particulière sauf un nettoyage si nécessaire et selon l'emploi. 1 nettoyage tous les 5 ans à l'eau savonneuse est préconisé dans certains cas (entre dans le critère de coupure).

Paramètre	Durée de vie	
B702	15	ans
702 ; 702 OPAQUE ; 832 ; 782 OPAQUE	15	ans
902 ; 912 ; 942	20	ans
1002 ; 1202 ; 1302 ; 1402 ; 1502	25	ans
Gamme TX30	30	ans
392 ; 492	20	ans

ETAPES DU CYCLE DE VIE

DIAGRAMME DE CYCLE DE VIE



[A1-A3] PHASE DE PRODUCTION DU PRODUIT

Paramètres	Informations
Produit	
Informations générales	- L'ensemble des substances et des matériaux constitutifs nécessaires à la fabrication du produit a été pris en compte. - Les modules utilisés pour modéliser les matières premières ne contiennent pas de matière secondaire. - Le transport amont a été intégré à l'étude. Il a été modélisé par un transport via camion articulé de 27 tonnes chargé à 80% avec un taux de retour à vide de 30%. - La consommation d'énergie sur le site de production a été modélisée par le mix électrique français Source : IEA - 2018 - Les déchets issus de l'étape de fabrication ont été considérés. Le transport jusqu'au site a été modélisé par un transport en camion benne de 17.3 tonnes chargés à 80% avec un taux de retour à vide de 100% et pour certains, par un transport en avion.
Tissage des fils	Le tissage est réalisé à la Tour du Pin (France). Il fait intervenir du polyester.
Enduction PVC	L'enduction est réalisée à la Tour du Pin (France). Elle fait intervenir des plastifiants, des stabilisants, du PVC, et des composés tels que la silice, le trioxyde d'antimoine, une charge minérale, un fongicide, un ignifugeant et du vernis acrylique.
Emballage	
Emballage du produit fini	- Film plastique - Caisse bois carton - Palettes bois - Tube carton
Allocation	Les quantités nécessaires pour la fabrication d'un produit en termes de matière première, énergies et déchets sont basées sur une année de production et ramenée par un produit en croix à un produit (allocation massique).
Informations particulières	Les impacts liés à la production des chutes de fabrication et les déchets ont été comptabilisés au moment où ils ont été générés. Ainsi les chutes de production ont été modélisées en phase A1-A3.

[A4] TRANSPORT JUSQU'AU CHANTIER

Paramètre	Unité	Valeur
Type de combustible et consommation du véhicule ou type de véhicule utilisé pour le transport, par exemple camion sur longue distance, bateau, etc.		Transport en camion 27t, depuis l'usine de fabrication (La Tour du Pin) jusqu'au chantier.
Distance jusqu'au chantier	km	750
Utilisation de la capacité (y compris les retours à vide)	%	80% de taux de charge et 30% de retours à vide
Masse volumique en vrac des produits transportés	kg/m^3	-
Coefficient d'utilisation de la capacité volumique	Coefficient : = 1 ou < 1 ou ≥ 1 pour les produits comprimés ou emboîtés	1

[A5] INSTALLATION DANS LE BATIMENT

Paramètre	Unité	Valeur
Intrants auxiliaires pour l'installation (spécifiés par matériau)	%	5% de taux de chute qui sont traités comme des déchets non dangereux et transportés sur 100 km par camion
Utilisation d'eau	m^3	-
Utilisation d'autres ressources	kg	-
Description quantitative du type d'énergie (mélange régional) et consommation durant le processus d'installation	kWh ou MJ	
Déchets produits sur le site de construction avant le traitement des déchets générés par l'installation du produit (spécifiés par type)	kg	
Matières (spécifiées par type) produites par le traitement des déchets sur le site de construction, par exemple collecte en vue du recyclage, de la récupération d'énergie, de l'élimination (spécifiées par voie)	kg	
Emissions directes dans l'air ambiant, le sol et l'eau	kg	-

[B1-B7] PHASE DE VIE EN ŒUVRE

MAINTENANCE

Paramètre	Unité	Valeur
Processus de maintenance	La vie en œuvre du produit nécessite uniquement un nettoyage ponctuel à l'eau.	
Cycle de maintenance	1 lavage tous les 5 ans	
Intrants auxiliaires pour la maintenance (par exemple, produit de nettoyage, spécifier les matériaux)	L	2L d'eau pour 1m², soit 6L d'eau sur le cycle de vie complet
Déchets produits pendant la maintenance (spécifier les matériaux)	kg	-
Consommation nette d'eau douce pendant la maintenance	L	2L d'eau pour 1m², soit 6L d'eau sur le cycle de vie complet
Intrant énergétique pendant la maintenance (par exemple nettoyage par aspiration), type de vecteur énergétique, par exemple électricité, et quantité, si applicable et pertinent	kWh	-

REPARATION

Paramètre	Unité	Valeur
Processus de réparation	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié à la réparation.	
Processus d'inspection	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié aux processus d'inspection.	
Cycle de réparation	Nombre par RSL ou année	-
Intrants auxiliaires (par exemple lubrifiant, spécifier les matériaux)	kg ou kg/cycle	-
Déchets produits pendant la réparation (spécifier les matériaux)	kg	-
Consommation nette d'eau douce pendant la réparation	m^3	-
Intrant énergétique pendant la réparation (par exemple activité de grutage), type de vecteur énergétique, par exemple électricité, et quantité	kWh/RSL, kWh/cycle	-

REMPLACEMENT

Paramètre	Unité	Valeur
Cycle de remplacement	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié au remplacement.	
Intrant énergétique pendant le remplacement (par exemple activité de grutage), type de vecteur énergétique (par exemple électricité), et quantité, si applicable et pertinent	kWh	-
Echange de pièces usées pendant le cycle de vie du produit, spécifier les matériaux	kg	-

REHABILITATION

Paramètre	Unité	Valeur
Processus de réhabilitation	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié à la réhabilitation.	
Cycle de réhabilitation	Nombre par RSL ou année	-
Intrant de matières pour la réhabilitation (par exemple briques), y compris les intrants auxiliaires pour le processus de réhabilitation (par exemple lubrifiant, spécifier les matériaux)	kg ou kg/cycle	-
Déchets produits pendant la réhabilitation (spécifier les matériaux)	kg	-
Intrant énergétique pendant la réhabilitation (par exemple activité de grutage), type de vecteur énergétique, par exemple électricité, et quantité, si applicable et pertinent	kWh	-
Autres hypothèses pour l'élaboration de scénarios (par exemple, fréquence et durée d'utilisation, nombre d'occupants)	Unité appropriée	-

UTILISATION DE L'ENERGIE ET DE L'EAU

Paramètre	Unité	Valeur
Intrants auxiliaires spécifiés par matière	kg ou unités appropriées	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié l'utilisation d'énergie.
Consommation nette d'eau douce	m3	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié l'utilisation d'eau.
Type de vecteur énergétique (par exemple, électricité, gaz naturel, chauffage urbain)	kWh	-
Puissance de sortie de l'équipement	kWh	-
Performance caractéristique (par exemple efficacité énergétique, émissions, variation de performance en fonction de l'utilisation de la capacité, etc.)	unités appropriées	-
Autres hypothèses pour l'élaboration de scénarios (par exemple, fréquence et durée d'utilisation, nombre d'occupants)	unités appropriées	-

[C1-C4] PHASE DE FIN DE VIE

Paramètre	Unité	Valeur
Processus de collecte spécifié par type	kg collecté individuellement kg collecté avec des déchets de construction mélangés	1,035
Système de récupération spécifié par type	kg destiné à la réutilisation	-
	kg destiné au recyclage	-
	kg destiné à la récupération d'énergie	-
Elimination spécifiée par type	kg de produit ou de matériau destiné à l'élimination finale	1,035 (enfouissement)
Hypothèses pour l'élaboration de scénarios (par exemple transport)	km	100 km en camion 17,3t

[D] POTENTIEL DE RECYCLAGE / REUTILISATION / RECUPERATION, D

Le module D n'est pas considéré.

INFORMATION POUR LE CALCUL DE L'ANALYSE DE CYCLE DE VIE

PCR utilisé	NF EN 15804+A1 - Avril 2014, NF EN 15804/CN – Juin 2016
Frontières du système	Les frontières du système respectent les limites imposées par la norme NF EN 15804+A1 et son complément national NF EN 15804/CN.
Allocations	Les quantités nécessaires pour la fabrication d'un produit en termes de matière première, énergies et déchets sont basées sur une année de production et ramenée par un produit en croix à un produit (allocation massique).
Représentativité géographique et représentativité temporelle des données primaires	Les données ont été collectées relativement à la production annuelle de l'usine SERGE FERRARI. La collecte a été lancée en Septembre 2020. Elle est représentative des technologiques utilisées pour l'année 2019. La base de données utilisée est la base de données BDD CODDE-2018-11 (mise à jour Novembre 2018) et ELCD version 3.2. Logiciel EIME, Version 5.9. Version de la base de données : Décembre 2020
Variabilité des résultats	Une analyse de variabilité a été réalisée entre les produits couverts par la FDES de la gamme. Les résultats permettent de dire que les impacts sont homogènes au sein de la famille de produit. Les impacts environnementaux déclarés dans la FDES sont donc basés sur une moyenne entre tous les produits de la gamme.

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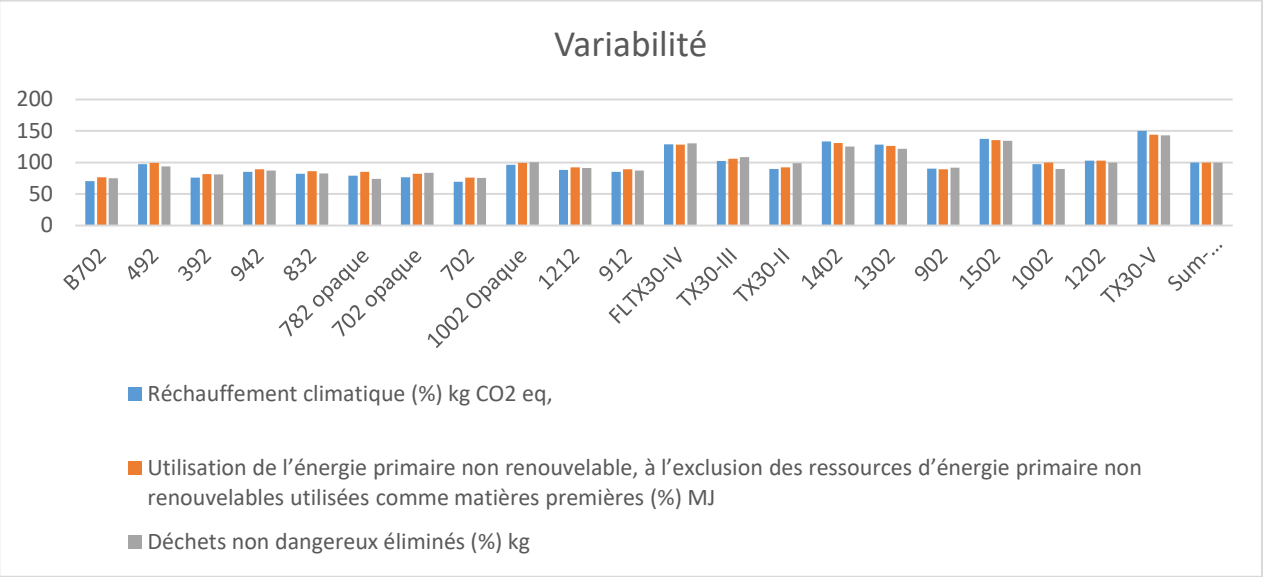
VARIABILITE



RESULTATS DE L'ANALYSE DE CYCLE DE VIE

Indicateurs d'impact	Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total B1-B7**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total C1-C4**	**Total Cycle de Vie**	**D Bénéfices et charges au-delà des frontières du système**
Réchauffement climatique kg CO2 eq/UF	**4,02E+00**	6,35E-02	2,84E-01	**3,48E-01**	0,00E+00	1,75E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,75E-01**	0,00E+00	9,64E-03	0,00E+00	9,31E-01	9,41E-01	**5,48E+00**	MND
Appauvrissement de la couche d'ozone kg CFC 11 eq/UF	**3,53E-07**	1,29E-10	1,79E-08	**1,80E-08**	0,00E+00	1,14E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,14E-09**	0,00E+00	1,95E-11	0,00E+00	3,07E-09	3,09E-09	**3,75E-07**	MND
Acidification des sols et de l'eau kg SO2 eq/UF	**8,26E-03**	2,85E-04	4,52E-04	**7,37E-04**	0,00E+00	3,81E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,81E-04**	0,00E+00	4,56E-05	0,00E+00	3,94E-04	4,40E-04	**9,82E-03**	MND
Eutrophisation kg (PO4)3- eq/UF	**1,29E-02**	6,56E-05	8,02E-04	**8,67E-04**	0,00E+00	1,20E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,20E-04**	0,00E+00	1,06E-05	0,00E+00	2,82E-03	2,83E-03	**1,67E-02**	MND
Formation d'ozone photochimique Ethene eq/UF	**6,53E-04**	2,03E-05	5,14E-05	**7,17E-05**	0,00E+00	2,05E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,05E-05**	0,00E+00	3,28E-06	0,00E+00	2,06E-04	2,09E-04	**9,55E-04**	MND
Epuisement des ressources abiotiques (éléments) kg Sb eq/UF	**7,92E-02**	2,54E-09	3,96E-03	**3,96E-03**	0,00E+00	6,09E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,09E-09**	0,00E+00	3,86E-10	0,00E+00	5,94E-09	6,33E-09	**8,31E-02**	MND
Epuisement des ressources abiotiques (fossiles) MJ/UF	**7,32E+01**	8,93E-01	3,76E+00	**4,66E+00**	0,00E+00	4,93E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,93E-01**	0,00E+00	1,35E-01	0,00E+00	1,05E+00	1,19E+00	**7,96E+01**	MND
Pollution de l'eau m3/UF	**5,19E+02**	1,04E+01	2,65E+01	**3,70E+01**	0,00E+00	1,75E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,75E+00**	0,00E+00	1,58E+00	0,00E+00	4,64E+00	6,22E+00	**5,64E+02**	MND
Pollution de l'air m3/UF	**6,07E+02**	2,60E+00	3,25E+01	**3,51E+01**	0,00E+00	2,12E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,12E+00**	0,00E+00	4,44E-01	0,00E+00	2,50E+01	2,54E+01	**6,70E+02**	MND

Utilisation des ressources	Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total B1-B7**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total C1-C4**		
Utilisation de l'énergie primaire renouvelable, à l'exclusion des ressources d'énergie primaire renouvelables utilisées comme matières premières MJ/UF	**5,16E+00**	1,20E-03	2,61E-01	2,62E-01	0,00E+00	5,68E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,68E-03	0,00E+00	1,82E-04	0,00E+00	3,31E-02	3,33E-02	**5,46E+00**	MND
Utilisation des ressources d'énergie primaire renouvelables en tant que matières premières MJ/UF	**9,85E-01**	0,00E+00	4,92E-02	4,92E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,03E+00**	MND
Utilisation totale des ressources d'énergie primaire renouvelables (énergie primaire et ressources d'énergie primaire utilisées comme matières premières) MJ/UF	**6,14E+00**	1,20E-03	3,10E-01	3,11E-01	0,00E+00	5,68E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,68E-03	0,00E+00	1,82E-04	0,00E+00	3,31E-02	3,33E-02	**6,49E+00**	MND
Utilisation de l'énergie primaire non renouvelable, à l'exclusion des ressources d'énergie primaire non renouvelables utilisées comme matières premières MJ/UF	**6,89E+01**	8,97E-01	3,56E+00	4,45E+00	0,00E+00	5,33E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,33E-01	0,00E+00	1,36E-01	0,00E+00	1,16E+00	1,29E+00	**7,52E+01**	MND
Utilisation des ressources d'énergie primaire non renouvelables en tant que matières premières MJ/UF	**2,22E+01**	0,00E+00	1,11E+00	1,11E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,33E+01**	MND
Utilisation totale des ressources d'énergie primaire non renouvelables (énergie primaire et ressources d'énergie primaire utilisées comme matières premières) MJ/UF	**9,11E+01**	8,97E-01	4,66E+00	5,56E+00	0,00E+00	5,33E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,33E-01	0,00E+00	1,36E-01	0,00E+00	1,16E+00	1,29E+00	**9,85E+01**	MND
Utilisation de matière secondaire kg/UF	**5,32E-02**	0,00E+00	2,66E-03	2,66E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,59E-02**	MND
Utilisation de combustibles secondaires renouvelables MJ/UF	**7,95E-01**	0,00E+00	3,97E-02	3,97E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**8,34E-01**	MND
Utilisation de combustibles secondaires non renouvelables MJ/UF	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	MND
Utilisation nette d'eau douce m3/UF	**2,35E-01**	5,69E-06	1,18E-02	1,18E-02	0,00E+00	6,27E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,27E-04	0,00E+00	8,62E-07	0,00E+00	3,08E-04	3,09E-04	**2,47E-01**	MND

Catégorie de déchets	Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3	A4 Transport	A5 Installation	Total A4-A5	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	Total B1-B7	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	Total C1-C4		
Déchets dangereux éliminés kg/UF	**4,35E-02**	0,00E+00	2,22E-03	**2,22E-03**	0,00E+00	2,11E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,11E-05**	0,00E+00	0,00E+00	0,00E+00	5,50E-04	**5,50E-04**	**4,63E-02**	MND
Déchets non dangereux éliminés kg/UF	**9,74E-01**	2,26E-03	1,42E-01	**1,44E-01**	0,00E+00	4,38E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,38E-02**	0,00E+00	3,42E-04	0,00E+00	1,15E+00	**1,15E+00**	**2,32E+00**	MND
Déchets radioactifs éliminés kg/UF	**1,89E-04**	1,61E-06	1,25E-05	**1,41E-05**	0,00E+00	1,34E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,34E-05**	0,00E+00	2,44E-07	0,00E+00	3,83E-05	**3,86E-05**	**2,55E-04**	MND

Flux sortants		Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
		Total A1-A3	A4 Transport	A5 Installation	Total A4-A5	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	Total B1-B7	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	Total C1-C4		
Composants destinés à la réutilisation kg/UF		**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
Matériaux destinés au recyclage kg/UF		**3,62E-02**	0,00E+00	7,28E-02	**7,28E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,09E-01**	MND
Matériaux destinés à la récupération d'énergie kg/UF		**1,39E-02**	0,00E+00	1,27E-02	**1,27E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,66E-02**	MND
Energie fournie à l'extérieur (par vecteur) J/UF	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND	MND
	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND	MND
	0,00E+00	0,00E+00	5,29E-02	**5,29E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	6,10E-01	**6,10E-01**	**6,63E-01**	MND	MND

INFORMATIONS ADDITIONNELLES SUR LE RELARGAGE DE SUBSTANCES DANGEREUSES DANS L'AIR INTERIEUR, LE SOL ET L'EAU PENDANT L'ETAPE D'UTILISATION

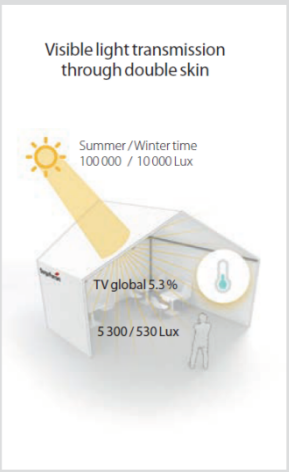
Caractéristiques sanitaires	
COV et formaldéhyde	GREENGUARD GOLD : 902 ; 1002 ; 1002 Opaque ; 1202 ; 1302 ; 1502 ; 1402 ; TX30-II ; TX30-III ; TX30-IV ; TX30-V ; 912 ; 1212 ; 702 ; 702 Opaque ; 782 ; Opaque ; 942 ; B702
Emissions dans l'air intérieur de substances dangereuses	Les membranes SERGE FERRARI respectent la réglementation REACH. Elles ne contiennent aucune substance de la liste SHVC (liste mise à jour le 19/01/2021) à un taux supérieur à 0,1% massique.
Comportement face aux micro-organismes	Se rapprocher des équipes commerciales Serge Ferrari, certains produits sont couverts et d'autres non selon les références commerciales
Odeurs	Aucun test réalisé
Emissions radioactives	Aucun test réalisé
Caractéristiques concernant la qualité de l'eau	Sans objet car ce produit n'est en contact ni avec l'eau destinée à la consommation humaine, ni avec les eaux de ruissellement, les eaux d'infiltration, la nappe phréatique ni encore avec les eaux de surface.

CONTRIBUTION DU PRODUIT A LA QUALITE DE VIE A L'INTERIEUR DES BATIMENTS

Caractéristiques de confort	
Confort hygrothermique	Les membranes étanches d'enveloppe du bâtiment : • peuvent être translucides ou opaques (Tv n-h de 0 à 20% - EN410) • peuvent sous certaines conditions bénéficier d'un traitement à faible émissivité (lowE) • peuvent être employées en simple peau ou multicouches Exemples de performances en configuration simple ou double peau :

Quality	Colour	U (W/sqm/°K)	G (%)	TV (%)
Simple membrane				
Flexlight Xtrem TX30-II	3001	5.6	14.0	8.0
Flexlight Lighting 1202 HT	3399	5.6	23.5	17.0
Flexlight Xtrem TX30-II blackout	White blackout	5.6	7.0	0.0
Flexlight Xtrem TX30-II blackout LowE	White LowE blackout	3.9	4.1	0.0
Double membrane				
Flexlight Xtrem TX30-II / Flexlight Lighting 402 HT		2.9	8.8	5.3
Flexlight Xtrem TX30-II / Alphalia Silent Aw Transluscent		2.9	8.8	6.3
Flexlight Xtrem TX30-II / Flexlight Lighting 702 HT		2.9	7.9	4.0
Flexlight Xtrem TX30-II / Flexlight Perform 702 Low E		2.6	6.6	1.0
Flexlight Xtrem TX30-II opaque LowE / Flexlight Perform 702 opaque LowE		2.0	2.1	0.0

U in vertical position = Heat transfer coefficient: W/sqm/°K — G = Solar Factor — TV =Visible light transmission EN 410



Article	Qualité Couleur	Facteur solaire G (%)
702 HT	3399	29
832 HT	3399	26
1002 HT	3399	24
702	8604S2	12
782	8100	11
832	8100	10
942	8100	10
1302	8636S2	8
782 opaque	8503	8
702 opaque	8603S2	7
702 opaque lowE (intérieur)	White LowE blackout	4

Calculs sur la base de mesures internes selon EN410 (spectrophotomètre PERKIN ELMER LAMBDA 950)

Confort acoustique

Pour traiter l'acoustique des locaux couverts par une membrane tendue, ces dernières peuvent être combinées avec une toile absorbante en face intérieure permettant de réduire fortement le temps de réverbération. En effet, combinée à une membrane ALPHALIA AW, le complexe double peau peut absorber entre 65 et 85% sur les fréquences de la voix humaine (500 à 2000Hz).

double membrane Serge ferrari	color	Acoustic Absorption **αw (NRC) (%)**	
Flexlight tx30-II + Alphalia AW **white**	Translucent + White	65 to 85%	on the frequencies of the human voice
Flexlight tx30-II + Alphalia AW **lux**	translucent + acoustic comfort	65 to 85%	on the frequencies of the human voice
Flexlight 702 S2 opaque + Alphalia AW	opaque + acoustic comfort	65 to 85%	on the frequencies of the human voice
Flexlight opaque Low E** + Alphalia AW	opaque alu low E** + acoustic comfort	65 to 85%	on the frequencies of the human voice
Flexlight tx30-II + MW 45mm + Alphalia AW	opaque + acoustic comfort	100%	on the frequencies of the human voice

MW Mineral Wool
*** fabrication speciale/special production*

Une autre solution consiste à installer en face intérieure, une toile transonore (fortement ajourée) associée avec un absorbant traditionnel.

Enfin, les membranes présentent un niveau d'affaiblissement acoustique R_w allant de 10 à 16 dB selon le niveau mécanique et le grammage de 590 g/m2 (502) à 1500 g/m2 (1502) respectivement

(Rapport CTTM N° A100194).

AFFAIBLISSEMENT ACOUSTIQUE						TX30-II	TX30-III	TX30-IV	TX30-V
		502 S2	702 S2	702 opac dualtone	902 S2	1002 S2	1202 S2	1302 S2	1502 S2
Acoustic Weakening index	ISO 717-1	**10dBA**	**11dBA**	**12dBA**	**13 dBA**	**14 dBA**	**14 dBA**	**15 dBA**	**16 dBA**

Confort visuel

Selon le niveau de translucidité des membranes, de la saison, du moment de la journée…, les membranes Serge Ferrari facilitent l'accès à l'autonomie lumineuse et limite l'usage d'éclairage artificiel.

Voir ci-dessous quelques exemples de membranes de caractéristiques mécaniques proches et ayant des niveaux de transmission de lumière différents (Tv n-h 0% à 20%). C'est le besoin qui guidera le choix d'une membrane plutôt qu'une autre.

SINGLE LAYER CALCULATION (EN 410)

		FLEXLIGHT 1202-3399 S2 Highly Translucent	FLEXLIGHT TX30-II	FLEXLIGHT 902 S2	FLEXLIGHT 1002 S2
Peau externe (simple peau)					
Tv		**17,0%**	**8,0%**	**5,0%**	**4,0%**
Light from outside		Real Light inside (Lux)	Real Light inside (Lux)	Real Light inside (Lux)	Real Light inside (Lux)
100 000	lux (Maximum)	17 000	8 000	5 000	4 000
80 000	lux (Sun without any cloud)	13 600	6 400	4 000	3 200
50 000	lux	8 500	4 000	2 500	2 000
20 000	lux	3 400	1 600	1 000	800
10 000	lux (grey cloudy)	1 700	800	500	400
5 000	lux (stormy sky)	850	400	250	200

	La gamme de produits offre une large palette de translucidité, de la haute translucidité jusqu'à une opacité totale. **Article** / **Qualité Couleur** / **T_V (Transmission visible EN 410)** 702 HT / 3399 / 23 832 HT / 3399 / 20 1002 HT / 3399 / 17 702 / 8604S2 / 7 832 / 8100 / 6 942 / 8100 / 6 1302 / 8636S2 / 3 782 opaque / 8503 / 0 702 opaque / 8603S2 / 0 702 opaque lowE (intérieur) / White LowE blackout / 0 *Calculs sur la base de mesures internes selon EN410 (spectrophotomètre PERKIN ELMER LAMBDA 950)*
Confort olfactif	Les produits ne revendiquent aucune performance olfactive.

CONTRIBUTION ENVIRONNEMENTALE POSITIVE

Aucune filière de recyclage ou calcul d'évitement d'énergie n'est considéré.

FICHE DE DECLARATION ENVIRONNEMENTALE ET SANITAIRE

Membranes composites tendue en application intérieure ou extérieure

STRUCTURES LEGERES

(hors accessoires de pose)

En conformité avec la norme NF EN 15804+A1 et son complément national NF EN 15804/CN

Avertissement

Les informations contenues dans cette déclaration sont fournies sous la responsabilité de SERGE FERRARI (producteur de la FDES) selon la NF EN 15804+A1 et le complément national NF EN 15804/CN.

Toute exploitation, totale ou partielle, des informations fournies dans ce document doit au minimum être accompagnée de la référence complète à la FDES d'origine ainsi qu'à son producteur qui pourra remettre un exemplaire complet.

GUIDE DE LECTURE

L'affichage des données d'inventaire respecte les exigences de la norme NF EN 15804+A1.

Dans les tableaux suivants 2,53E-06 doit être lu : 2,53x10 -6 (écriture scientifique).

Les unités utilisées dans les tableaux sont :

- Le kilogramme « kg »,
- Le gramme « g »,
- Le litre « L »
- Le kilowattheure « kWh »,
- Le mégajoule « MJ ».

ACV : Analyse du Cycle de Vie
DVR : Durée de Vie de Référence
UF : Unité Fonctionnelle
FDES: Fiche de Déclaration Environnementale et Sanitaire des Produits de la Construction

PRECAUTION D'UTILISATION DE LA FDES POUR LA COMPARAISON DES PRODUITS

Les FDES de produits de construction peuvent ne pas être comparables si elles ne sont pas conformes à la norme NF EN 15804+A1.

La norme NF EN 15804+A1 définie au *§ 5.3 Comparabilité des DEP* pour les produits de construction*, les conditions dans lesquelles les produits de construction peuvent être comparés, sur la base des informations fournies par la FDES :

« Une comparaison de la performance environnementale des produits de construction en utilisant les informations des DEP doit être basée sur l'usage des produits et leurs impacts sur le bâtiment, et doit prendre en compte la totalité du cycle de vie (tous les modules d'information) »

* La note 1 de l'avant-propos du complément national définit *« la traduction littérale en français de EPD (Environmental Product Declaration) est DEP (Déclaration Environnementale de Produit). Toutefois, en France, on utilise couramment le terme de FDES (Fiche de Déclaration Environnementale et Sanitaire) qui regroupe à la fois la Déclaration Environnementale et des informations Sanitaires pour le produit faisant l'objet de cette FDES.*
La FDES est donc bien une ''DEP'' complétée par des informations sanitaires. »

INFORMATION GENERALE

Nom et adresse des fabricants	**Références commerciales des produits**
SERGE FERRARI Zone industrielle – 246 Rue des Sétives 38110 ST JEAN DE SOUDAIN France	402 ; 402HT ; 412 ; 412 OPAQUE ; 502 ; 522 ; 572 ; 602 ; 602 OPAQUE ; 782 ; 251 ; 411 ; 456 ; 501 ; 332 ; 362 *Les versions translucides et opaques de ces références sont couvertes par cette FDES.
Type de FDES	**Circuit de distribution**
- "du berceau à la porte de l'usine, avec options" - individuelle	BtoB
Coordonnées du contact du déclarant	**Nom du vérificateur**
julien.lance@sergeferrari.com	Cécile Beaudard (Solinnen)
Date de publication	**Date de fin de validité**
Avril 2021	Mars 2026
Programme de vérification :	
Programme FDES-INIES http://www.inies.fr/ Association HQE 4, avenue du Recteur Poincaré 75016 PARIS FRANCE	
La norme EN 15804 et son complément national NF EN 15804/CN servent de RCP de référence. Vérification par tierce-partie indépendante en accord avec ISO 14025 et EN 15804 ainsi que les RCP spécifiques citées ci-dessus: ☐ Interne ☒ Externe Numéro d'enregistrement : 4-535:2021	

DESCRIPTION DE L'UNITE FONCTIONNELLE ET DU PRODUIT

UNITE FONCTIONNELLE

«Assurer une fonction de 1m² de couverture en membrane composite tendue en application intérieure ou extérieure pendant 2 ans »

DESCRIPTION DU PRODUIT

Les produits couverts par cette FDES sont des membranes composite légère ; pleine ou ajourée, de la société SERGE FERRARI fabriquées sur son site à La Tour du Pin.

Le produit de référence sur lequel porte l'étude est une moyenne arithmétique des produits de la gamme.

Les références commerciales couvertes par cette FDES sont cités ci-dessus. Tous les produits de cette famille sont fabriqués sur le site de La Tour du Pin avec les mêmes matières premières, les mêmes procédés de fabrication et ont les mêmes applications. Seul le design des produits diffère. La variabilité est présentée ci-après..

Tous les calculs sont rapportés à l'unité fonctionnelle, c'est-à-dire à 1m² de produit.

USAGE DU PRODUIT (DOMAINE D'APPLICATION)

Les produits sont utilisés dans la fabrication de produits finis destinés à la Structure Légère.

PERFORMANCE PRINCIPALE DE L'UNITE FONCTIONNELLE

Assurer une fonction de 1m² de couverture en membrane composite tendue en application intérieure ou extérieure

CARACTERISTIQUES TECHNIQUES

Paramètre		
Masse produit moyen	0,510	kg
Masse l'emballage moyen	0,054	kg
Masse totale moyenne	**0,564**	**kg**

Le produit de référence est un produit fictif, dont l'ensemble des valeurs ont été calculées à partir de la moyenne arithmétique de tous les produits de la gamme.

DESCRIPTION DES PRINCIPAUX COMPOSANTS ET/OU MATERIAUX DU PRODUIT

Tissu Polyester, PVC, vernis acrylique.

COMPOSITION / SUBSTANCES REACH

Les membranes SERGE FERRARI respectent la réglementation REACH. Elles ne contiennent aucune substance de la liste SHVC (liste mise à jour le 19/01/2021) à un taux supérieur à 0,1% massique.

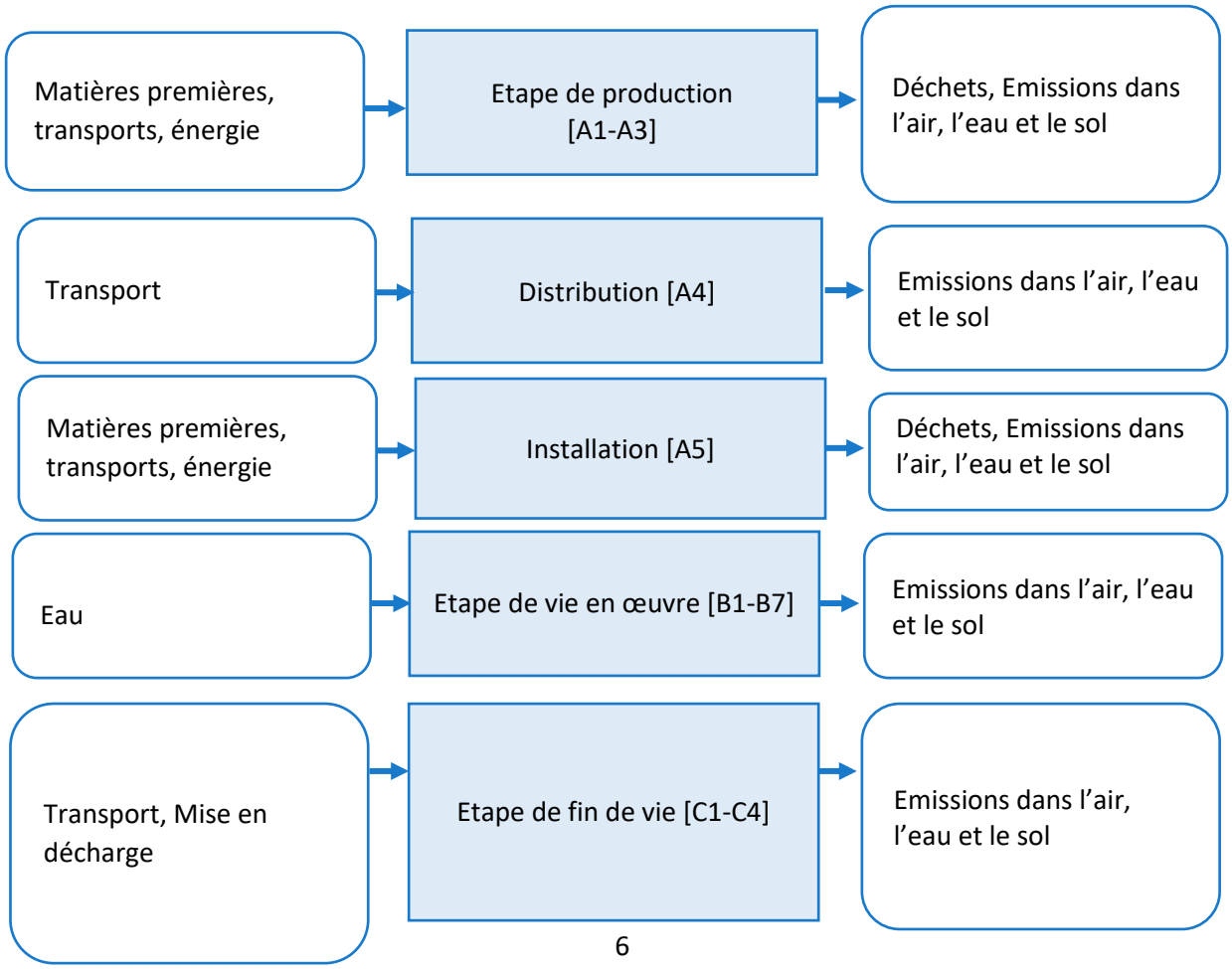
DUREE DE VIE DE REFERENCE

Paramètre	Valeur
Durée de vie de référence	2 ans (minimum). Certains produits de la gamme ont des durées de vie pouvant dépasser les 2 ans. Cf tableau ci-dessous.
Propriétés déclarées du produit (à la sortie de l'usine) et finitions, etc.	Membrane tendue pour réaliser l'enveloppe du bâtiment (toiture et/ou façade) ou des applications intérieures avec ou sans impression (murs, plafonds, séparations, éléments de communication visuels, …)
Paramètres théoriques d'application (s'ils sont imposés par le fabricant), y compris les références aux pratiques appropriées	Membrane tendue ou suspendue sur une structure généralement métallique ou bois
Qualité présumée des travaux, lorsque l'installation est conforme aux instructions du fabricant	Pour les applications extérieures, respect des règles de conception, des règles neige et vent et des Eurocodes Structuraux. Pour les applications intérieures « Batiment », respect des règles de marquage CE pour les plafonds et du NF DTU 58.2 Plafond tendu.
Environnement extérieur (pour les applications en extérieur), par exemple intempéries, polluants, exposition aux UV et au vent, orientation du bâtiment, ombrage, température	Résistance en extérieur contre les UV et les intempéries (pluie, neige, vent). Cf fiche technique.
Environnement intérieur (pour les applications en intérieur), par exemple température, humidité, exposition à des produits chimiques	Résistance à l'humidité, aux ambiances chlorées ou salines. Cf fiche technique. Résistance à des températures inférieures à 50°C en continu et 70°C ponctuellement. Cf fiche technique.
Conditions d'utilisation, par exemple fréquence d'utilisation, exposition mécanique	Non concernés
Maintenance, par exemple fréquence exigée, type et qualité et remplacement des composants remplaçables	Une fois installés, les produits ne requièrent pas de maintenance particulière sauf un nettoyage si nécessaire et selon l'emploi. 1 nettoyage tous les 5 ans à l'eau savonneuse est préconisé dans les applications semi-permanentes (entre dans le critère de coupure).

Paramètre	Démontable, lavable		Non démontable / Permanent	
	Durée de vie		Durée de vie	
251 ; 411 : intérieur 501 ; 456 : extérieur et intérieur	2	ans	/	ans
412 ; 412 OPAQUE ; 502 ; 522 ; 572	7	ans	10	ans
782	/	ans	10	ans
402 ; 402HT ; 602 ; 602 OPAQUE	3	ans	5	ans
332 ; 362	5	ans	7	ans

ETAPES DU CYCLE DE VIE

DIAGRAMME DE CYCLE DE VIE



[A1-A3] PHASE DE PRODUCTION DU PRODUIT

Paramètres	Informations
Produit	
Informations générales	- L'ensemble des substances et des matériaux constitutifs nécessaires à la fabrication du produit a été pris en compte. - Les modules utilisés pour modéliser les matières premières ne contiennent pas de matière secondaire. - Le transport amont a été intégré à l'étude. Il a été modélisé par un transport via camion articulé de 27 tonnes chargé à 80% avec un taux de retour à vide de 30%. - La consommation d'énergie sur le site de production a été modélisée par le mix électrique français Source : IEA - 2018 - Les déchets issus de l'étape de fabrication ont été considérés. Le transport jusqu'au site a été modélisé par un transport en camion benne de 17.3 tonnes chargés à 80% avec un taux de retour à vide de 100% et pour certains, par un transport en avion.
Tissage des fils	Le tissage est réalisé à la Tour du Pin (France). Il fait intervenir du polyester.
Enduction PVC	L'enduction est réalisée à la Tour du Pin (France). Elle fait intervenir des plastifiants, des stabilisants, du PVC, et des composés tels que la silice, le trioxyde d'antimoine, une charge minérale, un fongicide, un ignifugeant et du vernis acrylique.
Emballage	
Emballage du produit fini	- Film plastique - Caisse bois carton - Palettes bois - Tube carton
Allocation	Les quantités nécessaires pour la fabrication d'un produit en termes de matière première, énergies et déchets sont basées sur une année de production et ramenée par un produit en croix à un produit (allocation massique).
Informations particulières	Les impacts liés à la production des chutes de fabrication et les déchets ont été comptabilisés au moment où ils ont été générés. Ainsi les chutes de production ont été modélisées en phase A1-A3.

[A4] TRANSPORT JUSQU'AU CHANTIER

Paramètre	Unité	Valeur
Type de combustible et consommation du véhicule ou type de véhicule utilisé pour le transport, par exemple camion sur longue distance, bateau, etc.		Transport en camion 27t, depuis l'usine de fabrication (La Tour du Pin) jusqu'au chantier.
Distance jusqu'au chantier	km	550
Utilisation de la capacité (y compris les retours à vide)	%	80% de taux de charge et 30% de retours à vide
Masse volumique en vrac des produits transportés	kg/m^3	-
Coefficient d'utilisation de la capacité volumique	Coefficient : = 1 ou < 1 ou ≥ 1 pour les produits comprimés ou emboîtés	1

[A5] INSTALLATION DANS LE BATIMENT

Paramètre	Unité	Valeur
Intrants auxiliaires pour l'installation (spécifiés par matériau)	%	5% de taux de chute qui sont traités comme des déchets non dangereux et transportés sur 100 km par camion
Utilisation d'eau	m^3	-
Utilisation d'autres ressources	kg	-
Description quantitative du type d'énergie (mélange régional) et consommation durant le processus d'installation	kWh ou MJ	
Déchets produits sur le site de construction avant le traitement des déchets générés par l'installation du produit (spécifiés par type)	kg	
Matières (spécifiées par type) produites par le traitement des déchets sur le site de construction, par exemple collecte en vue du recyclage, de la récupération d'énergie, de l'élimination (spécifiées par voie)	kg	
Emissions directes dans l'air ambiant, le sol et l'eau	kg	-

[B1-B7] PHASE DE VIE EN ŒUVRE

MAINTENANCE

Paramètre	Unité	Valeur
Processus de maintenance	La vie en œuvre du produit nécessite uniquement un nettoyage ponctuel à l'eau.	
Cycle de maintenance	1 lavage tous les 5 ans	
Intrants auxiliaires pour la maintenance (par exemple, produit de nettoyage, spécifier les matériaux)	L	2L d'eau pour 1m², soit 0,8L d'eau sur le cycle de vie complet
Déchets produits pendant la maintenance (spécifier les matériaux)	kg	-
Consommation nette d'eau douce pendant la maintenance	L	2L d'eau pour 1m², soit 0,8L d'eau sur le cycle de vie complet
Intrant énergétique pendant la maintenance (par exemple nettoyage par aspiration), type de vecteur énergétique, par exemple électricité, et quantité, si applicable et pertinent	kWh	-

REPARATION

Paramètre	Unité	Valeur
Processus de réparation	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié à la réparation.	
Processus d'inspection	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié aux processus d'inspection.	
Cycle de réparation	Nombre par RSL ou année	-
Intrants auxiliaires (par exemple lubrifiant, spécifier les matériaux)	kg ou kg/cycle	-
Déchets produits pendant la réparation (spécifier les matériaux)	kg	-
Consommation nette d'eau douce pendant la réparation	m^3	-
Intrant énergétique pendant la réparation (par exemple activité de grutage), type de vecteur énergétique, par exemple électricité, et quantité	kWh/RSL, kWh/cycle	-

REMPLACEMENT

Paramètre	Unité	Valeur
Cycle de remplacement	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié au remplacement.	
Intrant énergétique pendant le remplacement (par exemple activité de grutage), type de vecteur énergétique (par exemple électricité), et quantité, si applicable et pertinent	kWh	-
Echange de pièces usées pendant le cycle de vie du produit, spécifier les matériaux	kg	-

REHABILITATION

Paramètre	Unité	Valeur
Processus de réhabilitation	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié à la réhabilitation.	
Cycle de réhabilitation	Nombre par RSL ou année	-
Intrant de matières pour la réhabilitation (par exemple briques), y compris les intrants auxiliaires pour le processus de réhabilitation (par exemple lubrifiant, spécifier les matériaux)	kg ou kg/cycle	-
Déchets produits pendant la réhabilitation (spécifier les matériaux)	kg	-
Intrant énergétique pendant la réhabilitation (par exemple activité de grutage), type de vecteur énergétique, par exemple électricité, et quantité, si applicable et pertinent	kWh	-
Autres hypothèses pour l'élaboration de scénarios (par exemple, fréquence et durée d'utilisation, nombre d'occupants)	Unité appropriée	-

UTILISATION DE L'ENERGIE ET DE L'EAU

Paramètre	Unité	Valeur
Intrants auxiliaires spécifiés par matière	kg ou unités appropriées	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié l'utilisation d'énergie.
Consommation nette d'eau douce	m3	La vie en œuvre du produit ne nécessite pas d'action particulière. Il n'y a donc aucun intrant et sortant lié l'utilisation d'eau.
Type de vecteur énergétique (par exemple, électricité, gaz naturel, chauffage urbain)	kWh	-
Puissance de sortie de l'équipement	kWh	-
Performance caractéristique (par exemple efficacité énergétique, émissions, variation de performance en fonction de l'utilisation de la capacité, etc.)	unités appropriées	-
Autres hypothèses pour l'élaboration de scénarios (par exemple, fréquence et durée d'utilisation, nombre d'occupants)	unités appropriées	-

[C1-C4] PHASE DE FIN DE VIE

Paramètre	Unité	Valeur
Processus de collecte spécifié par type	kg collecté individuellement kg collecté avec des déchets de construction mélangés	0,510
Système de récupération spécifié par type	kg destiné à la réutilisation	-
	kg destiné au recyclage	-
	kg destiné à la récupération d'énergie	-
Elimination spécifiée par type	kg de produit ou de matériau destiné à l'élimination finale	0,510 (enfouissement)
Hypothèses pour l'élaboration de scénarios (par exemple transport)	km	100 km en camion 17,3t

[D] POTENTIEL DE RECYCLAGE / REUTILISATION / RECUPERATION, D

Le module D n'est pas considéré.

INFORMATION POUR LE CALCUL DE L'ANALYSE DE CYCLE DE VIE

PCR utilisé	NF EN 15804+A1 - Avril 2014, NF EN 15804/CN – Juin 2016
Frontières du système	Les frontières du système respectent les limites imposées par la norme NF EN 15804+A1 et son complément national NF EN 15804/CN.
Allocations	Les quantités nécessaires pour la fabrication d'un produit en termes de matière première, énergies et déchets sont basées sur une année de production et ramenée par un produit en croix à un produit (allocation massique).
Représentativité géographique et représentativité temporelle des données primaires	Les données ont été collectées relativement à la production annuelle de l'usine SERGE FERRARI. La collecte a été lancée en Septembre 2020. Elle est représentative des technologiques utilisées pour l'année 2019. La base de données utilisée est la base de données BDD CODDE-2018-11 (mise à jour Novembre 2018) et ELCD version 3.2. Logiciel EIME, Version 5.9. Version de la base de données : Décembre 2020
Variabilité des résultats	Une analyse de variabilité a été réalisée entre les produits couverts par la FDES de la gamme. Les résultats permettent de dire que les impacts sont homogènes au sein de la famille de produit. Les impacts environnementaux déclarés dans la FDES sont donc basés sur une moyenne entre tous les produits de la gamme.

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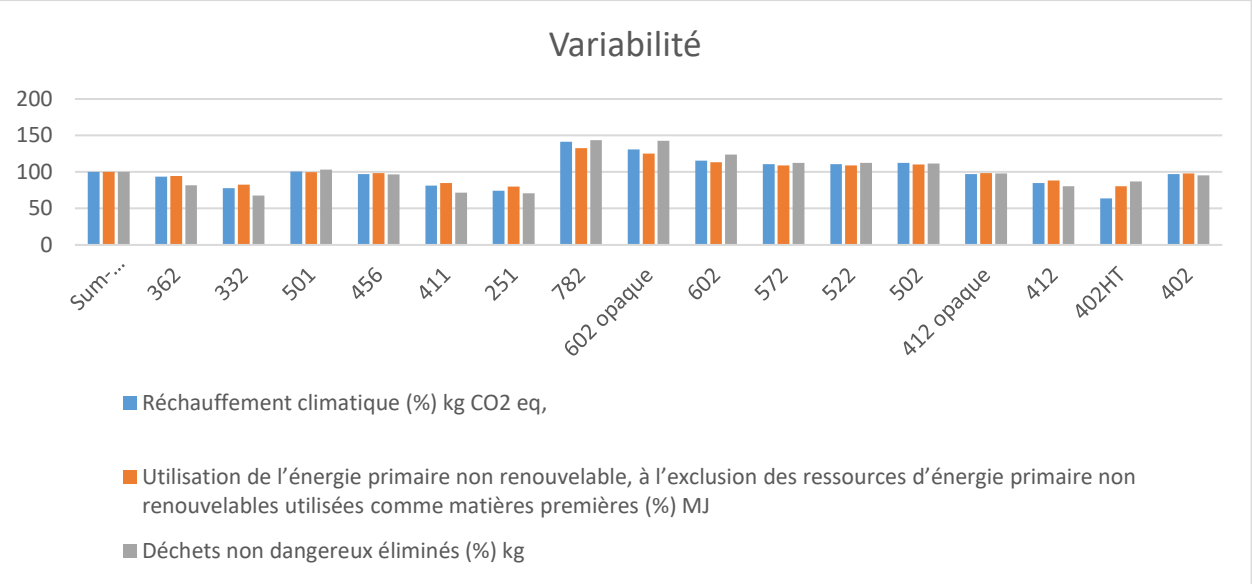
VARIABILITE



RESULTATS DE L'ANALYSE DE CYCLE DE VIE

Indicateurs d'impact	Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total B1-B7**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total C1-C4**		
Réchauffement climatique kg CO2 eq/UF	**2,10E+00**	2,30E-02	1,46E-01	**1,69E-01**	0,00E+00	2,33E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,33E-02**	0,00E+00	4,75E-03	0,00E+00	4,59E-01	4,64E-01	**2,75E+00**	MND
Appauvrissement de la couche d'ozone kg CFC 11 eq/UF	**1,83E-07**	4,65E-11	9,29E-09	**9,33E-09**	0,00E+00	1,52E-10	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,52E-10**	0,00E+00	9,62E-12	0,00E+00	1,51E-09	1,52E-09	**1,94E-07**	MND
Acidification des sols et de l'eau kg SO2 eq/UF	**4,02E-03**	1,03E-04	2,20E-04	**3,23E-04**	0,00E+00	5,07E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,07E-05**	0,00E+00	2,25E-05	0,00E+00	1,94E-04	2,17E-04	**4,62E-03**	MND
Eutrophisation kg (PO4)3- eq/UF	**6,63E-03**	2,37E-05	4,09E-04	**4,33E-04**	0,00E+00	1,60E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,60E-05**	0,00E+00	5,20E-06	0,00E+00	1,39E-03	1,40E-03	**8,48E-03**	MND
Formation d'ozone photochimique Ethene eq/UF	**3,51E-04**	7,33E-06	2,68E-05	**3,42E-05**	0,00E+00	2,73E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,73E-06**	0,00E+00	1,62E-06	0,00E+00	1,02E-04	1,04E-04	**4,91E-04**	MND
Epuisement des ressources abiotiques (éléments) kg Sb eq/UF	**2,63E-02**	9,19E-10	1,31E-03	**1,31E-03**	0,00E+00	8,12E-10	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**8,12E-10**	0,00E+00	1,90E-10	0,00E+00	2,93E-09	3,12E-09	**2,76E-02**	MND
Epuisement des ressources abiotiques (fossiles) MJ/UF	**3,82E+01**	3,23E-01	1,96E+00	**2,28E+00**	0,00E+00	6,57E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,57E-02**	0,00E+00	6,67E-02	0,00E+00	5,17E-01	5,84E-01	**4,12E+01**	MND
Pollution de l'eau m3/UF	**2,71E+02**	3,78E+00	1,39E+01	**1,76E+01**	0,00E+00	2,33E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,33E-01**	0,00E+00	7,81E-01	0,00E+00	2,29E+00	3,07E+00	**2,92E+02**	MND
Pollution de l'air m3/UF	**3,17E+02**	9,41E-01	1,69E+01	**1,79E+01**	0,00E+00	2,83E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,83E-01**	0,00E+00	2,19E-01	0,00E+00	1,23E+01	1,25E+01	**3,48E+02**	MND

Utilisation des ressources	Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total B1-B7**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total C1-C4**		
Utilisation de l'énergie primaire renouvelable, à l'exclusion des ressources d'énergie primaire renouvelables utilisées comme matières premières MJ/UF	**2,62E+00**	4,33E-04	1,32E-01	1,33E-01	0,00E+00	7,58E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,58E-04	0,00E+00	8,95E-05	0,00E+00	1,63E-02	1,64E-02	**2,77E+00**	MND
Utilisation des ressources d'énergie primaire renouvelables en tant que matières premières MJ/UF	**4,90E-01**	0,00E+00	2,45E-02	2,45E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,14E-01**	MND
Utilisation totale des ressources d'énergie primaire renouvelables (énergie primaire et ressources d'énergie primaire utilisées comme matières premières) MJ/UF	**3,11E+00**	4,33E-04	1,57E-01	1,57E-01	0,00E+00	7,58E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,58E-04	0,00E+00	8,95E-05	0,00E+00	1,63E-02	1,64E-02	**3,28E+00**	MND
Utilisation de l'énergie primaire non renouvelable, à l'exclusion des ressources d'énergie primaire non renouvelables utilisées comme matières premières MJ/UF	**4,00E+01**	3,24E-01	2,05E+00	2,38E+00	0,00E+00	7,11E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,11E-02	0,00E+00	6,70E-02	0,00E+00	5,70E-01	6,37E-01	**4,31E+01**	MND
Utilisation des ressources d'énergie primaire non renouvelables en tant que matières premières MJ/UF	**1,07E+01**	0,00E+00	5,34E-01	5,34E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,12E+01**	MND
Utilisation totale des ressources d'énergie primaire non renouvelables (énergie primaire et ressources d'énergie primaire utilisées comme matières premières) MJ/UF	**5,06E+01**	3,24E-01	2,59E+00	2,91E+00	0,00E+00	7,11E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,11E-02	0,00E+00	6,70E-02	0,00E+00	5,70E-01	6,37E-01	**5,43E+01**	MND
Utilisation de matière secondaire kg/UF	**2,65E-02**	0,00E+00	1,32E-03	1,32E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,78E-02**	MND
Utilisation de combustibles secondaires renouvelables MJ/UF	**3,45E-01**	0,00E+00	1,72E-02	1,72E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,62E-01**	MND
Utilisation de combustibles secondaires non renouvelables MJ/UF	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	MND
Utilisation nette d'eau douce m3/UF	**1,47E-01**	2,06E-06	7,38E-03	7,38E-03	0,00E+00	8,36E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,36E-05	0,00E+00	4,25E-07	0,00E+00	1,52E-04	1,52E-04	**1,55E-01**	MND

Catégorie de déchets	Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total B1-B7**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total C1-C4**		
Déchets dangereux éliminés kg/UF	**2,39E-02**	0,00E+00	1,22E-03	**1,22E-03**	0,00E+00	2,81E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,81E-06**	0,00E+00	0,00E+00	0,00E+00	2,71E-04	**2,71E-04**	**2,54E-02**	MND
Déchets non dangereux éliminés kg/UF	**5,50E-01**	8,16E-04	7,34E-02	**7,42E-02**	0,00E+00	5,84E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,84E-03**	0,00E+00	1,69E-04	0,00E+00	5,69E-01	**5,69E-01**	**1,20E+00**	MND
Déchets radioactifs éliminés kg/UF	**1,13E-04**	5,81E-07	7,17E-06	**7,75E-06**	0,00E+00	1,78E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,78E-06**	0,00E+00	1,20E-07	0,00E+00	1,89E-05	**1,90E-05**	**1,41E-04**	MND

Flux sortants		Etape de production	Etape du processus de construction			Etape d'utilisation								Etape de fin de vie					Total Cycle de Vie	D Bénéfices et charges au-delà des frontières du système
		Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total B1-B7**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total C1-C4**		
Composants destinés à la réutilisation kg/UF		**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
Matériaux destinés au recyclage kg/UF		**3,62E-02**	0,00E+00	3,71E-02	**3,71E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**7,34E-02**	MND
Matériaux destinés à la récupération d'énergie kg/UF		**1,39E-02**	0,00E+00	6,67E-03	**6,67E-03**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,06E-02**	MND
Energie fournie à l'extérieur (par vecteur) J/UF	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND	MND
	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND	MND
	0,00E+00	0,00E+00	2,62E-02	**2,62E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	3,00E-01	**3,00E-01**	**3,27E-01**	MND	MND

INFORMATIONS ADDITIONNELLES SUR LE RELARGAGE DE SUBSTANCES DANGEREUSES DANS L'AIR INTERIEUR, LE SOL ET L'EAU PENDANT L'ETAPE D'UTILISATION

Caractéristiques sanitaires	
COV et formaldéhyde	 GREENGUARD GOLD : 402 ; 402HT ; 412 ; 412 OPAQUE ; 502 ; 522 ; 572 ; 602 ; 602 OPAQUE ; 782 ; 251 ; 411
Emissions dans l'air intérieur de substances dangereuses	Les membranes SERGE FERRARI respectent la réglementation REACH. Elles ne contiennent aucune substance de la liste SHVC (liste mise à jour le 19/01/2021) à un taux supérieur à 0,1% massique.
Comportement face aux micro-organismes	Se rapprocher des équipes commerciales Serge Ferrari, certains produits sont couverts et d'autres non selon les références commerciales
Odeurs	Aucun test réalisé
Emissions radioactives	Aucun test réalisé
Caractéristiques concernant la qualité de l'eau	Sans objet car ce produit n'est en contact ni avec l'eau destinée à la consommation humaine, ni avec les eaux de ruissellement, les eaux d'infiltration, la nappe phréatique ni encore avec les eaux de surface.

CONTRIBUTION DU PRODUIT A LA QUALITE DE VIE A L'INTERIEUR DES BATIMENTS

Caractéristiques de confort

Confort hygrothermique

Article	Qualité Couleur	Facteur solaire G (%)
402 HT	1399	40
412	8100	18
402	8104	18
502	8604S2	16
522	8102	14
602	8100	12
782	8100	11
602 opaque	8503	8

<table>
<tr><td></td><td>Calculs sur la base de mesures internes selon EN410 (spectrophotomètre PERKIN ELMER LAMBDA 950)</td></tr>
<tr><td>Confort acoustique</td><td>Pour traiter l’acoustique des locaux couverts par une membrane tendue, ces dernières peuvent être combinées avec une toile absorbante en face intérieure (a_w = 0,65 ; rapport CTTM A100008 pour lame d’air 100 et 400 mm) permettant de réduire fortement le temps de réverbération. Une autre solution consiste à installer en face intérieure, une toile transonore (fortement ajourée) associée avec un absorbant traditionnel.
Les membranes présentent niveau d’affaiblissement acoustique R_w allant de 10 à 12 dB selon le grammage de 590 g/m2 (502) à 750 g/m2 (702) respectivement (Rapport CTTM N° A100194).

Exemple de bâtiment en double peau thermique et acoustique

Exemple de bâtiment à usage sportif
Membrane extérieure étanche : 702, 782, …
Membrane intérieure : Aw 7005

 
Réverbération presque 3 fois inférieure après traitement avec membrane absorbante intérieure
TR = 6,9 s avant traitement
TR = 2,5 s après traitement</td></tr>
<tr><td>Confort visuel</td><td>La gamme de produits offre une large palette de translucidité, de la haute translucidité jusqu’à une opacité totale.

<table>
<tr><th>Article</th><th>Qualité Couleur</th><th>T_V (Transmission visible EN 410)</th></tr>
<tr><td>402 HT</td><td>1399</td><td>37</td></tr>
<tr><td>412</td><td>8100</td><td>14</td></tr>
<tr><td>402</td><td>8104</td><td>13</td></tr>
<tr><td>502</td><td>8604S2</td><td>11</td></tr>
<tr><td>522</td><td>8102</td><td>9</td></tr>
<tr><td>602</td><td>8100</td><td>8</td></tr>
<tr><td>782</td><td>8100</td><td>7</td></tr>
<tr><td>602 opaque</td><td>8503</td><td>0</td></tr>
</table>

Calculs sur la base de mesures internes selon EN410 (spectrophotomètre PERKIN ELMER LAMBDA 950)</td></tr>
<tr><td>Confort olfactif</td><td>Les produits ne revendiquent aucune performance olfactive.</td></tr>
</table>

CONTRIBUTION ENVIRONNEMENTALE POSITIVE

Aucune filière de recyclage ou calcul d’évitement d’énergie n’est considéré.

EPD - ENVIRONMENTAL PRODUCT DECLARATION

Tensile composite membranes for interior and exterior applications

SOLAR PROTECTION

(excluding installation accessories)

Environmental product declaration in accordance with standards NF EN ISO 14025, NF EN 15804+A1 and its French national complement NF EN 15804/CN

Advertisement

The information contained in this declaration is provided under the responsibility of Serge Ferrari (producer of the EPD) in accordance with NF EN 15804+A1 and its French national supplement NF EN 15804/CN.

Any use, in whole or in part, of the information provided in this document must at least be accompanied by a complete reference to the original EPD and to its producer, who may supply a complete copy.

GUIDE DE LECTURE

The display of inventory data complies with the requirements of NF EN 15804+A1.

In the following tables 2.53E-06 should be read: 2.53x10 -6 (scientific writing).

The units used are specified before each flow, they are:

- the kilogram « kg »,
- the cubic meter « m3»,
- the kilowatt-hour « kWh »,
- the mega joule « MJ »,
- square meter «m²».

Abbreviations:

LCA: Life Cycle Analysis
RSL: Reference Service Life
FU : Functional Unit
FDES: « Fiche de Déclaration Environnementale et Sanitaire » (Environmental And Health Product Declaration)
EPD: Environmental Product Declaration

PRECAUTIONARY USE OF THE EPD FOR PRODUCT COMPARISON

The FDES of construction products may not be comparable if they do not comply with the NF EN 15804+A1 standard.

The standard NF EN 15804+A1 defines in § 5.3 Comparability of EPDs for construction products, the conditions under which construction products can be compared, based on the information provided by the EPD:

"A comparison of the environmental performance of construction products using EPD information should be based on the use of the products and their impacts on the building and should consider the entire life cycle (all information modules)."

* Note 1 of the foreword to the National Supplement defines *"the literal translation in French of EPD (Environmental Product Declaration) is DEP (Déclaration Environnementale de Produit). However, in France, the term FDES (Fiche de Déclaration Environnementale et Sanitaire) is commonly used, which includes both the Environmental Declaration and the Health information for the product that is the subject of this FDES.*
The FDES is therefore a ''EPD'' completed by health information."

GENERAL INFORMATION

Name and address of the manufacturer	**Commercial references**
SERGE FERRARI Zone industrielle – 246 Rue des Sétives 38110 ST JEAN DE SOUDAIN France	SOLTIS 86 ; SOLTIS 88 ; SOLTIS 92 ; SOLTIS 96 ; SOLTIS 99 ; SOLTIS B99 ; SOLTIS B990 ; SOLTIS B92 ; SOLTIS W96 ; 302 ; 432 ; 502 V2 ; 582 ; 371 ; 381
Type of EPD	**Distribution channel**
- "from cradle to gate, with options" - individual	Professionals (BtoB)
Contact information of the declarant's person	**Auditor's name:**
julien.lance@sergeferrari.com	Cécile Beaudard (Solinnen)
Date of publication	**Validity end date**
April 2021	April 2026
Verification program	
FDES-INIES program http://www.inies.fr/ Association HQE 4, avenue du Recteur Poincaré 75016 PARIS FRANCE	
CEN standard EN 15804 and its national complement NF EN 15804/CN serves as the Product Category Definition Rules (PCR). Independent verification of the declaration, in accordance with EN ISO 14025 and EN 15804 as well as the specific PCR mentioned above: ☐ Internal ☒ External Registration number : 4-534:2021	

DESCRIPTION OF THE FUNCTIONAL UNIT AND THE PRODUCT

FUNCTIONAL UNIT

«To ensure a function of 1m² of tensile composite membrane coverage in interior or exterior application for 15 years»

PRODUCT DESCRIPTION

The products covered by this EPD are heavy composite membranes, plain or perforated, manufactured by SERGE FERRARI on its site in La Tour du Pin.

The reference product used in the study is an arithmetic average of the products in the range.

The commercial references covered by this EPD are quoted above. All the products of this family are manufactured on the site of La Tour du Pin with the same raw materials, the same manufacturing processes and have the same applications. Only the design of the products differs. The variability is presented below.

All calculations are related to the functional unit, i.e. to 1m² of product.

PRODUCT USE (FIELD OF APPLICATION)

The products are used in the manufacture of finished products for the solar protection.

MAIN PERFORMANCE OF THE FUNCTIONAL UNIT

To provide a function of 1m² of tensile composite membrane coverage in interior or exterior application.

TECHNICAL CHARACTERISTICS

Parameter		
Average product weight	0,462	kg
Weight of the average packaging	0,050	kg
Average total weight	**0,512**	**kg**

The reference product is a fictitious product, whose values have been calculated from the arithmetic average of all the products in the range.

DESCRIPTION OF THE MAIN COMPONENTS AND/OR MATERIALS OF THE PRODUCT

Polyester fabric, PVC, acrylic varnish.

COMPOSITION / REACH SUBSTANCES

SERGE FERRARI membranes respect the REACH regulation. The products do not contain any substance from the "candidate list of substances with very high concern subject to authorization" at more than 0.1% in mass.

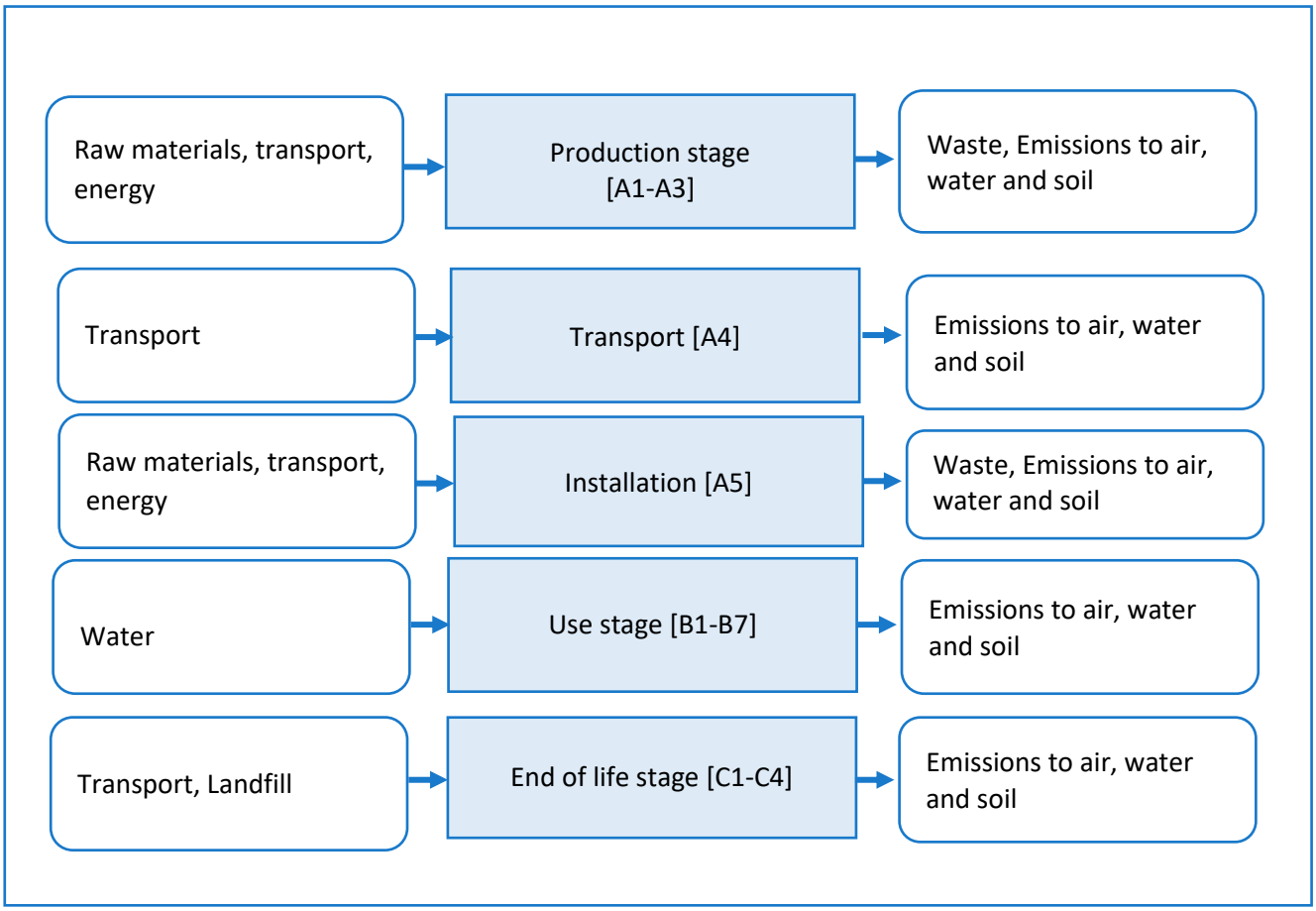
TECHNICAL SPECIFICATIONS

Parameter	Value
Reference Service Life	15 years (minimum). Some of the products in the range have life spans that can exceed 15 years. See table below.
Declared product properties (at the exit of the factory) and finishes, etc.	Tensile membrane for the building envelope (roof and/or façade)
Theoretical application parameters (if required by the manufacturer), including references to appropriate practices	Blinds on fixed or mobile structures, motorized or not
Assumed quality of the work, when the installation complies with the manufacturer's instructions	Not concerned
Outdoor environment (for outdoor applications). e.g. inclement weather, pollutants, UV and wind exposure, building orientation, shade, temperature	Outdoor resistance to bad weather, UV rays. Protects against glare, heat and bad weather without depriving yourself of natural light. See technical data sheet.
Indoor environment (for indoor applications) e.g. temperature, humidity, exposure to chemicals	Protects from glare and heat without depriving yourself of natural light. Low VOC emissions and no formaldehyde release
Conditions of use, e.g. frequency of use, mechanical exposure	None
Maintenance. e.g. frequency required, type and quality and replacement of replaceable components	Once installed, the products do not require any particular maintenance except cleaning if necessary and according to the use. 1 cleaning every 5 years with soapy water is recommended in certain cases (included in the cut-off criteria).

Parameter	Reference Service Life	
SOLTIS 86 ; SOLTIS 88 ; SOLTIS 92 ; SOLTIS 96 ; SOLTIS 99 ; SOLTIS B99 ; SOLTIS B990 ; SOLTIS B92 ; SOLTIS W96 ; 302 ; 432 (same compo as 302 with stripes); 502 V2 ; 582	15	years
371	20	years
381	25	years

STAGES OF THE LIFE CYCLE

LIFE CYCLE DIAGRAM



[A1-A3] PRODUCTION STAGE

Parameters	Information
Product	
General information	- All the substances and constituent materials necessary for the manufacture of the product have been taken into account. - The modules used to model the raw materials do not contain secondary materials. - Upstream transportation was included in the study. It was modeled by transport via a 27-ton articulated truck loaded to 80% with an empty return rate of 30%. - Energy consumption at the production site was modeled by the French electricity mix Source: IEA - 2018 - Waste from the manufacturing stage was considered. Transportation to the site was modeled by a 17.3 ton dump truck loaded at 80% with a 100% empty return rate and for some, by air transport.
Weaving of the wires	The weaving is made in La Tour du Pin (France). It uses polyester.
PVC coating	The coating is carried out at La Tour du Pin (France). It involves plasticizers, stabilizers, PVC, and compounds such as silica, antimony trioxide, a mineral filler, a fungicide, a flame retardant and acrylic varnish.
Packaging	
Packaging of the finished product	- Plastic film - Wooden cardboard box - Wooden pallets - Cardboard tube
Allocation	The quantities needed to manufacture a product in terms of raw materials, energy and waste are based on one year of production and brought proportionally to a product (mass allocation).
Specific information	Impacts related to the generation of production scrap and waste were accounted for when generated. Thus, production wastes were modeled in phase A1-A3.

[A4] TRANSPORTATION TO THE CONSTRUCTION SITE

Parameter	Unit	Value
Type of fuel and consumption of the vehicle or type of vehicle used for transportation, e.g. long distance truck, boat, etc.		Transport by 27t truck, from the manufacturing plant (La Tour du Pin) to the construction site.
Distance to the construction site	km	262
Capacity utilization (including empty returns)	%	80% loading rate et 30% empty return rate
Bulk density of transported products	kg/m^3	-
Volume capacity utilization coefficient	Coefficient: = 1 or < 1 or ≥ 1 for compressed or nested products	1

[A5] INSTALLATION IN THE BUILDING

Parameter	Unit	Value
Auxiliary inputs for the installation (specified by material)	%	5% waste rate that is treated as non-hazardous waste and transported 100 km by truck
Water use	m^3	-
Use of other resources	kg	-
Quantitative description of energy type (regional mix) and consumption during the installation process	kWh ou MJ	
Waste generated at the construction site prior to treatment of waste generated by the product installation (specified by type)	kg	
Materials (specified by type) generated by the processing of waste at the construction site, e.g. collection for recycling, energy recovery, disposal (specified by route)	kg	
Direct emissions to ambient air, soil and water	kg	-

[B1-B7] PRODUCT USE

MAINTENANCE

Parameter	Unit	Value
Maintenance process	The product only needs to be cleaned occasionally with water.	
Maintenance cycle	1 washing every 5 years	
Auxiliary inputs for maintenance (e.g. cleaning product, specify materials)	L	2L of water for 1m², representing 6L of water over the entire life cycle
Waste generated during maintenance (specify materials)	kg	-
Net consumption of fresh water during maintenance	L	2L of water for 1m², representing 6L of water over the entire life cycle
Energy input during maintenance (e.g. vacuum cleaning), type of energy carrier, e.g. electricity, and quantity, if applicable and relevant	kWh	-

REPAIR

Parameter	unit	Value
Repair process	The life of the product does not require any particular action. There are no inputs and outputs related to the repair.	
Inspection process	The life of the product does not require any particular action. There are therefore no inputs and outputs related to the inspection process.	
Repair cycle	Number by RSL or year	-
Auxiliary inputs (e.g. lubricant, specify materials)	kg or kg/cycle	-
Waste generated during repair (specify materials)	kg	-
Net consumption of fresh water during repair	m^3	-
Energy input during repair (e.g. craning activity), type of energy carrier, e.g. electricity, and amount	kWh/RSL, kWh/cycle	-

REPLACEMENT

Parameter	Unit	Value
Replacement cycle	The life of the product does not require any particular action. There are no inputs and outputs related to replacement.	
Energy input during replacement (e.g., crane activity), type of energy carrier (e.g., electricity), and quantity, if applicable and relevant	kWh	-
Replacement of used parts during the life cycle of the product, specify materials	kg	-

REHABILITATION

Parameter	Unit	Value
Rehabilitation process	The life of the product does not require any particular action. There are therefore no inputs and outputs related to the rehabilitation.	
Rehabilitation cycle	Number by RSL or year	-
Material input for rehabilitation (e.g. bricks), including auxiliary inputs for the rehabilitation process (e.g. lubricant, specify materials)	kg or kg/cycle	-
Waste generated during rehabilitation (specify materials)	kg	-
Energy input during rehabilitation (e.g. crane activity), type of energy carrier, e.g. electricity, and quantity, if applicable and relevant	kWh	-
Other assumptions for scenario elaboration (e.g., frequency and duration of use, number of occupants)	Appropriate unit	-

ENERGY AND WATER USE

Parameter	Unit	Value
Auxiliary inputs specified by material	kg or appropriate units	The life of the product does not require any particular action. There is therefore no input and output related to the use of energy.
Net freshwater consumption	m3	The life of the product does not require any particular action. There are no inputs and outputs related to the use of water.
Type of energy carrier (e.g. electricity, natural gas, district heating)	kWh	-
Output power of the equipment	kWh	-
Characteristic performance (e.g. energy efficiency, emissions, performance variation according to capacity utilization, etc.)	appropriate units	-
Other assumptions for scenario development (e.g., frequency and duration of use, number of occupants)	appropriate units	-

[C1-C4] END-OF-LIFE STAGE

Parameter	Unit	Value
Collection process specified by type	kg collected individually kg collected with mixed construction waste	0,462
Recovery system specified by type	kg for reuse	-
	kg for recycling	-
	kg for energy recovery	-
Elimination specified by type	kg of product or material for final disposal	0,462 (landfilling)
Assumptions for scenario elaboration (e.g. transportation)	km	100 km by truck 17,3t

[D] RECYCLING/REUSE/RECOVERY POTENTIAL, D

Module D is not considered.

INFORMATION FOR THE CALCULATION OF THE LIFE CYCLE ASSESSMENT

Used PCR	NF EN 15804+A1 - April 2014, NF EN 15804/CN – June 2016
System boundaries	The boundaries of the system respect the limits imposed by the NF EN 15804+A1 standard and its national complement NF EN 15804/CN.
Allocations	The quantities needed to manufacture a product in terms of raw materials, energy and waste are based on one year of production and brought back by a cross product to a product (mass allocation).
Geographical and temporal representativeness of primary data	The data was collected in relation to the annual production of the SERGE FERRARI plant. The collection was launched in September 2020. It is representative of the technologies used for the year 2019. The database used is the database BDD CODDE-2018-11 (updated November 2018) and ELCD version 3.2. EIME software, Version 5.9. Database version: December 2020
Variability of results	An analysis of variability was performed between the products covered by the EPD of the range. The results show that the impacts are homogeneous within the product family. The environmental impacts declared in the EPD are therefore based on an average between all the products in the range.

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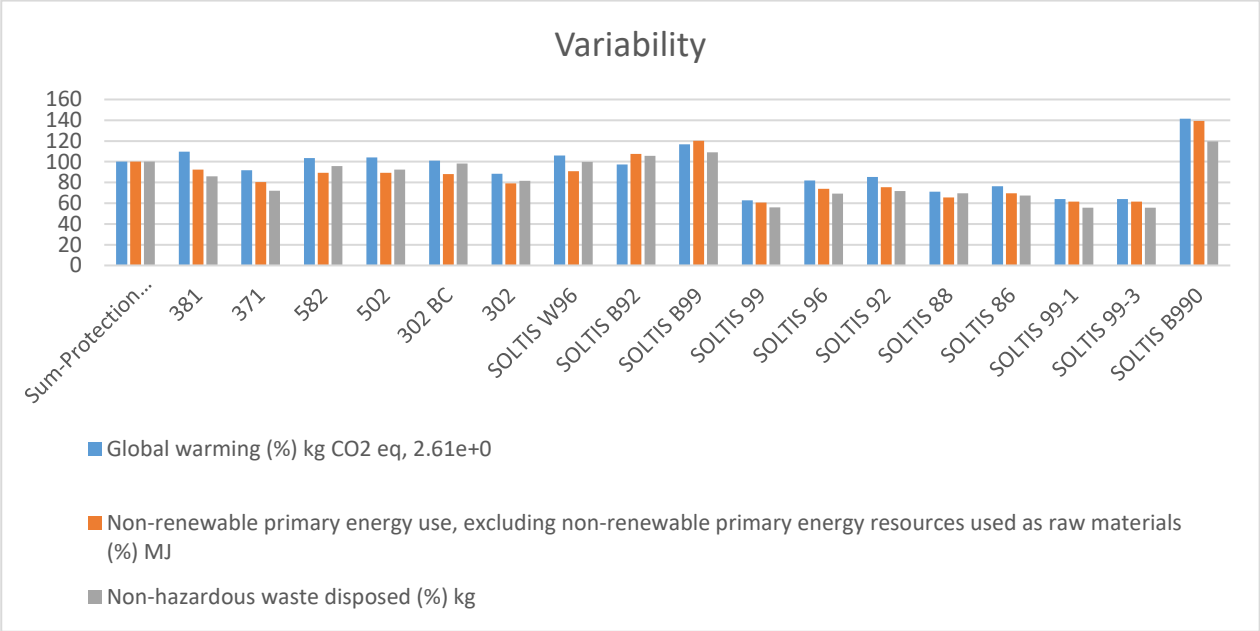
VARIABILITY



LIFE CYCLE ASSESSMENT RESULTS

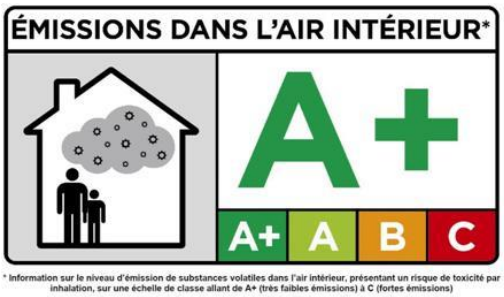
Impact Indicators	Production stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Profits and costs beyond the system's borders
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Rehabilitation	B6 Use of energy	B7 Water consumption	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Elimination	**Total C1-C4**		
Global Warming kg CO2 eq/FU	**2,16E+00**	9,93E-03	1,46E-01	**1,56E-01**	0,00E+00	1,75E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,75E-01**	0,00E+00	4,30E-03	0,00E+00	4,15E-01	4,19E-01	**2,91E+00**	ND
Ozone Depletion kg CFC 11 eq/FU	**3,21E-07**	2,01E-11	1,62E-08	**1,62E-08**	0,00E+00	1,14E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,14E-09**	0,00E+00	8,71E-12	0,00E+00	1,37E-09	1,38E-09	**3,40E-07**	ND
Acidification of soil and water kg SO2 eq/FU	**4,13E-03**	4,46E-05	2,24E-04	**2,68E-04**	0,00E+00	3,81E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,81E-04**	0,00E+00	2,04E-05	0,00E+00	1,76E-04	1,96E-04	**4,97E-03**	ND
Eutrophication kg (PO4)3- eq/FU	**5,49E-03**	1,03E-05	3,45E-04	**3,55E-04**	0,00E+00	1,20E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,20E-04**	0,00E+00	4,71E-06	0,00E+00	1,26E-03	1,26E-03	**7,23E-03**	ND
Photochemical ozone creation Ethene eq/FU	**3,75E-04**	3,17E-06	2,72E-05	**3,04E-05**	0,00E+00	2,05E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,05E-05**	0,00E+00	1,47E-06	0,00E+00	9,21E-05	9,36E-05	**5,20E-04**	ND
Depletion of abiotic resources (elements) kg Sb eq/FU	**2,47E-02**	3,97E-10	1,24E-03	**1,24E-03**	0,00E+00	6,09E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,09E-09**	0,00E+00	1,72E-10	0,00E+00	2,65E-09	2,82E-09	**2,59E-02**	ND
Depletion of abiotic resources (fossils) MJ/FU	**3,85E+01**	1,40E-01	1,97E+00	**2,11E+00**	0,00E+00	4,93E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,93E-01**	0,00E+00	6,04E-02	0,00E+00	4,68E-01	5,28E-01	**4,17E+01**	ND
Water pollution m3/FU	**2,48E+02**	1,63E+00	1,27E+01	**1,43E+01**	0,00E+00	1,75E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,75E+00**	0,00E+00	7,07E-01	0,00E+00	2,07E+00	2,78E+00	**2,67E+02**	ND
Air pollution m3/FU	**2,88E+02**	4,07E-01	1,54E+01	**1,58E+01**	0,00E+00	2,12E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,12E+00**	0,00E+00	1,98E-01	0,00E+00	1,12E+01	1,14E+01	**3,18E+02**	ND

Use of resources	Production stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Profits and costs beyond the system's borders
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Rehabilitation	B6 Use of energy	B7 Water consumption	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Elimination	**Total C1-C4**		
Use of renewable primary energy, excluding renewable primary energy resources used as raw materials MJ/FU	**3,17E+00**	1,87E-04	1,60E-01	1,60E-01	0,00E+00	5,68E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,68E-03	0,00E+00	8,10E-05	0,00E+00	1,48E-02	1,48E-02	**3,36E+00**	ND
Use of renewable primary energy resources used as raw materials MJ/FU	**4,51E-01**	0,00E+00	2,26E-02	2,26E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,74E-01**	ND
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) MJ/FU	**3,63E+00**	1,87E-04	1,83E-01	1,83E-01	0,00E+00	5,68E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,68E-03	0,00E+00	8,10E-05	0,00E+00	1,48E-02	1,48E-02	**3,83E+00**	ND
Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials MJ/FU	**4,82E+01**	1,40E-01	2,46E+00	2,60E+00	0,00E+00	5,33E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,33E-01	0,00E+00	6,07E-02	0,00E+00	5,16E-01	5,77E-01	**5,19E+01**	ND
Use of non-renewable primary energy resources used as raw materials MJ/FU	**9,72E+00**	0,00E+00	4,86E-01	4,86E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,02E+01**	ND
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) MJ/FU	**5,80E+01**	1,40E-01	2,95E+00	3,09E+00	0,00E+00	5,33E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,33E-01	0,00E+00	6,07E-02	0,00E+00	5,16E-01	5,77E-01	**6,22E+01**	ND
Use of secondary material kg/FU	**2,44E-02**	0,00E+00	1,22E-03	1,22E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,56E-02**	ND
Use of secondary renewable fuels MJ/FU	**2,06E-01**	0,00E+00	1,03E-02	1,03E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,16E-01**	ND
Use of non-renewable secondary fuels MJ/FU	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	ND
Net use of fresh water m3/FU	**1,90E-01**	8,89E-07	1,27E-01	1,27E-01	0,00E+00	6,27E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,27E-04	0,00E+00	3,85E-07	0,00E+00	1,37E-04	1,38E-04	**3,18E-01**	ND

Waste category	Production stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Profits and costs beyond the system's borders
	Total A1-A3	A4 Transport	A5 Installation	Total A4-A5	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Rehabilitation	B6 Use of energy	B7 Water consumption	Total B1-B7	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Elimination	Total C1-C4		
Hazardous waste disposed kg/FU	**2,45E-02**	0,00E+00	1,24E-03	**1,24E-03**	0,00E+00	2,11E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,11E-05**	0,00E+00	0,00E+00	0,00E+00	2,46E-04	**2,46E-04**	**2,60E-02**	ND
Non-hazardous waste disposed kg/FU	**6,62E-01**	3,53E-04	7,50E-02	**7,54E-02**	0,00E+00	4,38E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,38E-02**	0,00E+00	1,53E-04	0,00E+00	5,15E-01	**5,16E-01**	**1,30E+00**	ND
Radioactive waste disposed kg/FU	**3,16E-03**	2,51E-07	1,60E-04	**1,60E-04**	0,00E+00	1,34E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,34E-05**	0,00E+00	1,09E-07	0,00E+00	1,71E-05	**1,72E-05**	**3,35E-03**	ND

Output flow		Production stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Profits and costs beyond the system's borders
		Total A1-A3	A4 Transport	A5 Installation	Total A4-A5	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Rehabilitation	B6 Use of energy	B7 Water consumption	Total B1-B7	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Elimination	Total C1-C4		
Components for reuse kg/FU		**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	ND
Materials for recycling kg/FU		**4,12E-02**	0,00E+00	3,47E-02	**3,47E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**7,59E-02**	ND
Materials for energy recovery kg/FU		**2,10E-02**	0,00E+00	6,57E-03	**6,57E-03**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,76E-02**	ND
Energie fournie à l'extérieur (par vecteur) J/FU	**Electricity**	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	ND
	Steam	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	ND
	Gas and process	**0,00E+00**	0,00E+00	2,39E-02	**2,39E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	2,72E-01	**2,72E-01**	**2,96E-01**	ND

ADDITIONAL INFORMATION ON THE RELEASE OF HAZARDOUS SUBSTANCES INTO INDOOR AIR, SOIL AND WATER DURING USE

Sanitary characteristics	
VOCs and formaldehyde	 A+ : SOLTIS 88 ; SOLTIS 92 ; SOLTIS 96 ; SOLTIS 99 ; SOLTIS B990 ; SOLTIS B92  GREENGUARD GOLD : SOLTIS 86 ; SOLTIS 88 ; SOLTIS 92 ; SOLTIS 96 ; SOLTIS 99 ; SOLTIS B99 ; SOLTIS B990 ; SOLTIS B92 ; 302 ; 432 ; 502 V2 ; 582 ; 371 ; 381
Indoor air emissions of hazardous substances	SERGE FERRARI membranes comply with REACH regulations. They do not contain any substance from the SHVC list (list updated on 19/01/2021) at a rate higher than 0.1% by mass.
Behavior towards micro-organisms	Contact the Serge Ferrari commercial teams, some products are covered and others not, depending on the commercial references
Odors	No test performed
Radioactive emissions	No test performed
Water quality characteristics	Not applicable because this product is not in contact with water intended for human consumption, nor with runoff water, seepage water, groundwater or surface water.

Comfort characteristics

Hygrothermal comfort

The SOLTIS screens and plain blinds for awnings and the FRONTSIDE screens for bioclimatic facades contribute to the hygrothermal comfort in the building.

They are evaluated according to the EN14500 and EN14501 standards:

SOLTIS or FRONTSIDE articles	Minimum INTERIOR solar factor g_{tot}^{i} with glazing D – Method 2	% solar heat stopped (maximum value)	Thermal comfort - Class EN14501
SOLTIS 86	0.13	87%	Classe 3
SOLTIS 88	0.12	88%	Classe 3
SOLTIS 92	0.10	90%	Classe 3
SOLTIS 99	0.10	90%	Classe 3
SOLTIS B99	0.10	90%	Classe 3
SOLTIS B990	0.07	93%	Classe 4
SOLTIS B92	0.10	90%	Classe 3

SOLTIS or FRONTSIDE articles	Minimum EXTERIOR solar factor g_{tot}^{e} with glazing D – Method 2	% solar heat stopped (maximum value)	Thermal comfort - Class EN14501
SOLTIS 86	0.07	93%	Classe 4
SOLTIS 88	0.06	94%	Classe 4
SOLTIS 92	0.03	97%	Classe 4
SOLTIS B92	0.01	99%	Classe 4
371	0.14	86%	Classe 3
381	0.15	85%	Classe 2

The solar factor of Soltis and FRONTSIDE blinds is included in the calculation of the solar factor of the window unit (glazing + frame + opaque wall + solar protection + casing) and therefore impacts the final thermal performance of the system. An efficient solar protection blinds contributes to reach the performances of the RT2012 / RE2020.
The use of SOLTIS and FRONTSIDE blinds contributes to obtaining credits in the HQE building certification program.

(source: internal laboratory test - internal report))

Acoustic comfort

Slightly openwork fabrics (Soltis 99) are slightly sound-absorbing (aw = 0.20 with an air gap > 100 mm), thus contributing to the acoustic comfort of the premises.

(Report LNE - J020457 – Document CQPE/30)

The more strongly openworked blinds (Soltis 86, 88, 96 ...) are transparent to sound. This can be interesting for applications with stretched blinds in walls or ceilings. In this case, the blind is used in combination with traditional absorbents such as wool or absorbent foam. The sound transparency of the blind allows the wall to be covered without affecting the absorption potential of the wool or foam behind it.

(Report CTTM N° A130015_01_A - Soltis 86 and 92 associated with mineral wool).

The stretched plain blinds have a negligible level of absorption (aw = 0.10, CTTM report n° A110075). When used in separation, the plain blinds have a sound attenuation level Rw = 10 dB

(Report CTTM N° A100194 plain blind 590g/m2)

Visual comfort

The product contributes to the visual comfort in the building. The visual performances of SOLTIS and FRONTSIDE are evaluated according to the EN 14500 and EN 14501 standards.

SOLTIS or FRONTSIDE articles	TVnh value (%)	Glare control - Class EN14501	View on the outside - Class EN14501	Natural light use - Class EN14501	Privacy at night - Class EN14501	Opacity - Class EN14501
SOLTIS 86	From 14 to 28	Class 0	Class 4	Class 2	Class 0	NC
SOLTIS 88	From 8 to 22	Class 1	Class 3	Class 2	Class 1	NC
SOLTIS 92	From 2 to 17	Class 3	Class 2	Class 2	Class 2	NC
SOLTIS 96	From 4 to 19	Class 3	Class 2	Class 2	Class 2	NC
SOLTIS 99	From 3 to 21	Class 3	Class 2	Class 2	Class 2	NC
SOLTIS B99	0	Class 4	Class 0	Class 0	Class 4	Class 4
SOLTIS B990	0	Class 4	Class 0	Class 0	Class 4	Class 3
SOLTIS B92	0	Class 4	Class 0	Class 0	Class 4	Class 4
SOLTIS W96	From 3 to 17	Class 3	Class 0	Class 2	Class 4	NC
302	From 0 to 11	Class 4	Class 0	Class 1	Class 4	NC
502 VC	From 0 to 10	Class 4	Class 0	Class 1	Class 4	NC
582	From 0 to 10	Class 4	Class 0	Class 0	Class 4	NC
371	28	Class 0	Class 4	Class 2	Class 0	NC
381	From 26 to 35	Class 0	Class 4	Class 2	Class 0	NC

Classes may vary depending on the color. The classes indicated are the best levels achievable with the product in question

Olfactive comfort	The products do not claim any olfactory performance.

POSITIVE ENVIRONMENTAL CONTRIBUTION

No recycling channels or energy avoidance calculations are considered.

Sustainability & Comfort
Working Group Tensinet

EPD11 Sioen Industries NV

ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	Sioen Industries NV
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SIO-20220324-IBJ1-EN
Issue date	18.04.2023
Valid to	17.04.2028

1m² of Type II technical textile

Sioen Industries NV

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

www.ibu-epd.com | https://epd-online.com

1. General Information

Sioen Industries NV

Programme holder

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

Declaration number

EPD-SIO-20220324-IBJ1-EN

This declaration is based on the product category rules:

Plastic and elastomer roofing and sealing sheet systems,
01.01.0001
(PCR checked and approved by the SVR)

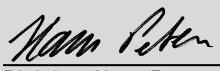
Issue date

18.04.2023

Valid to

17.04.2028

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



Dipl.-Ing. Hans Peters
(Managing Director Institut Bauen und Umwelt e.V.)

1m² of Type II technical textile

Owner of the declaration

Sioen Industries NV
Fabriekstraat 23
8850 Ardooie
Belgium

Declared product / declared unit

1m² of Type II technical textile (T2121E)

Scope:

This EPD covers the product Type II Technical Textile, more specifically the T2121E as representative product. This product is a technical textile made out of a combination of a polyester (PET) fabric and polyvinylchloride (PVC) coating with a polyvinyl fluoride (PVDF) and acrylic lacquer finish. The fully coated fabric weight is 900 g/m². The calculations are based on average yearly production data for 2019.
The producing company is Sioen Industries NV. The above named products are produced at the production sites of Mouscron (BE) and Flixecourt (FR).
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*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Dr. Matthew Fishwick,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The product is a technical textile made from a polyester (PET) fabric, coated with PVC and a finishing lacquer.
The base fabric is a woven textile based on high-tenacity multifilament polyester (PET) yarns. Each side of the fabric is coated with a well-impregnated adhesion layer, a main layer consisting largely of PVC, UV stabilizers, flexing additives and other additives, and a thin acrylic and PVDF lacquer top coat which allows for a better cleaning ability, improved UV resistance and perfect weldability. The declared product has an average weight of 900 g/m².
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.

2.2 Application

These products are (mainly) applied in tensile architecture. Tensile structures typically consist of 3 main components: a primary structure, connectors, and tensioned fabric, such as the Type II technical textile.

These structures may be stand-alone or integrated with (existing) regular buildings. Many different construction forms are possible, such as façade coverings, sun-shading elements, roof coverings,... either for permanent or temporary use.

The standard lifetime of the fabrics used in tensile architecture ranges from 15 to over 30 years. For lightweight Type II fabrics, the lifetime is typically 15 years.
This EPD (and the underlying LCA) has been made to allow customers to quantify the ecological impact of their constructions, as well as to allow comparison with other material types.

2.3 Technical Data

The technical specifications of the declared product is given in the table below.

Constructional data

Name	Value	Unit
Fabric material	PES material	
Thickness	0.75	mm
Total weight ISO 2286-2	900	g/m²
Breaking strength ISO 1421-1 – warp/weft	4300/4200	N/5cm
Tear strength DIN 53363 – warp/weft	600/500	N/5cm
Adhesion ISO 2411	120	N/5cm
Temperature resistance EN 1876-1	-30/+70	°C
Fire retardancy DIN 4102-1	B1	
U-value ISO 6946 – vertical/horizontal airflow	5.5/4.6	W/(m².K)

Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking).

2.4 Delivery status

The coated textile material is delivered on rolls of different lengths and widths. For the width, there are different standard widths available. The amount of fabric (length) on each roll can be determined by the customer.

2.5 Base materials/Ancillary materials

The main constituents of the product are:

- PVC: 30 wt%
- DINP: 25 wt%
- PET: 30 wt%
- additives such as titanium oxide, flame retardants,..:15 wt%

This product/article/at least one partial article contains substances listed in the candidate list (date: 10.06.2022) exceeding 0.1 percentage by mass: no.
This product/article/at least one partial article 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 (this then concerns a treated product as defined by the (EU) *Ordinance on Biocide Products No. 528/2012*): yes (Dichloroctylisothiazolinon; DCOIT)
The plasticizer used is diisononyl phthalate (DINP; CAS 28553-12-0)

2.6 Manufacture

The production of the PVC-coated fabric starts with the production of a woven fabric made from polyester (polyethylene terephthalate, PET) yarn. This is done by beaming, followed by weaving to the desired width in the weaving plant in Mouscron, Belgium. After quality control, the woven fabrics are transported to the coating site in Flixecourt, France.
At Flixecourt the PVC plastisol is made from PVC powder, DINP, pigments and additives. The plastisol is knife-coated onto the fabric in several steps with gelation occurring by intermediate (and a final) heating step(s). The first coated layer differs in composition to achieve optimal adhesion. After complete coating and gelation, the lacquer layers (based on acrylics and PVDF) are applied.

The consumed solvents are quantitatively evaporated from the material. The resulting vapours are treated at post-combustion to harmless gasses and water.

The produced material is inspected and tested according to *ISO 9001:2015*

2.7 Environment and health during manufacturing

Sioen actively commits to keeping their employees safe. Regular measurements of noise and air quality are done. The results are below the legal requirements.
Prescribed safety garments and safety devices are provided where neccessary, e.g. when employees are exposed to powder or solvents.
Production employees undergo mandatory health checks on regular occasions.

2.8 Product processing/Installation

Processing of the technical textiles and handling are under the control of the customer.

The technical textile is developed to be easily processed via high-frequency welding (radio frequency) or via heat welding. The weld produced in this fashion is equally strong as the surrounding base material.

In order to achieve a good lifetime, proper structure design (and

material selection) is required.

After construction, regular inspection of the technical textile is recommended, as damage may occur by faulty design, inappropriate clamping and other sources of high local loads. Excessive localized loads may lead to damage, which upon load redistribution results in tear propagation.

2.9 Packaging

The technical textiles are rolled on paper/cardboard roll cores, wrapped in foil and fixed by tape.
Rolls can be pyramidically stacked on pallets for transport. To ensure the rolls stay in place and no damage occurs to the material during transportation, plastic strappings and additional cardboard can be used.

2.10 Condition of use

No changes occur in the material composition over the service life of the product and/or regarding environmentally relevant material inherent properties over the service life of the product.

2.11 Environment and health during use

When the products are used as designated and according to the current state of knowledge, there are no hazards to water, air and soil.
When used normally and in accordance with the designated purpose, no health risks or restrictions are to be anticipated.

2.12 Reference service life

Not the entire life cycle is declared in this EPD, so no RSL is required. Nevertheless, the lightweight Type II technical textile has an average lifetime of 15 years. This lifetime is higher for the heavier fabrics.
The product service life may vary due to application, grade of user know-how, location and maintenance.
Description of the influences on the ageing of the product when applied in accordance with the rules of technology.

2.13 Extraordinary effects

Fire

The reaction to fire is determined according to *EN 13501-1* (B-s2,d0) and *DIN 4102-1* (B1).

Fire protection

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s2

Water

The technical textile is developed for long-term exterior use. Therefore, the products have good weatherabilty and water has no influence.

Mechanical destruction

Mechanical destruction doesn't lead to a change in chemical composition.

2.14 Re-use phase

Sioen Industries NV is conscious of its responsibility for acting in an environmentally compatible manner. The company is involved in a range of activities related to recycling, such as in-house and external recycling systems and sustainable production methods.
Sioen Industries actively supports the commitment of the Vinyl Plus Committee to significantly increase PVC recycling volumes and is a member of the *Industrieverband Kunststoffbahnen e.V.* (IVK Europe).
Post-consumer PVC coated fabric is recyclable. The material can be shredded and processed into the recyclate (plastic granulate), which can be applied in the production of e.g. windows, riding mats, pipes and foils.

2.15 Disposal

Construction waste of PVC-coated polyester fabrics falls under the category of the *European Waste Code EWC* 17 02 03

2.16 Further information

Further information about PVC coating polyester fabrics and other technical textiles can be found on the homepage of Sioen Industries.

3. LCA: Calculation rules

3.1 Declared Unit

In this study, only the production, transport to the construction and the EoL of the PVC-coated textile is included. Therefore the reference unit is a declared unit: 1 m² PVC coated polyester textile Type II (T2121E) with a mass of 0,9 kg

Declared unit and mass reference

Name	Value	Unit
Grammage	0.9	kg/m^2
Declared unit	1	m^2

3.2 System boundary

This EPD is cradle to gate with options, modules C1-C4, and module D:
The analysis of the product life cycle includes production of the basic materials, transport of the basic materials and manufacture of the product, which are declared in modules A1-A3.
In module A4, the burden of transporting the manufactured product to the customer is declared.
The deconstruction and demolition stage C1 has not been included, since this is largely dependent on the specific project. Also, the C1 stage has been assumed immaterial.
One scenario of the end-of-life (EoL) stage is considered. It is the incineration of the technical textiles in the incineration plant. This is taken into account in module C4.
The transport of the used product to the final disposal was also modelled (module C2).
Potential credits for electricity and thermal energy resulting from the waste incineration plant are declared in module D.

3.3 Estimates and assumptions

Module A2: All of the raw materials are supplied by truck to the site of Sioen. For most of the raw materials the distance from the supplier to Sioen was used to add transport. In the LCA calculation 313 kgkm/m^2 is used
Module A3: There are several emissions into air as a result of the production process. These are mainly caused by the incineration of natural gas. However some emissions are to be expected from the combustion of some of the solvents evaporating from the fabric. For emissions that are measured, the measured value is used instead of the literature values in the *Ecoinvent* process for natural gas emissions.
Module A4: In this LCA the transport of the finished product is included informatively based on average application 'somewhere in Europe'), and the transport distance is assumed to be 1500 km
Module C2: In this study, we expect that the PVC-coated fabric is transported to a waste incineration plant where it is

incinerated.
Module C3: Since the average waste incineration plant is expected to have an efficiency below 60% the incineration process is assigned to module C4.
Module D: The benefit of the recuperation of electricity and heat that often occurs in waste incineration plants was included in module D. For the electrical and thermal efficiency of the waste-to-energy plant we calculated 18% and 31% respectively. For the heat of combustion of PET and PVC, the lower heating value was used:

1. PET: 22,95 MJ/kg
2. PVC: 21,51 MJ/kg

3.4 Cut-off criteria

Several flows (raw materials) were excluded from the LCA study. All excluded flows pass the cut-off criteria: they represent less than 1% and are summing up to less than 5% of the total input (mass) and impact of renewable and non-renewable primary energy usage of mandatory modules (A1-A3). Machines and facilities required during production are neglected

3.5 Background data

For background processes, the *Ecoinvent* database v3.6 (allocation cut-off) has been used.

3.6 Data quality

Sioen Industries collected data on the production of the PVC-coated polyester fabric and the intermediate products (PET yarn and PET fabric). More specifically:

- Raw material use and transport to the production location
- Sioen contacted important suppliers if primary data was available for their product.
- Energy use
- Emissions
- Production waste

3.7 Period under review

Data sets are based on 1 year averaged data (time period: January 2019 to December 2019).

3.8 Geographic Representativeness

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

3.9 Allocation

The product is produced in 2 plants. Mouscron (BE) for warping & weaving, Flixecourt (FR) for coating & lacquering.
Warping & weaving: the process data is allocated based on the length of products produced
A variety of fabrics of different widths are produced in the same plant on the same machines. The difference between 2 fabrics of a different width in the required production time and energy is assumed insignificant. Therefore, allocation based on weight or surface area is incorrect and thus allocation is based on fabric lengths.
Coating & lacquering: the process data is allocated based on the surface of products produced (m²).
Some “waste” products arise from the process such as cutting losses, lower grade/off-spec products etc. Since all of these materials are sold these haven’t been treated as waste in the LCA calculations. This is a worst case approach for the product since a small part of the burdens and raw materials could have been allocated to these co-products.

3.10 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. For this study, the *Ecoinvent* database v3.6 (reference year 2016) was used. The data fulfill the required *EN 15804*.

4. LCA: Scenarios and additional technical information

Characteristic product properties biogenic carbon

Since the biogenic carbon content is (much) lower than 5% of the total mass, the declaration of biogenic carbon content may be omitted.

Transport to the building site (A4)

Name	Value	Unit
Transport distance	1500	km

Module A4: In this LCA the transport of the finished product is included informatively based on average application 'somewhere in Europe”), the transport distance is assumed to be 1500 km

Reference lifetime

The reference lifetime of the product is 15 years.

End of life (C1-C4)

Name	Value	Unit
Collected separately waste type	0.9	kg

Module C2: In this study we expect that the PVC-coated fabric is transported to a waste incineration plant where it is incinerated.
Module C4: Since the average waste incineration plant is expected to have an efficiency below 60% the incineration process is assigned to module C4.
The following processes were used to model the waste incineration process:

1. PET part, Waste polyethylene terephthalate {RoW}| treatment of waste polyethylene terephthalate, municipal incineration | Cut-off
2. PVC part, Waste polyvinylchloride {RoW}| treatment of waste polyvinylchloride, municipal incineration | Cut-off

5. LCA: Results

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	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m² Type II technical textile (T2121E)

Parameter	Unit	A1	A2	A3	A4	C2	C4	D
GWP-total	kg CO_2 eq	4.13E+00	1.18E-01	4.04E-01	1.78E-01	1.19E-02	2.13E+00	-8.24E-01
GWP-fossil	kg CO_2 eq	4.25E+00	1.18E-01	4.04E-01	1.78E-01	1.18E-02	1.89E+00	-8.24E-01
GWP-biogenic	kg CO_2 eq	-2.44E-01	1.43E-05	6.23E-07	1.08E-04	7.19E-06	2.44E-01	-2.15E-04
GWP-luluc	kg CO_2 eq	1.3E-01	6.3E-05	2.42E-07	6.29E-05	4.19E-06	1.32E-04	-2.34E-05
ODP	kg CFC11 eq	7.42E-07	2.53E-08	5.62E-10	4.09E-08	2.73E-09	4.41E-08	-1.07E-07
AP	mol H^+ eq	3.31E-02	2.36E-03	3.36E-03	1.01E-03	6.75E-05	1.11E-03	-6.74E-04
EP-freshwater	kg P eq	6.24E-04	7.1E-07	1.2E-08	1.46E-06	9.75E-08	4.9E-06	-8.88E-07
EP-marine	kg N eq	7.47E-03	6.16E-04	1.76E-03	3.62E-04	2.41E-05	3.01E-04	-2.02E-04
EP-terrestrial	mol N eq	7.73E-02	6.83E-03	1.93E-02	3.99E-03	2.66E-04	3.25E-03	-2.22E-03
POCP	kg NMVOC eq	2.24E-02	1.8E-03	4.95E-03	1.14E-03	7.61E-05	8.77E-04	-7.34E-04
ADPE	kg Sb eq	6.42E-02	1.89E-06	4.77E-09	4.6E-06	3.06E-07	7.05E-06	-2.18E-07
ADPF	MJ	9.75E+01	1.65E+00	3.68E-02	2.73E+00	1.82E-01	2.12E+00	-1.38E+01
WDP	m^3 world eq deprived	3.6E+00	3.76E-03	6.38E-05	8.37E-03	5.58E-04	1.9E+00	-5.99E-02

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 m² Type II technical textile (T2121E)

Parameter	Unit	A1	A2	A3	A4	C2	C4	D
PERE	MJ	8.09E+00	1.75E-02	2.25E-04	3.91E-02	2.61E-03	1.86E-01	-2.92E-02
PERM	MJ	0	0	0	0	0	0	0
PERT	MJ	8.09E+00	1.75E-02	2.25E-04	3.91E-02	2.61E-03	1.86E-01	-2.92E-02
PENRE	MJ	1.04E+02	1.75E+00	3.91E-02	2.9E+00	1.93E-01	2.26E+00	-1.53E+01
PENRM	MJ	0	0	0	0	0	0	0
PENRT	MJ	1.04E+02	1.75E+00	3.91E-02	2.9E+00	1.93E-01	2.26E+00	-1.53E+01
SM	kg	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0
FW	m^3	8.86E-02	1.37E-04	2.34E-06	3.09E-04	2.06E-05	5.75E-02	-7.94E-04

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 m² Type II technical textile (T2121E)

Parameter	Unit	A1	A2	A3	A4	C2	C4	D
HWD	kg	1.91E-03	2.89E-06	7.75E-08	6.97E-06	4.65E-07	3.9E-06	-1.74E-05
NHWD	kg	6.61E-01	5.41E-02	6.37E-05	1.69E-01	1.13E-02	3.6E-01	-5.53E-03
RWD	kg	2.32E-04	1.13E-05	2.46E-07	1.85E-05	1.24E-06	9.99E-06	-6.58E-06
CRU	kg	0	0	0	0	0	0	0
MFR	kg	0	0	2.09E-01	0	0	0	0
MER	kg	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	3.5574552	0
EET	MJ	0	0	0	0	0	6.1267284	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 m² Type II technical textile (T2121E)

Parameter	Unit	A1	A2	A3	A4	C2	C4	D
PM	Disease incidence	2.53E-07	6.9E-09	7.78E-09	1.6E-08	1.07E-09	7.76E-09	-1.91E-09
IR	kBq U235 eq	2.29E-01	7.14E-03	1.52E-04	1.19E-02	7.95E-04	8.22E-03	-4.43E-03
ETP-fw	CTUe	5.97E+02	1.2E+00	2.69E-02	2.21E+00	1.48E-01	7.3E+01	-7.98E-01
HTP-c	CTUh	5.79E-09	6.01E-11	2E-11	7.88E-11	5.26E-12	2.75E-10	-5.19E-11
HTP-nc	CTUh	2.22E-07	1.23E-09	1.45E-10	2.64E-09	1.76E-10	2.2E-08	-7.35E-10
SQP	SQP	3.26E+01	8.3E-01	4.9E-03	2.33E+00	1.56E-01	1.18E+00	-1.98E-01

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

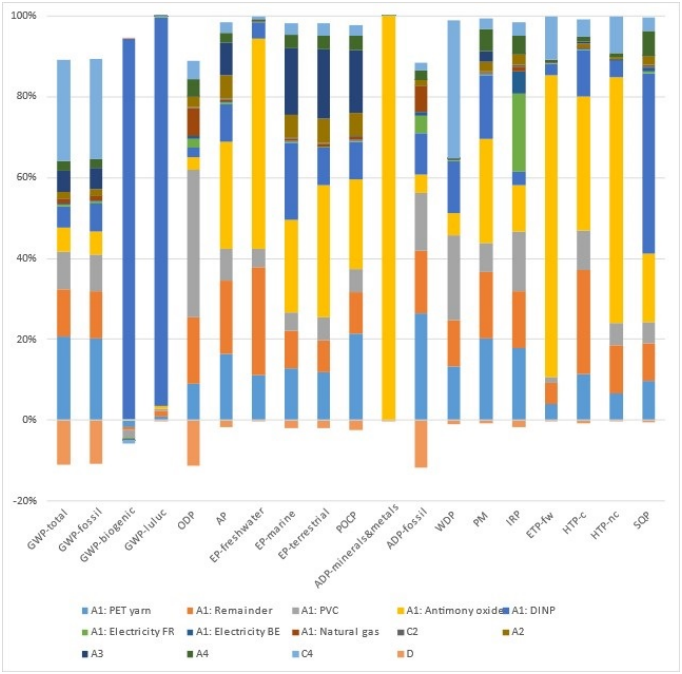
Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”. This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from 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 or as there is limited experienced with the indicator.

6. LCA: Interpretation

Major contribution analysis

To visualize which materials and processes give the largest contribution to the environmental indicators a major contributions analysis has been included. In the graph below the total value of each indicator has been set to 100%. The colours indicate which part of the environmental effects are caused by the different materials and processes in the life cycle of the PVC-coated fabric.



The production-related materials and processes give the most significant contributions to all environmental indicators. For most indicators the production of PET and PVC are clearly visible, however, sometimes the production of additives gives the most significant contribution. This especially holds for the production of antimony oxide, and plasticizer (DINP).
Sioen's own emissions of NOx and to a lesser extent SOx contribute to acidification potential (AP). The NOx emissions also contribute to the eutrophication (EP) indicators. VOC emissions of Sioen contribute to photochemical oxidation potential (PCOP).
The waste treatment processes (incineration, C4) also gives a significant contribution to GWP (total, fossil and biogenic).

Sensitivy analysis

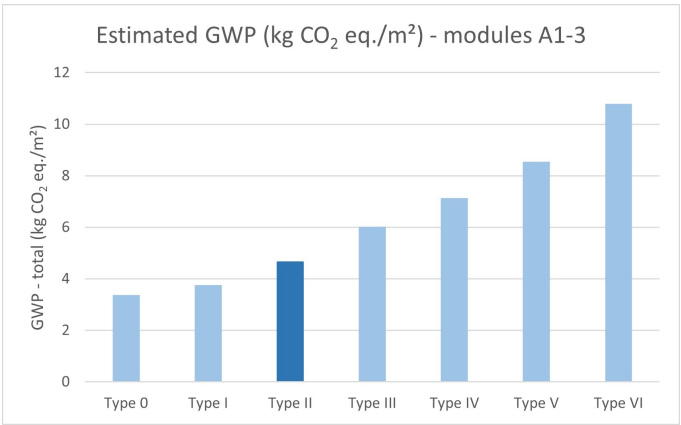
Separate indicators for PET- and PVC part of the product

The environmental profiles have been calculated for the PET fabric part of the calculation and the PVC coating part of the calculation separately. Many production variants exist and regarding the production process only the amount and ratio between PET and PVC significantly affects the environmental results for these products.
The GWP-total results for the production A1-A3 for 1 m² are given below:

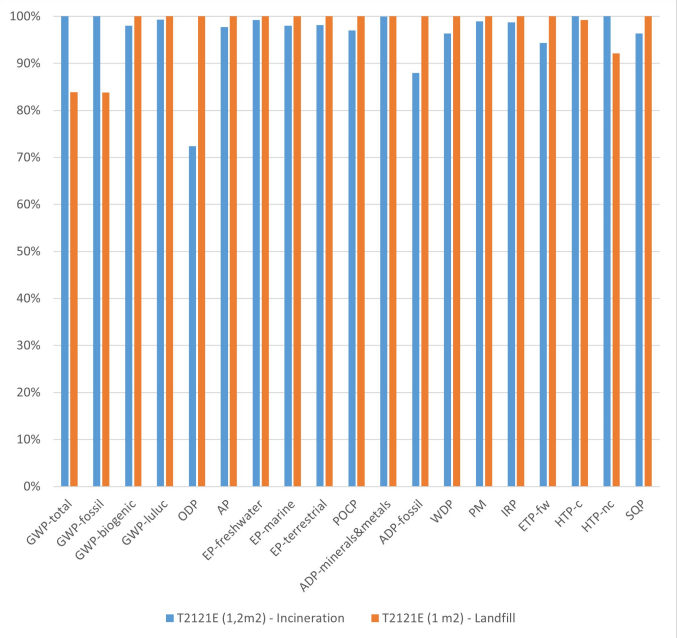
- PET fabric: 1.69 kg CO_2 eq.
- Fabric coating: 2.97 kg CO_2 eq.

Using these environmental profiles an estimation can be given on the environmental indicators for these product variants.

The GWP score estimates of the production (modules A1-3) for the product family are given in the chart below.



Final waste treatment - landfill
A sensitivity analysis has been performed for the waste treatment scenario since the fabric also could be landfilled (instead of incineration or recycling).
The result of the comparison (with end-of-life: incineration) is shown graphically. In the figure below the environmental score of the variant with the largest impact is set to 100%. The variant with the lower score is shown relative to the variant with the highest score.
For GWP fossil, and human toxicity potential non carcinogenic effects (nc) incineration at the end of life results in higher environmental burdens. For ozone layer depletion potential and abiotic depletion potential the landfill variant shows larger environmental burdens. Largely, this is not directly related to the landfill process but due to the effect that there are no environmental benefits in the landfill situation (no energy recuperation in the landfill situation).



7. Requisite evidence

Information on the used raw materials is acquired from the technical datasheets and Material Safety Data Sheets from the supplier.

The vapor generated in the coating ovens is directly treated by post-combustion. Emissions are measured on a regular basis and are below the legal limitations.

VOC emissions of the product are not relevant, since the PVC-coated polyester fabric is applied outside.

8. References

Standards

DIN 4102-1
DIN 4102-1 Fire behaviour of building materials and elements Part 1: Classification of building materials Requirements and testing

DIN 53363
DIN 53363, Testing of plastic films - Tear test using trapezoidal test specimen with incision

EN 13501-1
EN 13501-1:2018, Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 1402-1
EN 1402-1:2004, Unshaped Refractory Products - Part 1: Introduction And Classification

EN 15804
EN 15804:2012+A2:2019, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products, 2019

EN 1876-1
EN 1876-1, Rubber- or plastics-coated fabrics - Low-temperature tests - Part 1: Bending test

ISO 14025
ISO, ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations — Principles and procedures, 2006.

ISO 14040
ISO, ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework, 2006

ISO 14044
ISO, ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines, 2006.

ISO 1421-1
ISO 1421:1998 Determination of Tensile Strength and Elongation at Break

ISO 21930
ISO, ISO 21930:2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services, 2017.

ISO 2286-2
ISO 2286-2: 2017-01: Rubber- or plastics┐coated fabrics - Determination of roll characteristics – Part 2: Methods for determination of total mass per unit area, mass per unit area of coating and mass per unit area of substrate

ISO 2411
ISO 2411:2017, Rubber- or plastics-coated fabrics — Determination of coating adhesion

ISO 6946
ISO 6946:2017, Building components and building elements — Thermal resistance and thermal transmittance — Calculation methods

ISO 9001
ISO 9001:2015, Quality management systems – Requirements

Further References

Ecoinvent database
Ecoinvent database v3.6, reference year 2016

European Waste Code (EWC)
2000/532/EC European Waste Catalogue / Ordinance on European List of Wastes

IBU 2021
Institut Bauen und Umwelt e.V.: General Instructions for the EPD programme of Institut Bauen und Umwelt e.V., Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021 http://www.ibu-epd.

Industriesverband Kunststoffbahnen e.v.
IVK Europe, the plastic sheets and films association (https://www.ivk-europe.com/)

Ordinance on Biocide Products No. 528/2012
Biocidal Products Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products (current consolidated version: 2022-04)

PCR Part A
Institut Bauen und Umwelt e.V., Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804+A2:2019

PCR Part B
Institut Bauen und Umwelt e.V., Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part B: Requirements on the EPD for Technical Textiles

REACH candidate list
Candidate List of substances of very high concern for Authorisation, published in accordance with Article 59(10) of the REACH Regulation, ECHA, www.echa.europa.eu/candidate-list-table

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Sustainability & Comfort
Working Group Tensinet

EPD12 Saint-Gobain, Sheerfill
see separated document

Sustainability & Comfort
Working Group TensiNet

EPD13 – EPD14 Verseidag – Serge Ferrari

ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	SERGE FERRARI group
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SER-20240197-IBI1-EN
Issue date	23.05.2024
Valid to	22.05.2029

PTFE coated glass fabrics for Tensile Architecture

Verseidag - Serge Ferrari group

Institut Bauen und Umwelt e.V.

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ECO PLATFORM EPD VERIFIED

1. General Information

Verseidag - Serge Ferrari group

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Declaration number

EPD-SER-20240197-IBI1-EN

This declaration is based on the product category rules:

structural membranes , 01.08.2021
(PCR checked and approved by the SVR)

Issue date

23.05.2024

Valid to

22.05.2029

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

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

PTFE coated glass fabrics for Tensile Architecture

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France

Declared product / declared unit

The declared products are glass fabrics coated on both sides with Polytetrafluoroethylene (Glass-PTFE). They are used as a structural membrane for tensile architecture including tensile shading and tensile facade.

This EPD covers the following products: B18039 / B18049 / B18089 / B18059 / B18589 / B18639 / B18689 /B18669 / B18656-LT / B18909-LT / B18905-LT; The representative product is B18589.

The declared unit is 1 m^2 PTFE coated glass fabric, with a FEP lacquer on both sides, or laminated PTFE on one side and its accompanying packaging materials.

Scope:

The declared membranes are manufactured by Serge Ferrari Group in its plant in Germany (Verseidag Indutex GmbH). Primary data is based on 2021 production amounts and background data is sourced from the databases LCA for Experts.
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*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Mrs Kim Allbury,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The products covered by the EPD are composite membranes manufactured by Serge Ferrari Group in its plants in Germany (Verseidag Indutex GmbH).

The declared products are glass fabrics coated on both sides with Polytetrafluoroethylene (Glass-PTFE). Those composite membranes are in the form of plain membranes or mesh (with a PTFE film on both sides for mesh).

This EPD covers the following product references:
- Plain membranes: B18039 / B18049 / B18089 / B18059 / B18589 / B18639 / B18689 / B18669,
- Plain membranes based on a mesh with a PTFE film: B18656-LT / B18909-LT / B18905-LT.

Those products used for tensile architecture are not covered by any harmonized European standards or procedure (hEN or ETA). They are covered by the European technical specification prCEN TS19102 that covers a wide range of specifications for materials, design and execution.
For the application and use, national provisions may also apply.

2.2 Application

The products are used as a structural membrane for Tensile Architecture including tensile roofs and tensile facades.

2.3 Technical Data

The technical specifications given here below are value ranges covering all products. For more precise information on each product see the technical data sheet.

Constructional data

Name	Value	Unit
Grammage DIN EN ISO 2286-1	750 to 1600	g/m^2
Tensile strength (warp/weft) DIN EN ISO 1421 V1	Plain: 3000/3000 to 8000/8000; Mesh-LT: 300 to 5300	N/mm^2
Tearing strength (warp/weft) DIN 53353	Plain: 300 to 6500; Mesh-LT: 300 to 5300	N/50mm
Light transmittance DIN EN 410	Tv n-h = Plain: 8 to 18; Tv n-h = Mesh-LT: 25 to 50	%
Reflection ratio (visual spectrum) DIN EN 410	Rv n-h = Plain: approx. 80; Rv n-h = Mesh-LT: approx. 55	%
Tearing strength acc. to EN 1875-3	Plain: 150/150 to 500/500	N/50mm
Fire tests EN 13501-1	B-s1;d0	-
Gen. appraisal certificate Building material class /DIN 4102-B1/	A2 to B1	-

Those products are not covered by the CPR (not harmonized, no hEN and no ETA).
They will be covered by the future TS19102. The technical performances requested by TS19102 are mentioned in the table here above (tensile strength EN ISO 1421, and tear strength EN 1875-3).

2.4 Delivery status

The width of the roll is from 140 to 475 cm. The length of the roll is from 50 to 250 m.
The total quantity delivered in a roll is equivalent to the width multiplied by the length.

2.5 Base materials/Ancillary materials

The following table summarizes the main components of the membrane. The values refer to the representative product.

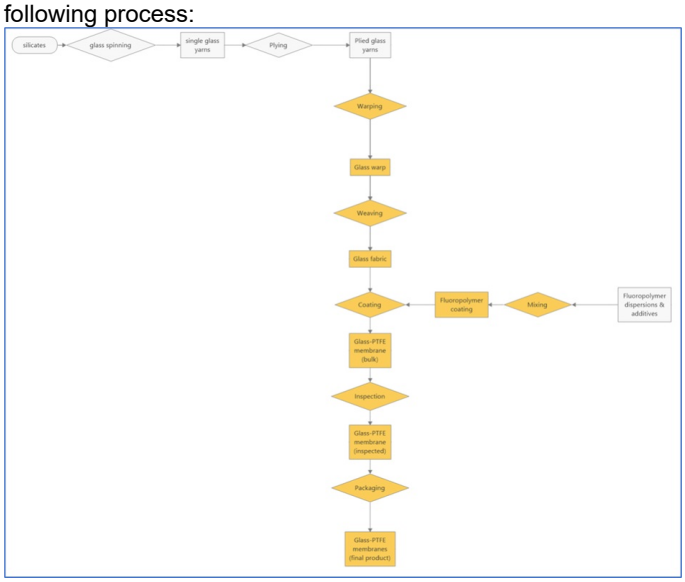
Name	Value	Unit
Glass textile	33.2	%
PTFE	36.6	%
FEP	2.8	%
Packaging	27.4	%

There are 2 types of membranes covered by this EPD:
- Plain membranes based on glass fabric coated with PTFE and FEP top-treatment
- Glass mesh fabric coated with PTFE ; and laminated with modified PTFE film.

The declared products comply with REACH regulation. They do not contain substances from the SVHC (Substances of High Concern) candidate list (list updated the 14th of June 2023) at a rate greater than 0.1% by weight.

2.6 Manufacture

The declared products are manufactured at Verseidag-Indutex GmbH (part of Serge Ferrari group) in Germany with the following process:



An external supplier provides plied glass yarns to be warped and weaved by Verseidag-Indutex GmbH, producing glass fabric. A flouropolymer coating is mixed and used in a coating process, producing the glass-PTFE membrane in bulk. After a quality review, the inspected membranes are packed, providing the final product.
Verseidag-Indutex GmbH is ISO 9001 certified.

2.7 Environment and health during manufacturing

All workers wear personal protective equipment and special devices for handling of raw materials, e.g. safety shoes, safety gloves, suitable work wear etc.
Raw materials used exclude powders and solvents, therefore there is no risk of inhalation or toxicity. Exhaust air from production is filtered and treated by catalysis incineration processes. Emissions of HF, CO, CO2, HCl, NOx etc. are regularly checked and are far below the legal limits.
Fluoropolymer waste is collected and externally treated and incinerated by specialized waste management companies.
There are no effluents in the water as the production plant is not connected to a sewage system and no water is used in the production process. The emissions in the soil are under control.
Verseidag-Indutex GmbH is certified according to ISO 14001

and ISO 50001.

2.8 Product processing/Installation

Additional handling and fabrication guidelines are available on request.

2.9 Packaging

The packing of the composite membranes consists of the following elements:

- Iron tube
- Wooden crate
- Stretch film
- Plastic bag

The packing weigths a total of 0.397 kg per m^2 of membrane and corresponds to 27.4% of the final weight of the representative packed product.

2.10 Condition of use

There is no change in material composition over the service life of the product.

2.11 Environment and health during use

The declared products don't contain harmful substances and theoretically have poor VOC emissions.

2.12 Reference service life

A reference service life according to ISO 15686 could not be declared for the product. Furthermore, there is no suitable construction element in the BBSR table "Service life of components for life cycle analysis according to BNB" (BNB_Nutzungsdauern_von_Bauteilen_2017-02-24.xls (nachhaltigesbauen.de)) to estimate the service life. According to manufacturer, the service life of the Verseidag coated fabric is expected to be at least 50 years. Serge Ferrari also manufactures PVC coated polyester fabrics for tensile architecture. The lifespan of PVC products is declared in independently-verified EPD to be 30 years (INIES, 2021). In comparison, PTFE is a much more stable polymer and durable than PVC due to its high fluorine content. It is considered as inert and non-sensitive to UV.

An impact after decades of use can come from mechanical influences, e.g. small particles like dust in combination with high winds abrading the surface. This will very slowly lead to a slightly rougher surface, which can lead to more deposition of dust.
However, this can be cleaned by rain or – if there is no sufficient rain in an area – by cleaning with pure water.

2.13 Extraordinary effects

Fire

The declared products meet B-s1,d0 regarding the norm EN 13501-1.

Fire protection

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s1

Water

The membranes have similar impacts on rainwater run-off and flodding as other roof materials. They protect the building occupants against rain water.

Mechanical destruction

The declared products are made of PTFE and glass which are inert and highly resistant against almost any chemicals. As they are flexible and designed to resist unforseeable destructive events, they may have limited damages (tears, ...) but remain as a whole and they will not totally disaggregate and spread in the environment.

2.14 Re-use phase

These composite membranes are most of the time not re-used. They are not recycled yet.
They can be incinerated with energy recovery.

2.15 Disposal

These composite membranes can be landfilled.
The waste code for the composite membranes is '04 02 09: composites materials (impregnated textile, elastomer, plastomer)'.

2.16 Further information

For further information, please visit the website www.sergeferrari.com.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m^2 PTFE coated glass fabric, coated with a FEP lacquer on both sides, or laminated PTFE on one side, and its accompanying packaging materials.

Declared unit and mass reference

Name	Value	Unit
Declared unit	1	m^2
Layer thickness	0.007	m
Grammage	1.05	kg/m^2
Packaging	0.397	kg/m^2

Other declared units are allowed if the conversion is shown transparently.

The selection of the representative product (B18589) was based on a variability study, in comparison to the weighted average product. Variability is further discussed in the Interpretation in Chapter 6.

3.2 System boundary

This EPD considers all processes within the selected system boundary "Cradle to grave". Modules A1-A3, C1-C4, and D are considered.

Modules A1-A3
For modules A1-A3, the system boundaries include all raw material extraction processes as well as transports, for both material and energy flows, used in the manufacturing of the products from cradle to factory gate.

Module A5 (technical scenario)
In module A5, the packaging resulting from the installation of the product on the construction site is sent for waste treatment. The installation of the membrane is not declared and depends on the architectural application intended after the Gate.

Modules C1-C4
Modules C1-C4 describe the burdens of environmental impacts after the product's end of life for dismantling or demolition (C1), the transports to the disposal processes (C2) , and the necessary processes for waste treatment (C3-C4) at the end of the product life cycle. The loads for waste treatment are mapped here until the end of the waste property is reached.

Emissions of waste treatment are assigned to module C3 and emissions of landfilling are assigned to module C4. Resulting credits are assigned to module D.

Module D
The output flows or secondary materials/fuels resulting from the waste treatment in C3, which can potentially serve as energetic (waste-to-energy route) or material input (recycling) for a downstream product system, are reported in Module D.

3.3 Estimates and assumptions

Modeling was done on the basis of yearly manufacturing data of 2021, forming a weighted average for a representitive product. When a product was not manufactured in this period, modelling was done based on corresponding material composition, average energy inputs and with allocated waste in proportion to the product most similar in material composition, showing no significant deviation in environmental performance.

In order to best represent the environmental impact of glass fibre plying done by an external provider in Germany, the GaBi dataset Glass wool was used, including energy demands for plying, as well as the burdens of raw material extraction and related waste treatment.

Where Fluorinated Ethylene Propylene (FEP) was used for top-treatment of the product, modelling was done with the GaBi dataset Polyvinylidene fluoride (PVDF) as a proxy, due to similiarties in chemical structure, manufacturing processes and uses.

It was assumed, that any PTFE production waste is incinerated, modelled with the GaBi dataset Waste incineration (plastics). The heating value for PTFE is estimated to be approximately 5 MJ/kg.

3.4 Cut-off criteria

An attempt was made to take into account all data gathered in the operational data collection. Thus, material flows with a mass fraction of less than one percent were also balanced. No material or energy flow from the primary data of production was cut-off from the study.

3.5 Background data

The manufacturing process was modeled as far as possible using the manufacturer-specific data. For the upstream and downstream processes, however, generic background datasets were used.
All used background data sets are from the current version of the GaBi databases (Service pack 2023.2). The data sets contained in the databases are documented online.

3.6 Data quality

Foreground data
The collected material and energy data originate from the year 2021. The data collection for the investigated products was carried out on the basis of evaluations of internal production and environmental data, the collection of LCA-relevant data within the supplier chain, as well as by measuring relevant data for the energy supply. The data collected was checked for plausibility and consistency. A good level of representativeness can be assumed.

Background data
The background data sets used for the balancing are generally not older than 3 years. All datasets received an overall rating of very good or good data quality for temporal, technical, and geographical representativeness.

3.7 Period under review

The collected material and energy data originate from the period 01.01.2021 - 31.12.2021.

3.8 Geographic Representativeness

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

3.9 Allocation

Within the defined system boundaries, data for the manufacturing was determined for the total produced area (m^2) during 2021. The inputs of materials, energy, and auxiliaries and the outputs of waste and evaporation were measured for all membranes produced in 2021 and allocated, based on manufacturer information, to each product by production amounts (m^2). The production is modelled with specific data for the declared product and there are no co-products. The thickness of the product does not play a role in the energy demands for production.

3.10 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. All used background data sets are from the current version of the GaBi databases (Service pack 2023.2).

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon
The declared products themselves do not contain biogenic carbon. The part of their accompanying packaging containing biogenic carbon (wood-based) amounts to 0.301kg per m2 of membrane.

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.1358	kg C

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO2 .

Since the use of packaging material is declared in the module A1-A3 and the end-of-life of packaging materials is not declared (technical scenario for module A5), the biogenic carbon content is balenced for A1- A3.

The treatment of packaging waste is declared in a technical scenario in Module A5.

Installation into the building (A5)
Technical scenario: The following information corresponds to the packaging waste exiting the system in module A5.

Name	Value	Unit
Wood Packaging	0.301	kg
Metal Packaging	0.095	kg
Aluminium Packaging	0.001	kg
HDPE Packaging	0.0003	kg

The reference lifetime of the product is expected to be 50 years.

Service life

Name	Value	Unit
Life Span according to the manufacturer	50	a

The manufacturer's instructions for installation shall be followed to achieve the declared service life.

End of life (C1-C4)

Two different disposal routes were modelled as 100% scenarios, to represent both landfilling (Scenario1) and the incineration without energy recovery (Scenario 2). The environmental impacts of incineration are assigned to module C3, without the inclusion of benefits in module D. The environmental impacts of landfilling are assigned to module C4.

Name	Value	Unit
Collected as mixed construction waste	1.05	kg
Landfilling Scenario 1	1.02	kg
Incineration Scenario 2	1.05	kg

During the dismantling of the membranes in Module C1 it is assumed, based on the Federal Environment Agency (2012), that the process requires diesel-driven machinery and approximately 0.01 kg of diesel is required to dismantle 1 kg of product.
The distance of transport for disposal (Module C2) is estimated to be 100 km.

Module D
The PTFE production waste in module A1- A3 is incinerated in Germany. The energy recovery results in a benefit for module D.

5. LCA: Results

The present results in the impact categories refer to the potential environmental impacts in an analysis period of 100 years. Long-term emissions (> 100 years) are not considered in the impact assessment.
Note: Impact assessment results are relative statements only and do not provide information on impact category endpoints, thresholdexceedances, margins of safety, or on risks.

Two different disposal routes were modelled as 100% scenarios. In the 1st scenario, the product is 100% landfilled (C3/1;C4/1) and in the 2nd scenario, it is 100% incinerated (C3/2; C4/2).

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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m2 PTFE coated glass fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
GWP-total	kg CO_2 eq	1.64E+01	6.08E-03	9.14E-03	2.71E-03	1.43E+00	1.53E-02	0	-1.02E-01
GWP-fossil	kg CO_2 eq	1.64E+01	5.74E-03	9.06E-03	2.69E-03	1.43E+00	1.53E-02	0	-1.02E-01
GWP-biogenic	kg CO_2 eq	0	0	0	0	0	0	0	0
GWP-luluc	kg CO_2 eq	2.77E-03	3.4E-04	8.33E-05	2.02E-05	6.78E-05	4.75E-05	0	-9.29E-06
ODP	kg CFC11 eq	2.94E-07	4.78E-15	1.17E-15	4.49E-15	6.89E-13	3.89E-14	0	-1.24E-12
AP	mol H^+ eq	3.97E-02	2.78E-05	5.77E-05	1.4E-05	3.87E-04	1.09E-04	0	-1.02E-04
EP-freshwater	kg P eq	2.09E-05	1.34E-07	3.29E-08	9.15E-09	2.92E-07	3.08E-08	0	-2.74E-07
EP-marine	kg N eq	7.72E-03	6.63E-06	2.83E-05	6.43E-06	1.02E-04	2.8E-05	0	-3.78E-05
EP-terrestrial	mol N eq	1.02E-01	8.42E-05	3.13E-04	7.11E-05	1.62E-03	3.08E-04	0	-4.02E-04
POCP	kg NMVOC eq	2.28E-02	2.22E-05	5.47E-05	1.75E-05	2.81E-04	8.46E-05	0	-9.72E-05
ADPE	kg Sb eq	9.69E-04	2.42E-09	5.92E-10	2.88E-09	5.97E-09	7.05E-10	0	-8.83E-09
ADPF	MJ	2.15E+02	5E-01	1.22E-01	5.29E-02	1.17E+00	2.04E-01	0	-1.58E+00
WDP	m^3 world eq deprived	7.31E-01	4.43E-04	1.09E-04	5.22E-04	1.9E-01	1.68E-03	0	-1.34E-03

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 m2 PTFE coated glass fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
PERE	MJ	4.88E+01	3.64E-02	8.91E-03	4.92E-03	3.78E-01	3.32E-02	0	-6.02E-01
PERM	MJ	0	0	0	0	0	0	0	0
PERT	MJ	4.88E+01	3.64E-02	8.91E-03	4.92E-03	3.78E-01	3.32E-02	0	-6.02E-01
PENRE	MJ	1.94E+02	5.02E-01	1.23E-01	5.3E-02	2.34E+01	2.24E+01	0	-1.58E+00
PENRM	MJ	2.22E+01	0	0	0	-2.22E+01	-2.22E+01	0	0
PENRT	MJ	2.16E+02	5.02E-01	1.23E-01	5.3E-02	1.17E+00	2.04E-01	0	-1.58E+00
SM	kg	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	7.71E-02	3.99E-05	9.76E-06	1.51E-05	4.57E-03	5.15E-05	0	-2.14E-04

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 m2 PTFE coated glass fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
HWD	kg	2.72E-08	1.55E-12	3.81E-13	-1.37E-13	-5.17E-11	4.44E-12	0	-9.67E-11
NHWD	kg	3.23E-01	7.65E-05	1.87E-05	1.39E-05	3.63E-01	1.02E+00	0	-8.5E-04

RWD	kg	7.99E-03	9.39E-07	2.3E-07	7.11E-07	5.67E-05	2.32E-06	0	-6.23E-05
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	5.4E-02	0	0	0	0	0	0	0
EEE	MJ	3.72E-01	0	0	0	0	0	0	0
EET	MJ	8.63E-01	0	0	0	0	0	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 m2 PTFE coated glass fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
PM	Disease incidence	5.46E-07	2.24E-10	2.15E-10	2.66E-10	5.2E-09	1.33E-09	0	-7.43E-10
IR	kBq U235 eq	7.64E-01	1.4E-04	3.43E-05	1.14E-04	7.83E-03	2.69E-04	0	-6.59E-03
ETP-fw	CTUe	1.16E+02	3.55E-01	8.7E-02	3.55E-02	6.72E-01	1.11E-01	0	-2.69E-01
HTP-c	CTUh	2.63E-09	7.26E-12	1.78E-12	7.75E-13	3.37E-11	1.71E-11	0	-1.92E-11
HTP-nc	CTUh	1.06E-07	3.79E-10	1.01E-10	4.06E-11	3.31E-09	1.88E-09	0	-6E-10
SQP	SQP	1.73E+02	2.09E-01	5.12E-02	1.42E-02	3.57E-01	4.95E-02	0	-4.18E-01

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

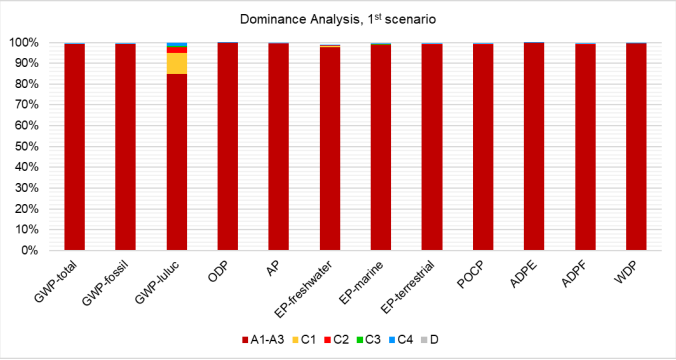
Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”. This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure 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.

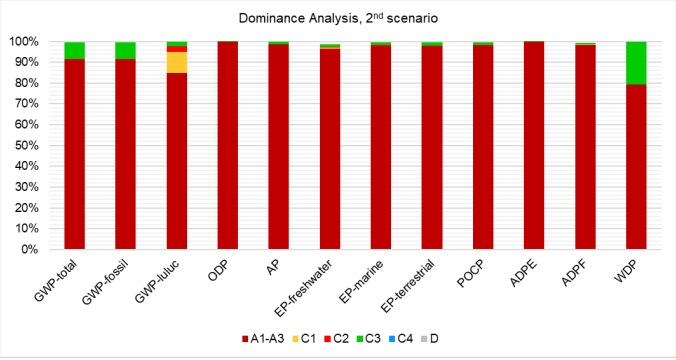
Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit 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.

This EPD was created using a software tool.

6. LCA: Interpretation

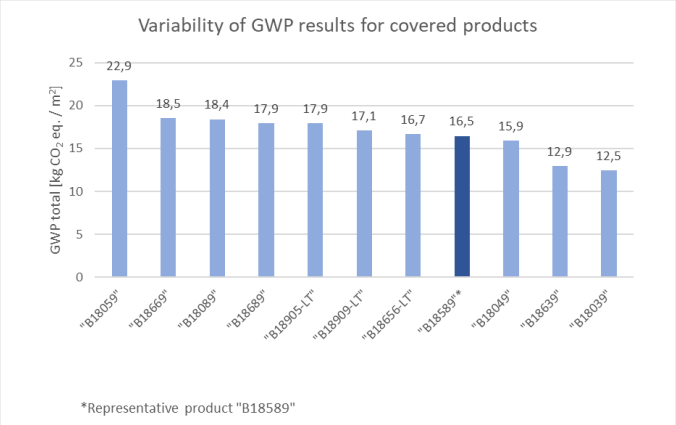
Contribution Analysis
The following dominance analysis diagrams shows the participation of each module in the different environmental impact categories, for scenario 1 (landfill) and scenario 2 (incineration).





In both scenarios, the production stage (module A1-A3) clearly dominates the LCA results, with the highest environmental impacts in all categories. Transports play a subordinate yet not insignificant role.
For most categories, the highest contributor of environmental impact is the use of PTFE as a raw material, in module A3. Notably, it accounts largely for the potential of abiotic depletion of non-fossil resources (ADPE) and for over 60% of the total gobal warming potential (GWP-total), mainly due to the use of fossil fuels.
Besides that, the use of electric energy from the German residual mix is the second largest contributer to GWP-total, with a share of about 20%. It also holds substantial shares across nearly all other impact categories.
The production of FEP, modelled with PVDF as a proxy, has its largest impact in the category ozone depletion potential (ODP).
The production of glass wool is with 32% the highest contributor to terrestrial eutrophication potential (EP-terrestrial).

Variability Analysis
Weighted averaging based on yearly production amounts in m^2 was chosen as basis for determining the representative product. The following graph shows the results for GWP total [kg CO_2 eq.] per 1m^2 of product, with the representative product being highlighted in dark blue.
It is important to note that the variability between products relates directly to the quantity of PTFE and subsequent product grammage.



7. Requisite evidence

The PTFE coated glass fabrics for Tensile Architecture complies with REACH regulations. It does not contain substances from the SVHC (Substances of High Concern) candidate list (list updated on the 14th of June 2023) at a rate greater than 0.1% by weight.
No leaching test was performed.

8. References

Standards

EN 15804
DIN EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products.

CEN/TS 19102:2023
Design of tensioned membrane structures – Technical specification

DIN 4102-1:1998-05
Brandverhalten von Baustoffen und Bauteilen - Teil 1: Baustoffe; Begriffe, Anforderungen und Prüfungen

DIN EN 1875-3:2023-04
Rubber- or plastics-coated fabrics - Determination of tearstrength - Part 3: Trapezoidal method (five-highest-peakcalculation); German version EN 1875-3:2023

DIN 53363:2003-10
Testing of plastic films - Tear test using trapezoidal testspecimen with incision

DIN EN ISO 2286-1:2017-01
Rubber- or plastics-coated fabrics - Determination of rollcharacteristics. Part 1: Methods for determination of length,width and net mass

DIN EN 410:2011
Glass in building - Determination of luminous and solarcharacteristics of glazing

DIN EN 13501-1:2019-05
Fire classification of construction products and buildingelements - Part 1: Classification using data from reaction to firetests

DIN EN ISO 1421:2016
Rubber- or plastics-coated fabrics — Determination of tensilestrength and elongation at break

ISO 9001
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ISO 14001
DIN EN ISO 14001:2015, Environmental managementsystems - Requirements.

ISO 14025
DIN EN ISO 14025:2011, Environmental labels anddeclarations — Type III environmental declarations —Principles and procedures

ISO 15686-1
Buildings and constructed assets - Service life planning - Part1: General principles and framework

ISO 50001
DIN EN ISO 50001:2011-12 Energy management systems - Requirements with guidance for use

Further References

Ecoinvent
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Product Category Rules Part A
Institut Bauen und Umwelt e.V. Calculation Rules for the LifeCycle Assessment and Requirements on the Project Report Version 1.8 (04.07.2019)

Product Category Rules Part B
Institut Bauen und Umwelt e.V. Requirements on the EPD for Structural Membranes. Version 1 (05.01.2024)

REACH Candidate List
Candidate List of substances of very high concern forAuthorisation (published in accordance with Article 59(10) oft he REACH Regulation). Available online

athttps://echa.europa.eu/candidate-list-table

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GaBiDatabase data-on-demand. Sphera Solutions, Inc. 130 ERandolph Street #1900, Chicago, IL 60601.ULGREENGUARD Certification.

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ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	SERGE FERRARI group
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SER-20240198-IBI1-EN
Issue date	23.05.2024
Valid to	22.05.2029

PTFE coated glass mesh fabrics for Tensile Architecture

Verseidag - Serge Ferrari group

Institut Bauen und Umwelt e.V.

www.ibu-epd.com | https://epd-online.com

ECO PLATFORM EPD VERIFIED

1. General Information

Verseidag - Serge Ferrari group

Programme holder

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

Declaration number

EPD-SER-20240198-IBI1-EN

This declaration is based on the product category rules:

structural membranes , 01.08.2021
(PCR checked and approved by the SVR)

Issue date

23.05.2024

Valid to

22.05.2029

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

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

PTFE coated glass mesh fabrics for Tensile Architecture

Owner of the declaration

SERGE FERRARI group
Rue Joseph Jacquard 87
38110 ROCHETOIRIN
France

Declared product / declared unit

The declared products are glass mesh fabrics coated on both sides with Polytetrafluoroethylene (Glass-PTFE). They are used as a structural membrane for tensile architecture including tensile shading and tensile facade.

This EPD covers the following products: B18656 / B18646 / B18909 / B18905; The representative product is B18909.

The declared unit is 1 m^2 PTFE coated glass mesh fabric and its accompanying packaging materials.

Scope:

The declared membranes are manufactured by Serge Ferrari Group in its plant in Germany (Verseidag Indutex GmbH). Primary data is based on 2021 production amounts and background data is sourced from the databases LCA for Experts.
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*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Mrs Kim Allbury,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The products covered by the EPD are composite membranes manufactured by Serge Ferrari Group in its plant in Germany (Verseidag Indutex GmbH).

The declared products are glass mesh fabrics coated on both sides with Polytetrafluoroethylene (Glass-PTFE).
This EPD covers the following products: B18656 / B18909 / B18905 / B18646. Those products used for tensile architecture are not covered by any harmonized European standards or procedure (hEN or ETA). They are covered by the European technical specification prCEN TS19102 that covers a wide range of specifications for materials, design and execution.
For the application and use, national provisions may also apply.

2.2 Application

The products are used as a structural membranes for Tensile Architecture including tensile shading and tensile facade.

2.3 Technical Data

The technical specifications given below are value ranges covering all products. For more precise information on each product refer to the technical data sheet.

Constructional data

Name	Value	Unit
Grammage Din EN ISO 2286-1	600 to 800	g/m^2
Tensile strength (warp/weft) DIN EN ISO 1421 v1	3000/3000 to 6000/6000	N/mm^2
Tearing strength (warp/weft) DIN 53363	450 to 500	N/50mm
Light transmittance DIN EN 410	Tv n-h = 20 to 60	%
Reflection ratio (visua spectrum) DIN EN 410	Rv n-h = approx. 22 to 60	%
Fire tests EN 13501-1	A2-s1;d0 or B-s1;d0	-
Gen. appraisal certificate Building material class /DIN 4102-B1/	A2 to B1	-

The products are not covered by the CPR (not harmonized, no hEN and no ETA).
They will be covered by the future TS19102. The technical performances requested by TS19102 are mentioned in the table above.

2.4 Delivery status

The width of the roll is from 150 to 470 cm. The length of the roll is from 50 to 300 m.
The total quantity delivered in a roll is equivalent to the width multiplied by the length.

2.5 Base materials/Ancillary materials

The following table summarizes the main components of the membrane. The values refer to the representative product.

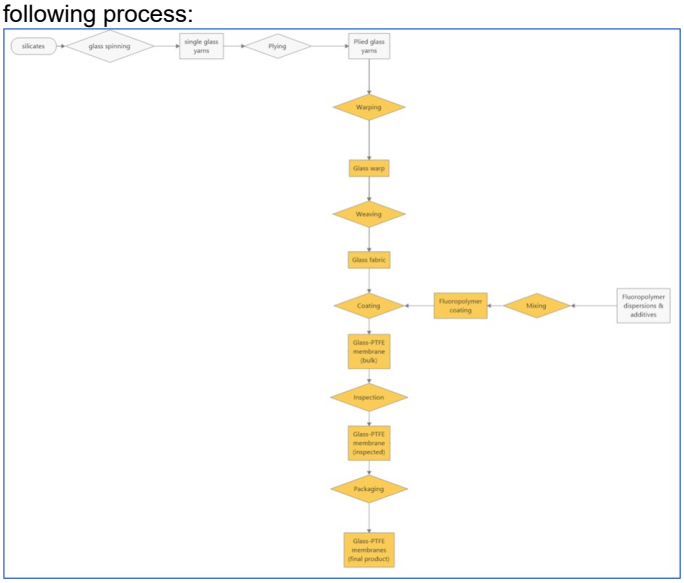
Name	Value	Unit
Glass textile	43.8	%
PTFE	20.1	%
Packaging	36.2	%

The declared products are glass mesh fabric coated with PTFE.

The declared products comply with REACH regulation. They do not contain substances from the SVHC (Substances of Very High Concern) candidate list (list updated the 14th of June 2023) at a rate greater than 0.1% by weight.

2.6 Manufacture

The declared products are manufactured at Verseidag-Indutex GmbH (part of Serge Ferrari group) in Germany with the following process:



An external supplier provides plied glass yarns to be warped and weaved by Verseidag-Indutex GmbH, producing glass fabric. A flouropolymer coating is mixed and used in a coating process, producing the glass-PTFE membrane in bulk. After a quality review, the inspected membranes are packed, providing the final product.
Verseidag-Indutex GmbH is ISO 9001 certified.

2.7 Environment and health during manufacturing

All workers wear personal protective equipment and special devices for handling of raw materials, e.g. safety shoes, safety gloves, suitable work wear etc.
Raw materials used exclude powders and solvents, therefore there is no risk of inhalation or toxicity.
Exhaust air from production is filtered and treated by catalysis incineration processes. Emissions of HF, CO, CO2, HCl, NOx etc. are regularly checked and are far below the legal limits.
Fluoropolymer waste is collected and externally treated and incinerated by specialized waste management companies.
There are no effluents in the water as the production plant is not connected to a sewage system and no water is used in the production process. The emissions in the soil are under control.
Verseidag-Indutex GmbH is certified according to ISO 14001 and ISO 50001.

2.8 Product processing/Installation

Additional handling and fabrication guidelines are available on request.

2.9 Packaging

The packing of the composite membranes consists of the following elements:

- Iron tube
- Wooden crate
- Stretch film
- Plastic bag

The packing weigths a total of 0.397 kg per m^2 of membrane and corresponds to 35.8% of the final weight of the representative packed product.

2.10 Condition of use

There is no change in material composition over the service life of the product.

2.11 Environment and health during use

The declared products do not contain harmful substances and theoretically have poor VOC emissions.

2.12 Reference service life

A reference service life according to ISO 15686 could not be declared for the product. Furthermore, there is no suitable construction element in the BBSR table "Service life of components for life cycle analysis according to BNB" (BNB_Nutzungsdauern_von_Bauteilen_2017-02-24.xls (nachhaltigesbauen.de)) to estimate the service life.
According to manufacturer, the service life of the Verseidag coated mesh fabric is expected to be at least 50 years. Serge Ferrari also manufactures PVC coated polyester fabrics for tensile architecture. The lifespan of PVC products is declared in independently-verified EPD to be 30 years (INIES, 2021). In comparison, PTFE is a much more stable polymer and durable than PVC due to its high fluorine content. It is considered as inert and non-sensitive to UV. An impact after decades of use can come from mechanical influences, e.g. small particles like dust in combination with high winds abrading the surface. This will very slowly lead to a slightly rougher surface, which can lead to more deposition of dust.
However, this can be cleaned by rain or – if there is no sufficient rain in an area – by cleaning with pure water.

2.13 Extraordinary effects

Fire

The declared products meet B-s1,d0 regarding the norm EN 13501-1 and some even A2-s1,d0 respectively

Fire protection

Name	Value
Building material class	A2 or B
Burning droplets	d0
Smoke gas development	s1

Water

The products are an open mesh textile. The water passes through the mesh without impact on the rainwater run-off and flooding.

Mechanical destruction

The declared products are made of PTFE and glass which are inert and highly resistant against almost any chemicals. As they are flexible and designed to resist unforeseeable destructive events, they may have limited damages (tears, ...) but remain as a whole and they will not totally disaggregate and spread in the environment.

2.14 Re-use phase

These composite membranes are most of the time not re-used. They are not recycled yet. They can be incinerated with energy recovery.

2.15 Disposal

The composite membranes can be landfilled.
The waste code for the composite membranes is '04 02 09': composites materials (impregnated textile, elastomer, plastomer)'.

2.16 Further information

For further information, please visit the website www.sergeferrari.com.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m^2 PTFE membrane, a flexible composite material glass mesh fabric, coated on both sides with Polytetrafluoroethylene, and its accompanying packaging materials.

Declared unit and mass reference

Name	Value	Unit
Declared unit	1	m^2
Layer thickness	0.011	m
Grammage	0.7	kg/m^2
Packaging	0.397	kg/m^2

Other declared units are allowed if the conversion is shown transparently.

The selection of the representative product (B18909) was based on a variability study, in comparison to the weighted average product. Variability is further discussed in the Interpretation in Chapter 6.

3.2 System boundary

This EPD considers all processes within the selected system boundary "Cradle to grave". Modules A1-A3, C1-C4, and D are considered.

Modules A1-A3
For modules A1-A3, the system boundaries include all raw material extraction processes as well as transports, for both material and energy flows, used in the manufacturing of the products from cradle to factory gate.

Module A5 (technical scenario)
In module A5, the packaging resulting from the installation of the product on the construction site is sent for waste treatment. The installation of the membrane is not declared and depends on the architectural application intended after the Gate.

Modules C1-C4
Modules C1-C4 describe the burdens of environmental impacts after the product's end of life for dismantling or demolition (C1), the transports to the disposal processes (C2) , and the necessary processes for waste treatment (C3-C4) at the end of the product life cycle. The loads for waste treatment are mapped here until the end of the waste property is reached. Emissions of waste treatment are assigned to module C3 and emissions of landfilling are assigned to module C4. Resulting credits are assigned to module D.

Module D
The output flows or secondary materials/fuels resulting from the waste treatment in C3, which can potentially serve as energetic (waste-to-energy route) or material input (recycling) for a downstream product system, are reported in Module D.

3.3 Estimates and assumptions

Modeling was done on the basis of yearly manufacturing data of 2021, forming a weighted average for a representitive product. As the product B18646 was not manufactured in this period, here modelling was done based on corresponding material composition, average energy inputs and with allocated waste in proportion to the product most similar in material composition, showing no significant deviation in environmental performance.

In order to best represent the environmental impact of glass fibre plying done by an external provider in Germany, the GaBi dataset Glass wool was used, including energy demands for plying, as well as the burdens of raw material extraction and related waste treatment.

It was assumed, that any PTFE production waste is incinerated, modelled with the GaBi dataset Waste incineration (plastics). The heating value for PTFE is estimated to be approximately 5 MJ/kg.

3.4 Cut-off criteria

An attempt was made to take into account all data gathered in the operational data collection. Thus, material flows with a mass fraction of less than one percent were also balanced. No material or energy flow from the primary data of production was cut-off from the study.

3.5 Background data

The manufacturing process was modeled as far as possible using the manufacturer-specific data. For the upstream and downstream processes, however, generic background datasets were used.
All used background data sets are from the current version of the GaBi databases (Service pack 2023.2). The data sets contained in the databases are documented online.

3.6 Data quality

Foreground data
The collected material and energy data originate from the year 2021. The data collection for the investigated products was carried out on the basis of evaluations of internal production and environmental data, the collection of LCA-relevant data within the supplier chain, as well as by measuring relevant data for the energy supply. The data collected was checked for plausibility and consistency. A good level of representativeness can be assumed.

Background data
The background data sets used for the balancing are generally not older than 3 years. All datasets received an overall rating of very good or good data quality for temporal, technical, and geographical representativeness.

3.7 Period under review

The collected material and energy data originate from the period 01.01.2021 - 31.12.2021.

3.8 Geographic Representativeness

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

3.9 Allocation

Within the defined system boundaries, data for the manufacturing was determined for the total produced area (m^2) during 2021. The inputs of materials, energy, and auxiliaries and the outputs of waste and evaporation were measured for all membranes produced in 2021 and allocated, based on manufacturer information, to each product by production amounts (m^2). The production is modelled with specific data for the declared product and there are no co-products. The thickness of the product does not play a role in the energy demands for production.

3.10 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. All used background data sets are from the current version of the GaBi databases (Service pack 2023.2).

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon
The declared products themselves do not contain biogenic carbon. The part of their accompanying packaging containing biogenic carbon (wood-based) amounts to 0.301kg per m^2 of membrane.

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.1358	kg C

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO2 .

Since the use of packaging material is declared in the module A1-A3 and the end-of-life of packaging materials is not declared (technical scenario for module A5), the biogenic carbon content is balenced for A1- A3.

The treatment of packaging waste is declared in a technical scenario in Module A5.

Installation into the building (A5)
Technical scenario: The following information corresponds to the packaging waste exiting the system in module A5.

Name	Value	Unit
Wood Packaging	0.301	kg
Metal Packaging	0.095	kg
Aluminium Packaging	0.001	kg
HDPE Packaging	0.0003	kg

The reference lifetime of the product is expected to be 50 years.

Service life

Name	Value	Unit
Life Span according to the manufacturer	50	a

The manufacturer's instructions for installation shall be followed to achieve the declared service life.

End of life (C1-C4)
Two different disposal routes were modelled as 100% scenarios, to represent both landfilling (Scenario1) and the incineration without energy recovery (Scenario 2). The environmental impacts of incineration are assigned to module C3, without the inclusion of benefits in module D. The environmental impacts of landfilling are assigned to module C4.

Name	Value	Unit
Collected as mixed construction waste	0.7	kg
Landfilling Scenario 1	0.68	kg
Incineration Scenario 2	0.7	kg

During the dismantling of the membranes in Module C1 it is assumed, based on the Federal Environment Agency (2012),

that the process requires diesel-driven machinery and approximately 0.01 kg of diesel is required to dismantle 1 kg of product.
The distance of transport for disposal (Module C2) is estimated to be 100 km.
During the dismantling of the membranes in Module C1 it is assumed, based on the Federal Environment Agency (2012), that the process requires diesel-driven machinery and approximately 0.01 kg of diesel is required to dismantle 1 kg of product.
The distance of transport for disposal (Module C2) is estimated to be 100 km.

Module D
The PTFE production waste in module A1- A3 is incinerated in Germany. The energy recovery results in a benefit for module D.

5. LCA: Results

The present results in the impact categories refer to the potential environmental impacts in an analysis period of 100 years. Long-term emissions (> 100 years) are not considered in the impact assessment.
Note: Impact assessment results are relative statements only and do not provide information on impact category endpoints, thresholdexceedances, margins of safety, or on risks.

Two different disposal routes were modelled as 100% scenarios. In the 1st scenario, the product is 100% landfilled (C3/1;C4/1) and in the 2nd scenario, it is 100% incinerated (C3/2; C4/2).

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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m2 PTFE coated glass mesh fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
GWP-total	kg CO_2 eq	1.01E+01	4.06E-03	6.1E-03	1.8E-03	6.12E-01	1.02E-02	0	-5.68E-02
GWP-fossil	kg CO_2 eq	1.01E+01	3.83E-03	6.04E-03	1.79E-03	6.12E-01	1.02E-02	0	-5.68E-02
GWP-biogenic	kg CO_2 eq	0	0	0	0	0	0	0	0
GWP-luluc	kg CO_2 eq	1.91E-03	2.27E-04	5.55E-05	1.35E-05	5.05E-05	3.17E-05	0	-5.2E-06
ODP	kg CFC11 eq	1.15E-10	3.18E-15	7.8E-16	3E-15	5.59E-13	2.59E-14	0	-6.93E-13
AP	mol H^+ eq	2.4E-02	1.85E-05	3.85E-05	9.35E-06	2.69E-04	7.23E-05	0	-5.72E-05
EP-freshwater	kg P eq	1.03E-05	8.95E-08	2.19E-08	6.1E-09	2.52E-07	2.05E-08	0	-1.54E-07
EP-marine	kg N eq	4.92E-03	4.42E-06	1.89E-05	4.29E-06	7.7E-05	1.87E-05	0	-2.12E-05
EP-terrestrial	mol N eq	7.15E-02	5.62E-05	2.09E-04	4.74E-05	1.04E-03	2.06E-04	0	-2.25E-04
POCP	kg NMVOC eq	1.39E-02	1.48E-05	3.64E-05	1.16E-05	2.11E-04	5.64E-05	0	-5.44E-05
ADPE	kg Sb eq	4.24E-04	1.61E-09	3.95E-10	1.92E-09	5.15E-09	4.7E-10	0	-4.94E-09
ADPF	MJ	1.39E+02	3.33E-01	8.16E-02	3.53E-02	1.11E+00	1.36E-01	0	-8.85E-01
WDP	m^3 world eq deprived	4.54E-01	2.96E-04	7.24E-05	3.48E-04	1.11E-01	1.12E-03	0	-7.48E-04

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 m2 PTFE coated glass mesh fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
PERE	MJ	3.43E+01	2.43E-02	5.94E-03	3.28E-03	3.42E-01	2.21E-02	0	-3.37E-01
PERM	MJ	0	0	0	0	0	0	0	0
PERT	MJ	3.43E+01	2.43E-02	5.94E-03	3.28E-03	3.42E-01	2.21E-02	0	-3.37E-01
PENRE	MJ	1.3E+02	3.35E-01	8.19E-02	3.53E-02	9.69E+00	8.72E+00	0	-8.85E-01
PENRM	MJ	8.58E+00	0	0	0	-8.58E+00	-8.58E+00	0	0
PENRT	MJ	1.39E+02	3.35E-01	8.19E-02	3.53E-02	1.11E+00	1.36E-01	0	-8.85E-01
SM	kg	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	4.08E-02	2.66E-05	6.51E-06	1.01E-05	2.72E-03	3.43E-05	0	-1.2E-04

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 m2 PTFE coated glass mesh fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
HWD	kg	1.72E-08	1.04E-12	2.54E-13	-9.15E-14	-2.44E-11	2.96E-12	0	-5.41E-11
NHWD	kg	2.79E-01	5.1E-05	1.25E-05	9.29E-06	2.72E-01	6.8E-01	0	-4.75E-04

RWD	kg	6.43E-03	6.26E-07	1.53E-07	4.74E-07	6.97E-05	1.55E-06	0	-3.49E-05
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	5.4E-02	0	0	0	0	0	0	0
EEE	MJ	2.08E-01	0	0	0	0	0	0	0
EET	MJ	4.83E-01	0	0	0	0	0	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 m2 PTFE coated glass mesh fabric

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
PM	Disease incidence	3.48E-07	1.5E-10	1.43E-10	1.77E-10	3.82E-09	8.9E-10	0	-4.16E-10
IR	kBq U235 eq	6E-01	9.34E-05	2.29E-05	7.62E-05	1.08E-02	1.79E-04	0	-3.69E-03
ETP-fw	CTUe	8.94E+01	2.37E-01	5.8E-02	2.37E-02	5.91E-01	7.41E-02	0	-1.5E-01
HTP-c	CTUh	1.82E-09	4.84E-12	1.19E-12	5.17E-13	2.48E-11	1.14E-11	0	-1.08E-11
HTP-nc	CTUh	6.74E-08	2.53E-10	6.75E-11	2.71E-11	1.59E-09	1.25E-09	0	-3.36E-10
SQP	SQP	1.64E+02	1.39E-01	3.41E-02	9.49E-03	2.98E-01	3.3E-02	0	-2.34E-01

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.

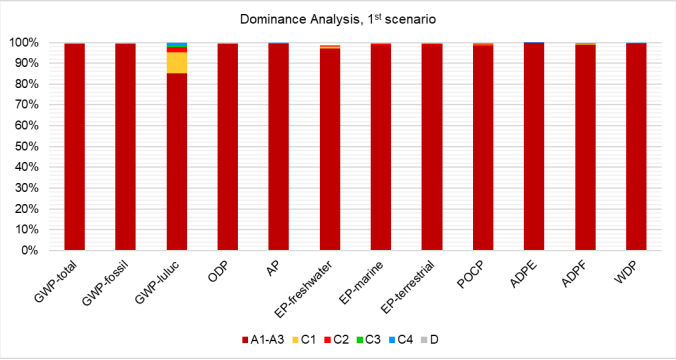
Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit 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.

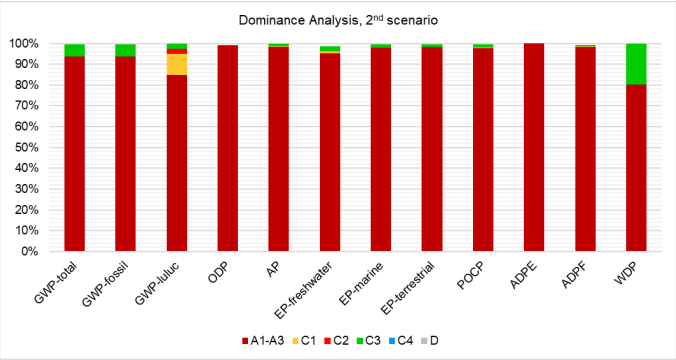
This EPD was created using a software tool.

6. LCA: Interpretation

Contribution Analysis

The following dominance analysis diagrams shows the participation of each module in the different environmental impact categories, for scenario 1 (landfill) and scenario 2 (incineration).

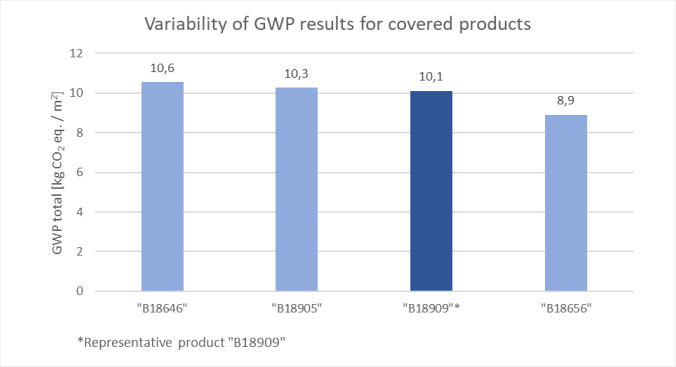




In both scenarios, the production stage (module A1-A3) clearly dominates the LCA results, with the highest environmental impacts in all categories. Transports play a subordinate yet not insignificant role.
For most categories, the highest contributor of environmental impact is the use of PTFE as a raw material, in module A3. Notably, it accounts largely for the potential of abiotic depletion of non-fossil resources (ADPE) and for over 45% of the total gobal warming potential (GWP-total), mainly due to the use of fossil fuels.
Besides that, the use of electric energy from the German residual mix is the second largest contributer to GWP-total, with a share of about 35%. It also holds substantial shares across nearly all impact categories and is the highest contributor to the impact category water drainage potential (WDP). The production of electricity from photovoltaic energy is with 74% the largest contributor to ozone depletion potential (ODP).The production of glass wool is with 45% the highest contributor to terrestrial eutrophication potential (EP-terrestrial).

Variability Analysis

Weighted averaging based on yearly production amounts in m^2 was chosen as basis for determining the representative product. The following graph shows the results for GWP total [kg CO_2 eq.] per 1m^2 of product, with the representative product being highlighted in dark blue.
It is important to note that the variability between products relates directly to the quantity of PTFE and subsequent product grammage.



7. Requisite evidence

The PTFE coated glass mesh fabrics for Tensile Architecture complies with REACH regulations. It does not contain substances from the SVHC (Substances of High Concern) candidate list (list updated on the 14th of June 2023) at a rate greater than 0.1% by weight. No leaching test was performed.

8. References

Standards

EN 15804
DIN EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products.

CEN/TS 19102:2023
Design of tensioned membrane structures – Technical specification

DIN 4102-1:1998-05
Brandverhalten von Baustoffen und Bauteilen - Teil 1: Baustoffe; Begriffe, Anforderungen und Prüfungen

DIN EN 1875-3:2023-04
Rubber- or plastics-coated fabrics - Determination of tearstrength - Part 3: Trapezoidal method (five-highest-peakcalculation); German version EN 1875-3:2023

DIN 53363:2003-10
Testing of plastic films - Tear test using trapezoidal testspecimen with incision

DIN EN ISO 2286-1:2017-01
Rubber- or plastics-coated fabrics - Determination of rollcharacteristics. Part 1: Methods for determination of length,width and net mass

DIN EN 410:2011
Glass in building - Determination of luminous and solarcharacteristics of glazing

DIN EN 13501-1:2019-05
Fire classification of construction products and buildingelements - Part 1: Classification using data from reaction to firetests

DIN EN ISO 1421:2016
Rubber- or plastics-coated fabrics — Determination of tensilestrength and elongation at break

ISO 9001
DIN EN ISO 9001:2015, Quality management systems – Requirements

ISO 14001
DIN EN ISO 14001:2015, Environmental managementsystems - Requirements.

ISO 14025
DIN EN ISO 14025:2011, Environmental labels anddeclarations — Type III environmental declarations —Principles and procedures

ISO 15686-1
Buildings and constructed assets - Service life planning - Part1: General principles and framework

ISO 50001
DIN EN ISO 50001:2011-12 Energy management systems - Requirements with guidance for use

Further References

Ecoinvent
Ecoinvent database v.3.9.1. Ecoinvent, Technoparkstrasse 1,8005 Zurich, Switzerland.

IBU 2021 Institut Bauen und Umwelt e.V.
General Instructions for the EPD programme of Institut Bauen und Umwelt e.V., Version 2.0, Berlin: Institut Bauen und Umwelte.V., 2021 www.ibu-epd.com IBU 2016

Product Category Rules Part A
Institut Bauen und Umwelt e.V. Calculation Rules for the LifeCycle Assessment and Requirements on the Project Report Version 1.8 (04.07.2019)

Product Category Rules Part B
Institut Bauen und Umwelt e.V. Requirements on the EPD for Structural Membranes. Version 1 (05.01.2024)

REACH Candidate List
Candidate List of substances of very high concern forAuthorisation (published in accordance with Article 59(10) oft he REACH Regulation). Available online athttps://echa.europa.eu/candidate-list-table

Sphera Solutions Inc.
LCA for experts (GaBi) Software for LCA version 10.7.1.28.GaBi Professional Database Service pack 2023.2. GaBiDatabase data-on-demand. Sphera Solutions, Inc. 130

ERandolph Street #1900, Chicago, IL 60601.ULGREENGUARD Certification.

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Sustainability & Comfort
Working Group Tensinet

EPD15 Nowofol Kunststoffprodukte

SUSTAINABILITY CONTRIBUTION DECLARATION

LEED v4® -
Leadership in Energy and Environmental Design

NOWOFOL® Kunststoffprodukte GmbH & Co. KG

Nowoflon®-ET film

NOWOFLON® ET film is a flexible and strong film, made of a fluorinated copolymer. NOWOFLON® ET films are characterized by a number of positive properties, e.g.:

- Excellent mechanical strength, particularly tear strength and tensile strength
- Excellent weather resistance
- High transparency of both visible and UV light
- Due to its anti-adhesive surface the film has anti-graffiti and self-cleaning properties
- The film can be colored or tinted in different shades to meet each customer's specifications
- Film can be printed in different designs
- Available as heat absorbing film (IRcut)
- Flame resistant and self-extinguishing

This allows them to be used in applications for which a highly–capable, hardwearing and durable material is required.

SUSTAINABILITY CONTRIBUTION DECLARATION

Sustainable Sites (SS)

Heat Island Reduction
→ To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.

Product information

Item	Value	Unit
solar reflectance index (SRI) value (roofing materials)	1-60 *	%

*Solar Reflectance Index (SRI) is dependent on the optical performance of the film (clear, colored, printed or IRcut), thus a range of values is given for the SRI value. Construction of the layers, color and printing all influence the final values. The project-specific values can be determined upon request.

Innovation (IN)

→ To encourage projects to achieve exceptional or innovative performance.

Description:

- Extremely light weight, reducing substructure strength requirements.
- Low energy demand for production (*see LCA results in section MR*).
- The variant “IRcut” film absorbs the heat in the film with high transparency at the same time, so that heating of the interior is reduced; therefore considerable savings in air-conditioning can be achieved.
- Similar savings are possible due to pigmentation or printing.

None of the existing pilots for the innovation credit apply – for a specific certification project, the detailed data will be provided by NOWOFOL.

SUSTAINABILITY CONTRIBUTION DECLARATION

Materials & Resources (MR)

Building product disclosure and optimization - environmental product declarations
→ To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts.

Item	Value
Critically reviewed LCA acc. to ISO 14044?	No. Manufacturer's declaration.
Author of the LCA	thinkstep AG, Hauptstraße 111-113, 70771 Leinfelden-Echterdingen, Germany
Declared unit	1 m² (90 µm; 0.157 kg/m²)*
Declared modules (EN 15804)	A1 - A3 (Product stage)
Results of the LCA – ENVIRONMENTAL IMPACTS	
GWP [kg CO_2-eq.]	1.88E+00
ODP [kg CFC11-eq.]	2.90E-07
AP [kg SO_2- eq.]	6.14E-03
EP [kg PO_4^{3-}-eq.]	4.83E-04
POCP [kg ethene-eq.]	4.57E-04
ADPE [kg Sb-eq.]	5.66E-06
ADPF [MJ]	3.28E+01
Results of the LCA – RESOURCE USE	
PERE [MJ]	3.12E+00
PERM [MJ]	0
PERT [MJ]	3.12E+00
PENRE [MJ]	1.87E+01
PENRM [MJ]	1.44E+01
PENRT [MJ]	3.31E+01
SM [MJ]	0
RSF [MJ]	0
NRSF [MJ]	0
FW [MJ]	1.25E-02
Results of the LCA – OUTPUT FLOWS AND WASTE CATEGORIES	
HWD [kg]	6.01E-03
NHWD [kg]	3.19E-02
RWD [kg]	1.66E-03
CRU [kg]	0
MFR [kg]	0
MER [kg]	0
EEE [MJ]	0
EET [MJ]	0

Note: *Detailed names of the given abbreviations can be found in the Glossary.*
**The LCA results can be scaled as an approximation on a linear basis according to the thickness or surface weight (e.g. for results for the thickness of 100 µm all results have to be multiplied by 1.11 (=100/90)).*

SUSTAINABILITY CONTRIBUTION DECLARATION

Materials & Resources (MR)

Building product disclosure and optimization – sourcing of raw materials *(2 points)*
→ To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically and socially preferable life-cycle impacts and sourcing.

Product information

Option 1. raw material source and extraction reporting (1 point)		**Description / Unit**
Third-party verified corporate sustainability report (CSR)?	no	
Option 2. leadership extraction practices (1 point)		**Description / Unit**
Participation in an extended producer responsibility program?	no	
Postconsumer recycled content	0	%
Preconsumer recycled content	0	%

Building product disclosure and optimization – material ingredients *(2 points)*
→ To reward the selection of products verified to minimize the use and generation of harmful substances based on an accepted methodology for chemical ingredient listing.

Product information

Type of reporting	**Certification program (e.g. Green screen, cradle to cradle version/level, REACH)**	**Value/Comment**
Option 1: material ingredient reporting	Health Product Declaration	No
	Manufacturer Inventory	No
Option 2: Material ingredient optimization	GreenScreen v1.2 Benchmark	No
	Cradle to Cradle Certified	No
	International Alternative Compliance Path – REACH Optimization	Yes The films do not contain substances that meet REACH criteria for substances of very high concern (see also Safety data sheet).
	USGBC approved program	No

Indoor Environmental Quality (IEQ)

Low-emitting materials
→ To reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment.

Product information

Item	Value
Test institute / organization	Environmental Institute „*Bremer Umweltinstitut – Gesellschaft für Schadstoffanalysen und Begutachtung mbH*“ (commissioned by Vector Foiltec GmbH)
Test method applied	At 23 °C and a surface specific air throughput rate of 0.5 $m^3/(m^2h)$ and load of 2 m^2/m^3.
SVOC (C16 – C22)	< 5 µg/m^3
TVOC (C6 – C16, 28 days)	27 µg/m^3 (no formaldehyde, as the film doesn’t contain any; CAS number is 74499-71-1)
Criteria	Committee for Health-related evaluation of Building Products (AgBB) 2010

SUSTAINABILITY CONTRIBUTION DECLARATION

General Information

Company name:	NOWOFOL® Kunststoffprodukte GmbH & Co. KG
Address:	Breslauer Str. 15, 83313 Siegsdorf
Contact person:	Herr Freutsmiedl
Phone:	+49 (0) 8662 6602-0
Email:	info@nowofol.de
Homepage:	www.nowofol.de
Date:	09.02.2017

Technical data

Following technical data at delivery state are relevant for the declared product:

Name	Thickness [µm]	Surface weight [kg/m²]
NOWOFLON®-ET film	12 – 500*	21 – 875*
Composition	100 % ETFE	(CAS number 74499-71-1)

**The LCA results can be scaled on a linear basis according to the thickness or surface weight.*

Structural data for an exemplary thickness of 200 µm and a basis weight of 350 g/m²:

Name	Value	Unit
Melting range (ASTM D 4591-07)	265±10	°C
Tensile strength (DIN EN ISO 527-1)	> 40	N/mm²
Strain at 10 % elongation (DIN EN ISO 527-1)	> 18	N/mm²
Elongation at rupture (DIN EN ISO 527-1)	> 300	%
Tear growth resistance (DIN 53363)	> 300	N/mm
Weld seam strentgh (DIN 527-1)	≥ 33	N/mm²
Weatherability (ISO 4892-2)	No change of mech. values.	

Glossary

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
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
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 energy per energy carrier (electric)
EET	Exported energy per energy carrier (thermal)

Sustainability & Comfort
Working Group Tensinet

EPD16 Serge Ferrari

ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	SERGE FERRARI group
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SER-20230502-IBB2-EN
Issue date	23.05.2024
Valid to	22.05.2029

STFE 50: transparent and structural membrane for tensile architecture

Serge Ferrari group

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

www.ibu-epd.com | https://epd-online.com

1. General Information

Serge Ferrari group

Programme holder

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

Declaration number

EPD-SER-20230502-IBB2-EN

This declaration is based on the product category rules:

structural membranes , 01.08.2021
(PCR checked and approved by the SVR)

Issue date

23.05.2024

Valid to

22.05.2029

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

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

STFE 50: transparent and structural membrane for tensile architecture

Owner of the declaration

SERGE FERRARI group
Rue Joseph Jacquard 87
38110 ROCHETOIRIN
France

Declared product / declared unit

The declared product is named STFE 50. The declared unit is 1 m^2 STFE 50 membrane, a flexible composite material mesh fabric, and its accompanying packaging materials.

Scope:

The production occurs both at the Serge Ferrari Italian plant (Serge Ferrari S.P.A. at Carmignano) and at the French plant (Serge Ferrari SAS at La Tour Du Pin). Primary data based on 2021 production amounts and background data sourced from the databases LCA for Experts.
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*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Vito D'Incognito,
(Independent verifier)

2. Product

2.1 Product description/Product definition

This EPD covers the product STFE 50.
STFE 50 is a composite membrane manufactured by Serge Ferrari Group.
The declared product is polyarylate mesh fabric sheeted with a fluoropolymer compound and laminated with a fluoropolymer film. This product used for tensile architecture is not covered by any harmonized European standards or procedures (hEN or ETA). It is covered by the European technical specification prCEN TS19102 which covers a wide range of specifications for materials, design, and execution.
For the application and use, national provisions may also apply.

2.2 Application

The product is used as a structural membrane for tensile architecture including tensile roofs and tensile facades.

2.3 Technical Data

The technical specifications given here below are covering the product. For more precise information, please see the technical data sheet.

Constructional data

Name	Value	Unit
Tensile strength (warp/weft) acc. to EN ISO 1421 (5% fractile)	-	N/50mm
Total mass per unit area acc. to EN ISO 2286-1	850	g/m^2
Light transmittance DIN EN 410	53	%
Tearing Strength according to DIN 53363	800	N/50mm
Tearing strength DIN EN 1875-31	80	daN
fire tests EN 13501-1	B-s1,d0	
Tensile strength (warp) according to EN ISO 1421	450	daN/5cm
Tensile strength (werft) according to EN ISO 1421	470	daN/5cm

The STFE 50 is not covered by the CPR (not harmonized, no hEN, and no ETA).
The future *TS19102* will cover it. The technical performances requested by *TS19102* are mentioned in the table above (tensile strength *EN ISO 1421*, and tear strength *EN 1875-3*).

2.4 Delivery status

The product is delivered as packed rolls. The width of the roll is 155 cm. The length of the roll ranges from 1 to 125 m.

2.5 Base materials/Ancillary materials

Material composition of the STFE 50 membrane

Name	Value	Unit
Fluoropolymer	90.14	%
Polyarylate yarns	9.77	%
Black pigment (cut off)	0.09	%

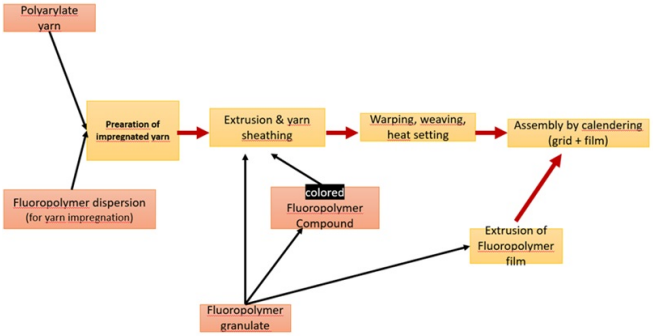
The accompanying packaging material consists of 3.2% HDPE, 31.2% paper and 65.6% wood.

The STFE 50 is a polyarylate mesh fabric sheeted with a fluoropolymer compound and laminated with a fluoropolymer film.

The STFE 50 complies with *REACH* regulations. It does not contain substances from the *SVHC* (Substances of High Concern) candidate list (list updated on the 14th of June 2023) at a rate greater than 0.1% by weight. The black pigment makes up less than 0.1% of the membrane and has been cut off.

2.6 Manufacture

The STFE 50 are manufactured with the following processes:



There are 2 Serge Ferrari plants that participate in the manufacturing: The Italian plant (Serge Ferrari S.P.A. at Carmignano) and the French plant (Serge Ferrari SAS at La Tour Du Pin).

Both the French and Italian plants are certified *ISO 9001*. The French plant (Serge Ferrari SAS) is certified *ISO 14001*.

2.7 Environment and health during manufacturing

Personnel utilize personal protective equipment and specialized equipment for managing the raw materials. The use of powder or solvent is avoided, thereby eliminating the possibility of inhalation or toxicity.
The exhaust air emanating from the manufacturing units is subjected to a catalytic incineration process followed by filtration. Furthermore, as there is no water input in the production, there are no wastewater discharges. The release of contaminants into the soil is kept under control through appropriate measures.

2.8 Product processing/Installation

The product processing and installation vary greatly on the design of the tensile structure. Options include cutting into panels with an automated cutting table and welding of the holding frames by HF High-Frequency Welding machine to obtain a finalized panel with varying details: overlapping, Kedar or eyelet system, sacrificial strip, reinforcement, etc. The membrane must be handled with care to avoid crushed folds which could generate unsightly marks by transparency and, in some cases, irreversible damages that may occur during installation or use. The membrane is deployed on the site with care and then stretched according to its characteristics, the panel's dimensions, and the location's climatic conditions.
The environmental impact of installation is outside the system boundaries in this EPD.

2.9 Packaging

The packaging used for the composite membrane includes HDPE Plastic film, wood or cardboard boxes, wooden pallets, and paper or cardboard tubes. The packaging for STFE 50 membrane is 0,086 kg/m^2 and is composed of 66.3 % wood, 30.2 % paper and 3.5 % HDPE.

2.10 Condition of use

There is no change in material composition over the service life of the product.

2.11 Environment and health during use

The declared product doesnt contain harmful substances and theoretically has poor VOC emissions.

The STFE 50 is certified *Greenguard Gold* (VOC emissions label).

2.12 Reference service life

A reference service life of STFE 50 according to ISO 15686 could not be declared. Furthermore, there is no suitable construction element in the BBSR table "Service life of components for life cycle analysis according to BNB" to estimate the service life.
The service life is declared by manufacturer information based on external accelerated tests according to the ISO 10640 standard in a climatic chamber. The tests simulate 17 years by exposure to high temperature and UV radiation during a period of 5000 hours (7 Month exposure). These tests allow the manufacturer to expect at least a service life of 30 years (probably much more).
Serge Ferrari also manufactures PES/PVC membranes with a declared service life of 30 years (independently-verified EPD, INIES, 2021). Since a PVDF coating is more durable than PVC, STFE 50 should have a service life of more than 30 years.
There is negligible effect of UVs, sunlight, or rain on the product. The fluoropolymer used is extremely inert, even at very low and very high temperatures.
The biggest impact after decades of use can come from mechanical influences, e.g. small particles like dust in combination with high winds abrading the surface. This will very slowly lead to a slightly rougher surface, which can lead to more deposition of dust.
However, this can be cleaned by rain or – if there is no sufficient rain in an area – by cleaning with pure water.

2.13 Extraordinary effects

Fire
The STFE 50 is B-s1,d0 regarding the norm *EN 13501-1*.

Fire protection

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s1

Water
The membrane has similar impacts as other roof materials. They protect the building occupants against rain water.

Mechanical destruction
The STFE 50 is made of a fluoropolymer which is inert and highly resistant against almost any chemicals. As the STFE 50 is flexible and designed to resist to unforeseeable destructive events, it may have limited damages (tears, ...) but remain as a whole and it will not totally disaggregate and spread in the environment.

2.14 Re-use phase

The STFE 50 membrane is most of the time not re-used. It is not recycled yet. It can be incinerated.

2.15 Disposal

The STFE 50 can be landfilled or incinerated.
The waste code for the composite membranes is '04 02 09: composites materials (impregnated textile, elastomer, plastomer)'.

2.16 Further information

For further information, please visit the website www.sergeferrari.com

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m^2 STFE 50 membrane, a flexible composite material mesh fabric made of polyacrylate yarns impregnated with PVDF dispersion, sheeted with a PVDF film and its accompanying packaging materials.

Declared unit and mass reference

Name	Value	Unit
Declared unit	1	m^2
Layer thickness	0.002	m
Grammage	0.85	kg/m^2

Other declared units are allowed if the conversion is shown transparently.

The accompanying packaging material is 0.0872 kg/ m^2 STFE 50 membrane.

3.2 System boundary

This EPD considers all processes within the selected system boundary "Cradle to grave". Modules A1-A3, C1-C4, and D are considered.

Modules A1-A3
For modules A1-A3, the system boundaries include all raw material extraction processes as well as transports, for both material and energy flows, used in the manufacturing of the products from cradle to factory gate.

Module A5 (technical scenario)
In module A5, the packaging resulting from the installation of the product on the construction site is sent for waste treatment. The installation of the membrane is not declared and depends on the architectural application intended after the Gate.

Modules C1-C4
Modules C1-C4 describe the burdens of environmental impacts after the product's end of life for dismantling or demolition, the transports to the disposal processes, and the necessary processes for waste treatment at the end of the product life cycle. The loads for waste treatment are mapped here until the end of the waste property is reached. Emissions of waste treatment are assigned to module C3 and emissions of landfilling are assigned to module C4. Resulting credits are assigned to module D.

Module D
The output flows or secondary materials/fuels resulting from the waste treatment in C3, which can potentially serve as energetic (waste-to-energy route) or material input (recycling) for a downstream product system, are reported in Module D.

3.3 Estimates and assumptions

The polyacrylate yarn used for the STFE 50 product is the intellectual property of the supplier and therefore, its polycondensation was modeled based on the chemical structures of the individual monomers and the available datasets in both LCA databases used.

3.4 Cut-off criteria

Almost all material flows with a mass fraction of less than one percent were balanced. In case of insufficient input data, the cut-off rules for taking into account the use of primary energy

and mass, according to *EN 15804* (< 1 % in each case, < 5 % in total) have been considered.
The input of black pigment was cut off from the study. With a weight of 0.0008 kg it represents 0.09% of the total product weight without packaging. Some auxiliary output flows for the modeling of polyarylate yarn were cut off, which make up of 0.01% of the total product weight without packaging.

3.5 Background data

The manufacturing process was modeled as far as possible using the manufacturer-specific data. For the upstream and downstream processes, however, generic background datasets were used.
Most background data was taken from the LCA for experts (Servicepack 2023.2) database from Sphera. Few datasets were sourced from ecoinvent (v3.9.). The used datasets originated from both databases and are documented online. To ensure the comparability of the results, background data from the LCA for experts (Servicepack 2023.2) database were used as much as possible in the LCA (e.g., data sets on energy, transports, auxiliary, and operating materials).

3.6 Data quality

Foreground data
The collected material and energy data originate from the year 2021. The data collection for the investigated products was carried out on the basis of evaluations of internal production and environmental data, the collection of LCA-relevant data within the supplier chain as well as by measuring relevant data for the energy supply. The data collected was checked for plausibility and consistency. A good level of representativeness can be assumed.
Background data
The background data sets used for the balancing are valid in the current year. All datasets received an overall rating of very good or good data quality for temporal, technical, and geographical representativeness.

3.7 Period under review

The collected material and energy data originate from the period 01.01.2021 - 31.12.2021.

3.8 Geographic Representativeness

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

3.9 Allocation

Within the defined system boundaries, in the production process, data for the product was determined with respect to the total produced area (m^2). The data for material and energy inputs was gathered for all membranes produced in 2021 and allocated to each product by production amounts (m^2). The production is modelled with specific data for the declared product and there are no co-products.

3.10 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. Background databases used: Most datasets from the LCA for experts (Servicepack 2023.2) database from Sphera. Few datasets were sourced from the ecoinvent (v3.9.) database.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon
The biogenic carbon content quantifies the amount of biogenic carbon in a construction product leaving the factory gate and is declared for the product and for any accompanying packaging.

The STFE 50 product itself has no biogenic carbon.
The packaging used for the STFE 50 includes: plastic film, wooden or cardboard boxes, wooden pallets and paper or cardboard tubes.
The Biogenic carbon content in the packaging is 0.0355 kg per m^2 STFE 50.
Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO_2.

Since the use of packaging material is declared in the module A1-A3 and the end-of-life of packaging materials is not declared (technical scenario for module A5), the biogenic carbon content is balenced for A1- A3.

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.0355	kg C

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO2

The following technical scenario information is required for the declared modules and optional for non-declared modules.
The following technical information is a basis for the declared modules or can be used for developing specific scenarios in the context of a building assessment if modules are not declared (MND). Since A5 is not declared, the disposal of the packaging material on the construction site is declared as technical scenario information for Module A5.

Installation into the building (A5)
Output of waste packaging after installation

Name	Value	Unit
Wood	0.0572	kg
Paper	0.0272	kg
HDPE	0.0028	kg

Service life

Name	Value	Unit
Life Span according to the manufacturer	30	a

The membrane must be handled with care to avoid crushed folds which could generate unsightly marks by transparency and, in some cases, irreversible damages that may occur during installation or use. The membrane shall be deployed on the site with care and then stretched according to its characteristics, the dimensions of the panel, and the climatic conditions of the location. The manufacturer's instructions shall be followed upon purchase to achieve the declared reference service life.

End of life (C1-C4)
Two different disposal routes were modelled as 100% scenarios. In the 1st scenario, the STFE 50 product is 100% landfilled. In the 2nd scenario it is 100% incinerated (without energy credit).
During the dismantling of the membranes in Module C1 it is assumed, based on the Federal Environment Agency (2012)

that the process requires diesel-driven machinery, and approximately 0.01 kg diesel is required to dismantle 1 kg of product.
The Transport for disposal (Module C2) is estimated at 100 kg/km in each case.

Name	Value	Unit
Collected as mixed construction waste	0.85	kg
Landfilling (1nd scenario)	0.85	kg
Incineration (2nd scenario)	0.85	kg

5. LCA: Results

The present results in the impact categories refer to the potential environmental impacts in an analysis period of 100 years. Long-term emissions (> 100 years) are not considered in the impact assessment.
Note: Impact assessment results are relative statements only and do not provide information on impact category endpoints, threshold exceedances, margins of safety, or on risks.

Two different disposal routes were modelled as 100% scenarios. In the 1st scenario, the STFE 50 product is 100% landfilled (C3/1; C4/1) and in the 2nd scenario, it is 100% incinerated (C3/2; C4/2).

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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m2 STFE 50 membrane

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
GWP-total	kg CO_2 eq	7.48E+00	4.93E-03	7.4E-03	2.19E-03	9.27E-01	1.24E-02	0	-4.49E-02
GWP-fossil	kg CO_2 eq	7.48E+00	4.65E-03	7.33E-03	2.17E-03	9.27E-01	1.24E-02	0	-4.49E-02
GWP-biogenic	kg CO_2 eq	0	0	0	0	0	0	0	0
GWP-luluc	kg CO_2 eq	3.13E-03	2.75E-04	6.74E-05	1.64E-05	1.4E-05	3.85E-05	0	-1.77E-06
ODP	kg CFC11 eq	4.98E-06	3.87E-15	9.47E-16	3.64E-15	-2.53E-12	3.15E-14	0	-2.45E-13
AP	mol H^+ eq	1.93E-02	2.25E-05	4.67E-05	1.13E-05	-2.47E-04	8.78E-05	0	-4.05E-05
EP-freshwater	kg P eq	1.01E-04	1.09E-07	2.66E-08	7.4E-09	-5.01E-07	2.49E-08	0	-3.31E-08
EP-marine	kg N eq	4.71E-03	5.37E-06	2.29E-05	5.21E-06	-7.14E-05	2.27E-05	0	-1.63E-05
EP-terrestrial	mol N eq	5.12E-02	6.82E-05	2.54E-04	5.75E-05	-4.62E-04	2.5E-04	0	-1.74E-04
POCP	kg NMVOC eq	1.51E-02	1.8E-05	4.42E-05	1.41E-05	-1.96E-04	6.85E-05	0	-4.49E-05
ADPE	kg Sb eq	5.35E-06	1.96E-09	4.79E-10	2.33E-09	-2.35E-08	5.71E-10	0	-2.02E-09
ADPF	MJ	1.54E+02	4.05E-01	9.91E-02	4.28E-02	-6.28E+00	1.65E-01	0	-1.29E+00
WDP	m^3 world eq deprived	1.4E+00	3.59E-04	8.79E-05	4.23E-04	1.22E-01	1.36E-03	0	-2.29E-03

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 m2 STFE 50 membrane

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
PERE	MJ	3.14E+01	2.95E-02	7.21E-03	3.98E-03	-1.79E+00	2.69E-02	0	-1.64E-01
PERM	MJ	0	0	0	0	0	0	0	0
PERT	MJ	3.14E+01	2.95E-02	7.21E-03	3.98E-03	-1.79E+00	2.69E-02	0	-1.64E-01
PENRE	MJ	1.48E+02	4.06E-01	9.95E-02	4.29E-02	-5.62E-01	5.88E+00	0	-1.29E+00
PENRM	MJ	5.72E+00	0	0	0	-5.72E+00	-5.72E+00	0	0
PENRT	MJ	1.54E+02	4.06E-01	9.95E-02	4.29E-02	-6.28E+00	1.65E-01	0	-1.29E+00
SM	kg	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	1.05E-01	3.23E-05	7.9E-06	1.22E-05	2.12E-03	4.17E-05	0	-2.73E-04

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 m2 STFE 50 membrane

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
HWD	kg	1.43E-08	1.26E-12	3.08E-13	-1.11E-13	-3.8E-10	3.59E-12	0	-5.29E-11
NHWD	kg	1.47E-01	6.19E-05	1.52E-05	1.13E-05	2.61E-01	8.25E-01	0	-3.44E-04
RWD	kg	7.52E-03	7.6E-07	1.86E-07	5.75E-07	-5.01E-04	1.88E-06	0	-2.05E-04

CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	1.51E-01	0	0	0	0	0	0	0
EEE	MJ	2.85E-01	0	0	0	0	0	0	0
EET	MJ	5.81E-01	0	0	0	0	0	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 m2 STFE 50 membrane

Parameter	Unit	A1-A3	C1	C2	C3/1	C3/2	C4/1	C4/2	D
PM	Disease incidence	2.07E-07	1.82E-10	1.74E-10	2.15E-10	-2.19E-09	1.08E-09	0	-3.63E-10
IR	kBq U235 eq	1.49E+00	1.13E-04	2.78E-05	9.26E-05	-8.42E-02	2.17E-04	0	-5.24E-02
ETP-fw	CTUe	8.08E+01	2.87E-01	7.04E-02	2.88E-02	-8.74E-01	9E-02	0	-3.09E-01
HTP-c	CTUh	1.9E-09	5.88E-12	1.44E-12	6.28E-13	-5.87E-11	1.39E-11	0	-8.03E-12
HTP-nc	CTUh	8.06E-08	3.07E-10	8.2E-11	3.29E-11	1.28E-08	1.52E-09	0	-2.46E-10
SQP	SQP	5.51E+01	1.69E-01	4.14E-02	1.15E-02	-1.1E+00	4.01E-02	0	-6.73E-02

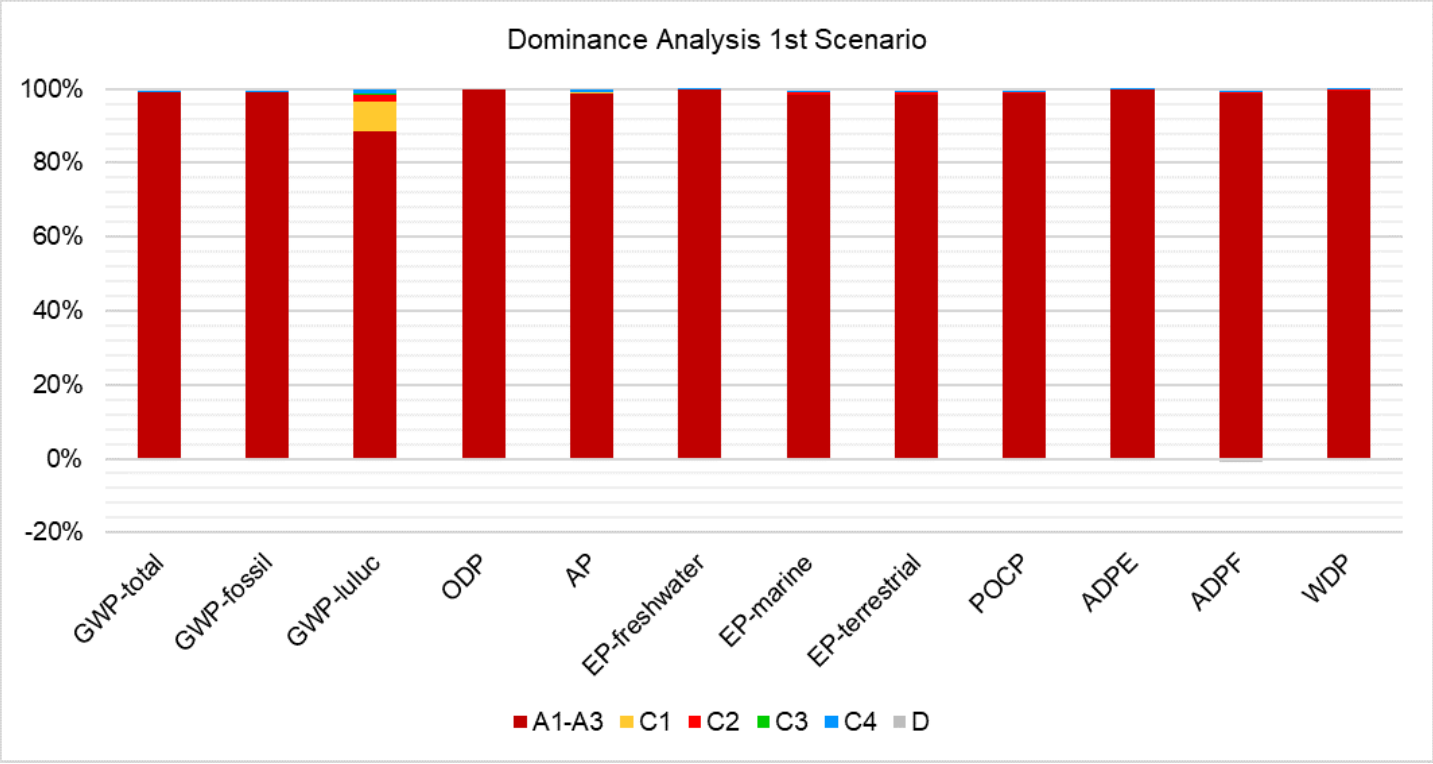
PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

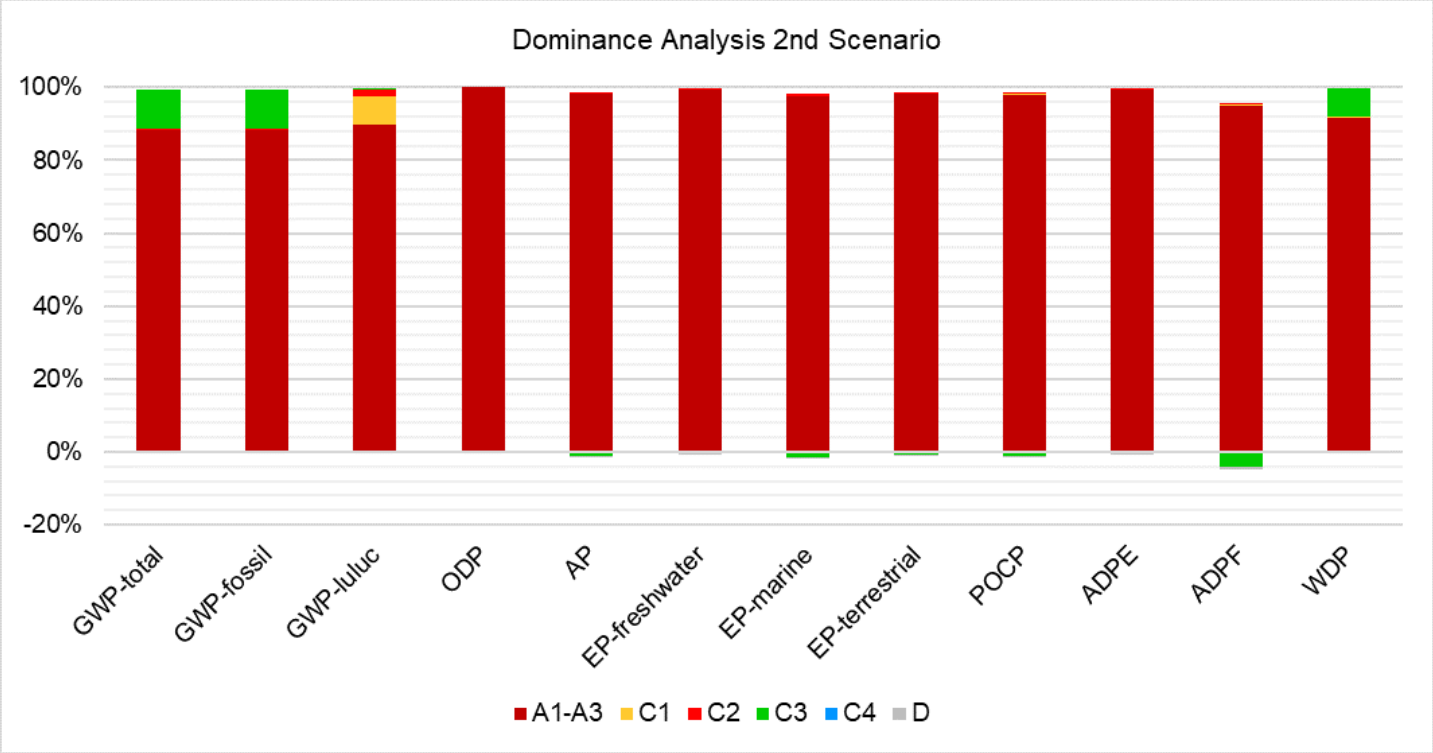
Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”. This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure 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.

This EPD was created using a software tool.

6. LCA: Interpretation





The production stage (module A1-A3) clearly dominates the LCA results for both scenarios. The main environmental impacts are in all categories located in module A1-A3. For almost all impact categories, the highest precursor of impact is the use of the fluoropolymer as a raw material in A3. Exceptions for this tendency are found in the impact categories EP-freshwater, ADPE, WDP, NHWD, and RWD. In these categories, however, the fluoropolymer remains as the second highest precursor of impact. The production of polyarylate yarn is the highest precursor of environmental impact for the categories EP-freshwater and ADPE. The impact category NHWD is dominated in module C4 by the disposal in landfill of the product in End-of-Life. The use of electric energy from the French residual mix is the highest precursor of environmental impact in the RWD impact category. The use of tap water as auxiliary during the production process is the highest precursor of WDP.

7. Requisite evidence

The STFE 50 has poor VOC emissions and is certified *Greenguard* and *Greenguard Gold* (label on VOC emissions). The STFE 50 complies with REACH regulations. It does not contain substances from the SVHC (Substances of High Concern) candidate list (list updated on the 14th of June 2023) at a rate greater than 0.1% by weight.
No leaching test was performed.

8. References

Standards

EN 15804
DIN EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

CEN/TS 19102:2023
Design of tensioned membrane structures – Technical specification

DIN EN 1875-3:2023-04
Rubber- or plastics-coated fabrics - Determination of tear strength - Part 3: Trapezoidal method (five-highest-peak calculation); German version EN 1875-3:2023

DIN 53363:2003-10
Testing of plastic films - Tear test using trapezoidal test specimen with incision

DIN EN ISO 2286-1:2017-01
Rubber- or plastics-coated fabrics - Determination of roll characteristics. Part 1: Methods for determination of length, width and net mass

DIN EN 410:2011
Glass in building - Determination of luminous and solar characteristics of glazing

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

ISO 1421:2016
Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break

ISO 9001
DIN EN ISO 9001:2015, Quality management systems – Requirements

ISO 10640
Plastics - Methodology for assessing polymer photoageing by

FTIR and UV/visible spectroscopy

ISO 14001
DIN EN ISO 14001:2015, Environmental management systems - Requirements.

ISO 14025
DIN EN ISO 14025:2011, Environmental labels and declarations — Type III environmental declarations — Principles and procedures

ISO 15686-1
Buildings and constructed assets - Service life planning - Part 1: General principles and framework

Further References

Ecoinvent
Ecoinvent database v.3.9.1. Ecoinvent, Technoparkstrasse 1, 8005 Zurich, Switzerland.

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General Instructions for the EPD programme of Institut Bauen und Umwelt e.V., Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021www.ibu-epd.comIBU 2016

Product Category Rules Part A
Institut Bauen und Umwelt e.V. Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report Version 1.8 (04.07.2019)

Product Category Rules Part B
Institut Bauen und Umwelt e.V. Requirements on the EPD for Structural Membranes. Version 1 (05.01.2024)

REACH Candidate List
Candidate List of substances of very high concern for Authorisation (published in accordance with Article 59(10) of the REACH Regulation). Available online at https://echa.europa.eu/candidate-list-table

Sphera Solutions Inc.
LCA for experts (GaBi) Software for LCA version 10.7.1.28. GaBi Professional Database Service pack 2023.2. GaBi Database data-on-demand. Sphera Solutions, Inc. 130 E Randolph Street #1900, Chicago, IL 60601.

UL
GREENGUARD Certification. UL GREENGUARD Certification for low chemical emission products. Available online at: https://www.ul.com/services/ul-greenguard-certification

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Sustainability & Comfort
Working Group TensiNet

EPD 17 - 18 Vector Foiltec

ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	Vector Foiltec GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-VFA-20170121-IBE1-EN
Issue date	15/01/2018
Valid to	14/01/2023

Texlon®-System with Fluon® ETFE FILM

Vector Foiltec GmbH

Asahi Glass Co., Ltd.

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com

1. General Information

Vector Foiltec GmbH,
Asahi Glass Co., Ltd.

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Declaration number
EPD-VFA-20170121-IBE1-EN

This Declaration is based on the Product Category Rules:
ETFE construction element, 07.2014
(PCR tested and approved by the SVR)

Issue date
15/01/2018

Valid to
14/01/2023

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

Dr. Burkhart Lehmann
(Managing Director IBU)

Texlon® System with Fluon® ETFE FILM

Owner of the Declaration
Vector Foiltec GmbH
Steinacker 3
28717 Bremen
GERMANY

Declared product / Declared unit
1 m² of an average TEXLON® foil cushion incl. frame with of 4.56 kg/m² mass per unit area. (see 3.1 declared unit)

Scope:
This EPD refers to individual building elements manufactured from ethylene tetrafluoroethylene (ETFE) and aluminium frame. It is valid for the German production facility. The building elements are manufactured by Vector Foiltec GmbH (Germany) with Fluon® ETFE FILM from Asahi Glass Co., Ltd. (AGC Asahi Glass) (Japan) and traded under the brand trade name Texlon®. The entire product chain associated with manufacturing of the ETFE building elements includes the following companies:

- Asahi Glass Co., Ltd. (ETFE granulate and foil)
- Vector Foiltec GmbH (ETFE foil cushions and building elements Texlon®)

The Texlon® systems are designed, fabricated and packaged for specific projects. This EPD declares the life cycle analysis (LCA) for a representative product.

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.

Verification

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

Matthias Schulz
(Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

The Texlon® System is based on the following principle: pneumatically stabilised foil elements are fixed to a sub-structure by means of a high-quality aluminium frame system. The system can consist of between two and five layers of ETFE foil (ethylene tetrafluoroethylene) depending on the building physics, static or design requirements and specifications. The g-values and U-values are determined by the number of layers and also the type of coating used. The ETFE foil thickness varies between 80 µm and 500 µm depending on the structural construction requirements. The individual layers are welded together at the edges and stabilised to approximately 220 Pa (220 N/m²) by means of a low-pressure air system.

The declared product in this EPD is an average system based on a typical 3-layer system with the following foil set up:

Outer: 200 µm // Middle: 100 µm // Inner: 200 µm

For use and application of the product, the respective national provisions at the place of use apply, in Germany for example the Building Codes of the countries and the corresponding national specifications.

2.2 Application

Texlon® systems are building elements used for cladding roofs and facades. The Texlon® system is suitable for new buildings and refurbishment projects looking to create additional spaces (such as courtyards). Well known examples of Texlon® include:

- Retail & Entertainment: The Avenues, Kuwait; Khan Shatyr Entertainment Center, Kazachstan
- Biospheres: Ecological Park, Heixidao, China
- Zoological Gardens: Zoo Emmen, the Netherlands; Arnhem Zoo Mangroove Hall, the Netherlands
- Stadia: National Swimming Center in Beijing, China; Olympic Stadium London, Refit, Great Britain; Baku Stadium, Azerbaijan; Forsyth Barr Stadium in Dunedin, New Zealand
- Airports: Gateway in Kuala Lumpur, Malaysia
- Exhibitions: Floating Pavilion in Rotterdam, the Netherlands
- Gallerias: Galleria Poznan, Poland
- Swimming Baths: Piscine in Champsaur, France
- Movable Roof: Sports Hub, Singapore
- Shopping Mall: Kocaeli Shopping Mall in Izmir, Turkey

2.3 Technical Data

The following technical data must indicate the relevant standard for the declared product at the time of delivery. Unless otherwise stated this data refers to an ETFE foil with a thickness of 200 µm.

Constructional data

Name	Value	Unit
Melting range /Melting point in accordance to /ASTM D 4591-07/	265±10	°C
Grammage	0.35	kg/m²
Tensile strength in accordance to /DIN EN ISO 527-3/	> 50	N/mm²
Tensile stress at 10% strain in accordance to /DIN EN ISO 527-3/	> 18	N/mm²
Tensile stress at break in accordance to /DIN EN ISO 527-3/	> 350	%
Tear Resistance in accordance to /DIN-EN-1875-3/	> 400	N/mm
Weld strength in accordance to /DIN 527-1/	≥ 33	N/mm²
Total energy transmittance in accordance to /ISO 15099/ 3 layers ETFE	75±5	%
Weathering resistance in accordance to /ISO 4892-1/ and /ISO 4892-2/ 3 layers ETFE	no optical or mechanical changes	-

Products for which no legal harmonization provisions of the EU exist: Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (No CE-marking).

2.4 Delivery status

From an economic and technical perspective, the maximum ETFE cushion dimensions span ≤ 3.7 metres (width) by ≤ 40 metres (length). The cushion area should not exceed 120 m².

2.5 Base materials / Ancillary materials

The essential base products are Fluon® ETFE FILM, F16.2 aluminium frame and silicone gaskets.

Primary products	Mass-%
Aluminum frame	71,9%
ETFE film	19,2%
Silicone gasket	8,1%
PP Keder	0,8%
ETFE valves	< 0,05%
Total	100%

AGC Fluon® ETFE FILM: Fluon® ETFE FILM is a flexible and strong fluorinated copolymer foil. These foils are transparent over the entire solar range. They can be clear, printed or dyed.

ETFE valves: These valves are small parts made of the same base material as the foil but they are not transparent and display a lower purity level.

Aluminium frames: The aluminium frame comprises of an extruded base element and a cap.

Polypropylene (keder) ropes: The cord edge welding comprises of flexible polypropylene (keder) ropes with a diameter of ~ 8 mm.

Silicone seals: Silicone seals are made from a waterproof rubber silicone material.

None of the substances used for manufacturing of the Texlon® foil cushions are included in the SVHC list of candidates or in Annex XIV of the EU /REACH/ Directive 1907/2006. No fire retardants, plasticizers or biocides are used.

2.6 Manufacture

Manufacture of ETFE granulate:

Raw materials and monomers: R22 (Chlorodifluoromethane) is produced from fluorite and natural gas. The perfluorinated monomers such as TFE (Tetrafluoroethylene) is produced from R22 by pyrolysis process. The TFE monomer is distilled in order to obtain high purity for the polymerization process.

Polymerization: The TFE monomer is polymerized in the autoclave together with ethylene and additives and the ETFE polymer is produced. The residual monomers are recovered and reused for the

polymerization.

Processing: The ETFE polymer is granulated and the ETFE beads are obtained. The beads are molten and pelletized with an extruder. The pellets are delivered to the customers and the film production process after quality check.

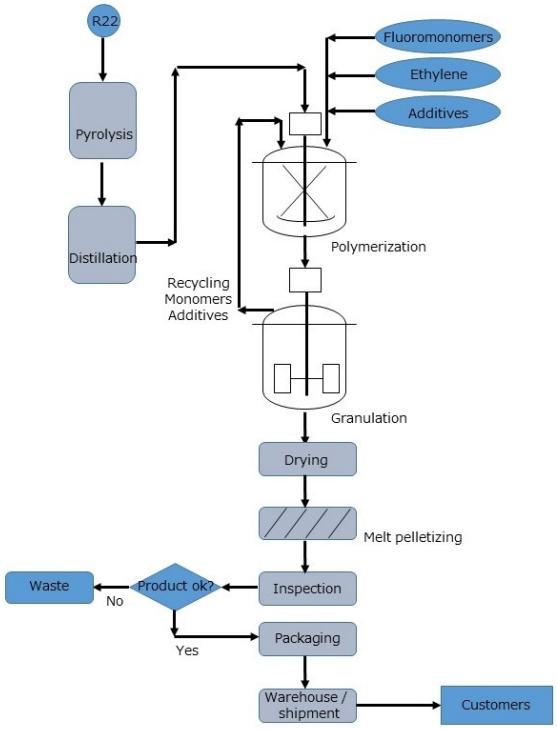


Figure : Flow chart of the ETFE production at AGC

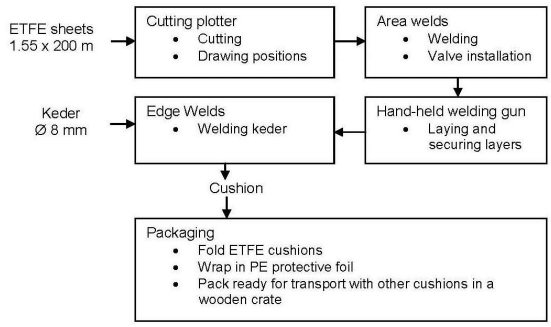
Production of AGC Fluon® ETFE FILM:

Fluon® ETFE FILM are manufactured by melt extrusion method.
Fluon® ETFE resin is fed into the extruder from the hopper.
The Fluon® ETFE resin is melted in the extruder and transferred to the die by the screw in the extruder.
Melted resin is extruded through the die onto the cooling roll and is formed into the foil.
The foil is carried on the rollers and the thickness or appearance of the foil are inspected by the inspection devices. After that, the edges of the foil are trimmed and finally the foil is rolled onto the core.

Fabrication of the foil cushions:

The foil rolls are produced in 1550 mm width and a length of between 100 to 500 metres, depending on the foil thickness. The rolls are cut in line with the project specifications. The individual cushion sections are cut to size on a plotter table, where also the position of other components like valves are drawn. In order to create larger areas, the individual sheets are welded together (area welding) and subsequently the valves are installed. The welded foil sheets are placed on top of each other in two or more layers and welded in place by means of a hand-held welding tongs. Edge welding involves welding a polypropylene keder rope along the perimeter of the foil package in order to seal the cushion and to make it airtight.

The large cushion is folded to form a sheet of approx. 30 cm in width and 2.5 metres in length and wrapped in a protective polyethylene foil. Between three to six cushions are placed in a wooden box in preparation for shipping. The other components of the Texlon® system (aluminium profiles, keder rails, gaskets, screws) are packaged separately for shipping.



2.7 Environment and health during manufacturing

Appropriate measures are taken in accordance with the current technology. To date, no environmental pollution as a direct result of the processing of the declared products is known.

The Texlon® quality management system at Vector Foiltec was implemented for internal monitoring. The QM system is based on /ISO 9001/ and the provisions of the general construction approval and/or the Building Regulation in individual cases. Over and above risk assessment and education for safety supervision by the body for social insurance against occupational accidents (SOZV), Vector Foiltec has commissioned an external consultant for training the employees on health and safety as well as on industrial protection measures.

Regarding the health and safety management during the manufacturing of the ETFE foil, AGC focuses on evaluating the volatile gases. AGC measures and controls the concentration of organic compounds at the workplace during the extrusion of fluoropolymers according to the Ordinance on Prevention of Organic Solvent Poisoning (The Ministry of Labour Ordinance No. 36, September 30, 1972).

The AGC Group is pushing ahead with health and safety activities by creating an occupational health and safety management system (OHSMS) in each business division, and regularly discusses at CSR Committee on its policies, measures and progress.

Also, the Group is urging each of its manufacturing plants to obtain certification from a third party OHSMS body, and, in addition, is taking steps to improve the management level of health and safety through internal audits conducted by the auditing division and each business division. Furthermore, the Group holds a Global Occupational Health and Safety Symposium on a regular basis with the participation of health and safety supervisors from various countries and regions, thereby disseminating best practices and deploying horizontal development at each manufacturing plant.

In 2013, in order to facilitate the integrated management of EHSQ (Environment, Occupational Health & Safety, and Quality) efforts across the Group as a whole, the AGC Group constructed and now operates the EHSQ Management System.

2.8 Product processing/Installation

Prior to installation of the roof areas, a risk assessment has to be performed in accordance with §5 of the German Occupational Safety Act (ArbSchG, §5):

a Environment-related risks
- Mechanical hazard
- Electrical hazard
- Hazardous substances
- Biological hazard
- Fire and explosion hazard
- Thermal hazard
- Hazards attributed to physical impact
- Hazard/Load due to working environment conditions
- Physical strain
- Other hazards/risks
- Psychological strain

b Planning the access equipment

c Site related inductions

In areas where there is a risk of falling, trained personnel are equipped with personal protective equipment (PPE) as well as working and safety ropes. In the event of tools or materials falling, the hazardous areas under the installation areas are secured.

2.9 Packaging

The packaging materials (wooden crates, polyethylene foil) are thermally recycled. The waste incurred can be allocated to the following waste codes /AVV/ 2012:

15 01 03: Wood
17 02 03: Plastic

2.10 Condition of use

No significant changes in the product characteristics are expected during its design life. To compensate for deviations in cushion pressure caused by changing external conditions (temperature, wind pressure loads/wind suction loads), the cushions are continuously supplied by one or more inflation units. The size of the roof determines the number and dimension of inflation units required. The units are controlled by a pressure sensor and internal pressure is maintained within a range between 180 Pa and 250 Pa. An average output of 60 W is required for a roof area of 1000 m². Under certain environmental climate conditions an air drier can be used.

2.11 Environment and health during use

In accordance with the evidence outlined in section 7, emissions to ambient air during the use phase are below the threshold values set by the /AgBB/ scheme.

2.12 Reference service life

Guaranteed service life is 25 years (up to 50 years are possible).

2.13 Extraordinary effects

Fire
Reaction to fire
In accordance with EN 13501 – 1, Fluon® ETFE FILM is specified as follows:

Fire safety

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s1

Water

ETFE foil is not effected by water. This is shown by a leaching test done in Norway /PD/CEN TS 16637 PD/CEN TS 16637-2/.

Mechanical destruction

The foils and cushions are extremely resistant to exterior pressure and tensile loads owing to their extraordinary elongation properties.

In the case of fire, explosions or even extreme hailstones, the system is extremely fault-tolerant and is resistant to consequential damage. The cushions can, however, be damaged by direct mechanical influences (or vandalism) with sharp or pointed items. Destruction of the exterior layer of foil does not lead to system failure. For example if the upper foil of a three-layer systems is damaged, a two-layer system is retained and the interior chamber remains protected from environmental influences. Minor damage can be easily repaired using Texlon® tape.

2.14 Re-use phase

As a general rule, the aluminium caps and base profiles of the Texlon® system can be re-used for new buildings and/or refurbishment projects. These components are usually recycled (statistic value for buildings: 85%).

Texlon® cushions that have reached the end of their useful phase as well as ETFE offcuts are recycled by external companies. ETFE valves and ETFE flexible pipes are produced from recycled ETFE foils. These parts are used for production of new Texlon® ETFE systems. Recycling is currently only carried out in Europe but will be extended to other regions in the near future. For the time being, waste in other countries is thermally recycled.

2.15 Disposal

The waste incurred can be allocated to the following waste codes:

17 02 03: Plastic
17 04 02: Aluminium

17 09 04: Mixed construction and demolition waste with the exception of waste covered by 17 09 01, 17 09 02 and 17 09 03

Silicone seals are thermally recycled but alternative recycling possibilities are currently being examined.

Polypropylene is recyclable but is usually thermally recycled.

2.16 Further information

Additional information is available on the Vector Foiltec homepage: www.vector-foiltec.com.

3. LCA: Calculation rules

3.1 Declared Unit

This declaration refers to the production of 1 m² of an average TEXLON® foil cushion incl. frame with a total mass of 4.56 kg/m² representing the average production of Vector Foiltec in 2015 converted into a 3-layer-system.

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Conversion factor to 1 kg	0.219	-

3.2 System boundary

The EPD of the TEXLON® system, developed in this study, includes the production as well as installation, use stage and the End of Life of the product.
It represents a "cradle-to-gate" EPD with two options for foil cushion waste disposal at the end of life:

1. Waste incineration for ETFE foil and recycling of aluminium (EoL scenario 1)
2. Recycling of ETFE foil and aluminium (EoL scenario 2)

In both EoL scenarios the silicon seal is incinerated, while the aluminium frame is recycled.

The life cycle stages are as following:

- Production (A1 - A3): including the upstream chain associated with manufacturing of the preliminary products, transport thereof to the respective plant and loads from producing the granulate, foil and foil cushions including processing of production wastes
- Transport to the construction site (A4): average distances by truck, ship and/or plane
- Installation on the construction site (A5): energy for inflating foil cushions as well as disposal of packaging
- Energy consumption during use (B6): energy requirements for maintaining the interior cushion pressure
- Transport to disposal/recycling by truck (C2)
- Waste treatment for recycling (C3): processing foil waste for EoL scenario 2
- Disposal (C4): incineration of seals and for EoL scenario 1 incineration of foil cushions
- Benefits and loads beyond the product system boundary (D): Regarding scenario 1: the energy substitution for incineration of packaging waste, ETFE cushions incl. silicone seals, keder etc. and material recycling of aluminium profiles. Regarding scenario 2: the material recycling of aluminium profiles and ETFE foil plus energy benefit for plastic parts.

3.3 Estimates and assumptions

Estimates need to be made for the following cases:

- Printing of foil: The composition of the water-based varnish is estimated.
- Aluminium frame: Secondary material is considered in form of 45% secondary aluminium in the frame as conservative approach, due to the fact that exact information of the supplier is not available.
- ETFE material recycling (scenario 2): The recycled granulate cannot be used to produce foil cushions but is used to produce valves. This down-cycling is depicted via a correction factor for the material benefit based on current market prices.

3.4 Cut-off criteria

The cut-off criteria for including or excluding materials, energy and emissions data of the study are as follows:

Packaging waste (like foil, paper) of pre-products is not considered in this study due to negligible amounts (< 0.1%).
Besides the packaging waste within A1-A3 all available data from production processes are considered, i.e. all raw materials used, utilised thermal energy and electric power consumption as well as emissions and waste management processes using best available LCI datasets.

Thus, most materials and energy flows contributing less than 1% of mass or energy are considered.
Transport processes for the packaging materials are neglected.
Production of capital equipment, facilities and infrastructure required for manufacture are outside the scope of this assessment.

The sum of the excluded material flows does not exceed 5% of mass, energy or environmental relevance.

3.5 Background data

The /GaBi ts/ software was used to model the life cycle associated with Texlon® ETFE systems. The basic data in the GaBi database is applied for energy,

transport, auxiliary products and preliminary products. It had been revised in 2016.

The headquarters of Vector Foiltec is in Germany, so the LCA for the TEXLON® element production is prepared under German boundary conditions. The ETFE foil production takes place in Japan and is considered as such. The electricity consumption for installation (A5) and utilization (B6) is related to Europe as an exemplified reference region.

3.6 Data quality

Overall the data quality can be described as good. The primary data collection has been done thoroughly, all relevant flows are considered.
To ensure consistency, all primary data are collected with the same level of detail, while all background data are sourced from the GaBi databases. Allocation and other methodological choices are made consistently throughout the model.

3.7 Period under review

Vector Foitec has provided production data based on the yearly average of 2015.
The printing process, raw material transport (beside ETFE foil; now Japan) and packaging material data have been collected in 2012 in the context of a former EPD study /Vector Foiltec EPD 2014/.

AGC has provided production data on yearly basis of 2014.

3.8 Allocation

The production process does not deliver any co-products. In this respect, the applied LCA model does not contain an allocation with the exception of a small amount of product waste that is recycled externally. Here a market allocation serves as calculation base for the potential benefits related to avoided burden of primary ETFE material.

Nevertheless, the overall Vector Foiltec production comprises further products beside the TEXLON construction elements with AGC Fluon® ETFE FILM (e.g. projects with other foil types and foil suppliers). Data for thermal and electrical energy as well as auxiliary material refer to the declared product. During data collection the allocation is done via mass.

A market price allocation serves as basis for the calculation of the potential avoided burden for virgin ETFE foil production in case of material recycling in End of Life (scenario 2).

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. GaBi ts serves as background database for the calculation /GaBi ts/ .

4. LCA: Scenarios and additional technical information

The following information forms the basis for the declared modules. It can be used to develop specific scenarios in the context of a building evaluation if modules are not declared (MND).

Transport to site (A4)

Average distance per mode of transport refers to global international transport data (2012).

Name	Value	Unit
Litres of fuel truck	0.00156	l/100km
Transport distance truck	1779	km
Capacity utilisation (including empty runs) truck	70	%
Litres of heavy fuel oil ship	0.00147	l/100 km
Ship transport distance ship	14123	km
Ship capacity utilisation (incl. empty runs) ship	48	%
Litres of kerosene airplane	0.0190	l/100 km
Air transport distance airplane	10221	km
Air capacity utilisation (incl. empty runs) airplane	66	%

Installation Process (A5)

Name	Value	Unit
Auxiliary	0	kg
Water consumption	0	m^3
Other resources	0	kg
Electricity consumption per a*m^2	0.00018	kWh
Other energy carriers	0	MJ
Material loss	0	kg
Output substances following waste treatment on site	0	kg
Dust in the air	0	kg
VOC in the air	0	kg

The amount of installation waste varies and is not declared within this EPD. For calculation of the environmental impact of the ETFE construction element including a certain amount of installation waste the values for the production stage (A1-A3) and end of life (C3, C4 and D) have to be multiplied with the amount of waste (e.g. 2% installation waste, factor 1.02)

Reference service life

Name	Value	Unit
Life Span according to BBSR	-	a
Life Span according to the manufacturer	25 - 50	a

Guaranteed service life is 25 years.

Operational energy (B6)

Name	Value	Unit
Electricity consumption per a*m^2	0.274	kWh

End of Life (C1-C4)

Conservative estimate for transport to EoL (scenario 2): 1,000 km for transport in Europe (material recycling is currently only performed in Europe). Shorter transport distance for EoL scenario 1.

Name	Value	Unit
Collected separately (total product)	4.56	kg
Collected as mixed construction waste	0	kg
Reuse	0	kg
Recycling Scenario 1+2: Aluminium	3.27	kg
Energy recovery: Scenario 1+2: Seals	0.37	kg
Recycling: Scenario 2: foil cushions	0.914	kg
Energy recovery: Scenario 1: foil cushions	0.914	kg
Landfilling	0	kg

Re-use, recovery and recycling potential (D), relevant scenario information
Module D includes benefits from energy substitutions from incineration processes of packaging waste (A5), seals, and the foil cushions in scenario 2 (C4) and from recycling the aluminum frames as well as foil cushions in scenario 1. A waste incineration plant with an R1 value of < 0.6 is assumed.

In case of material recycling the avoided burden to produce virgin material is considered as benefit (EoL scenario 2).

5. LCA: Results

The following table depicts the results of the indicators concerning the estimated impact, use of resources as well as waste and other output flows in relation to 1 m² of Texlon® system.
C2/1, C3/1, C4/1 and D/1 refer to incineration of ETFE.
C2/2, C3/2, C4/2 and D/2 refer to material recycling of ETFE.
The aluminium frame is recycled in both scenarios. The silicon sealing is assumed to be incinerated.

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MNR	MNR	MNR	X	MND	MND	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² Texlon-System

Parameter	Unit	A1-A3	A4	A5	B6	C2/1	C2/2	C3/1	C3/2	C4/1	C4/2	D/1	D/2
GWP	[kg CO_2-Eq.]	58.20	1.11	0.58	0.12	0.06	0.11	0.00	0.58	1.65	0.38	-14.50	-32.81
ODP	[kg CFC11-Eq.]	2.30E-4	6.07E-14	2.05E-14	5.40E-12	1.99E-14	3.64E-14	0.00E+0	2.11E-12	5.61E-13	1.37E-13	-5.44E-11	-1.30E-4
AP	[kg SO_2-Eq.]	1.43E-1	3.43E-3	4.95E-5	3.48E-4	1.40E-4	2.57E-4	0.00E+0	8.64E-4	1.84E-2	5.23E-4	-7.36E-2	-9.39E-2
EP	[kg $(PO_4)^{3-}$-Eq.]	1.02E-2	7.01E-4	1.08E-5	3.15E-5	3.35E-5	6.13E-5	0.00E+0	1.71E-4	6.55E-5	3.21E-5	-4.25E-3	-5.66E-3
POCP	[kg ethene-Eq.]	1.24E-2	2.26E-4	4.27E-6	2.22E-5	-4.52E-5	-8.27E-5	0.00E+0	5.94E-5	2.81E-5	9.69E-6	-4.03E-3	-6.47E-3
ADPE	[kg Sb-Eq.]	1.42E-4	4.22E-8	6.35E-9	4.86E-8	4.77E-9	8.72E-9	0.00E+0	2.81E-7	2.23E-7	2.03E-8	-7.12E-6	-2.12E-5
ADPF	[MJ]	563.00	15.40	0.10	1.30	0.82	1.50	0.00	5.48	0.72	0.19	-159.00	-287.00

Caption	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

RESULTS OF THE LCA - RESOURCE USE: 1 m² Texlon-System

Parameter	Unit	A1-A3	A4	A5	B6	C2/1	C2/2	C3/1	C3/2	C4/1	C4/2	D/1	D/2
PERE	[MJ]	131.00	0.10	2.91	0.73	0.04	0.08	0.00	3.07	0.16	0.03	-81.50	-84.30
PERM	[MJ]	2.89	0.00	-2.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	[MJ]	134.00	0.10	0.02	0.73	0.04	0.08	0.00	3.07	0.16	0.03	-81.50	-84.30
PENRE	[MJ]	593.00	15.40	1.85	2.13	0.82	1.50	0.00	7.12	20.26	5.52	-191.00	-317.00
PENRM	[MJ]	21.15	0.00	-1.74	0.00	0.00	0.00	0.00	-14.11	-19.41	-5.30	0.00	0.00
PENRT	[MJ]	613.00	15.40	0.11	2.13	0.82	1.50	0.00	-6.99	0.85	0.22	-191.00	-317.00
SM	[kg]	1.48E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.79E+0	2.69E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m³]	3.59E-1	1.32E-4	1.35E-3	1.04E-3	7.64E-5	1.40E-4	0.00E+0	2.29E-3	5.12E-3	1.42E-3	-2.10E-1	-2.55E-1

Caption	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 – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² Texlon-System

Parameter	Unit	A1-A3	A4	A5	B6	C2/1	C2/2	C3/1	C3/2	C4/1	C4/2	D/1	D/2
HWD	[kg]	4.26E-3	5.96E-8	9.07E-11	8.64E-10	4.32E-8	7.90E-8	0.00E+0	4.83E-9	3.95E-8	1.50E-9	4.88E-3	4.87E-3
NHWD	[kg]	5.46E+0	1.67E-4	1.05E-3	1.40E-3	6.28E-5	1.15E-4	0.00E+0	1.39E-2	3.27E-1	4.94E-2	-3.83E+0	-3.89E+0
RWD	[kg]	2.30E-2	1.15E-5	4.56E-6	3.32E-4	1.12E-6	2.05E-6	0.00E+0	6.54E-4	4.95E-5	1.11E-5	-1.23E-2	-1.35E-2
CRU	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	[kg]	0.00	0.00	0.00	0.00	3.27	3.27	0.00	0.90	0.00	0.00	0.00	0.00
MER	[kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EEE	[MJ]	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	1.72	0.90	0.00	0.00
EET	[MJ]	0.00	0.00	1.95	0.00	0.00	0.00	0.00	0.00	4.09	0.35	0.00	0.00

Caption	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; EEE = Exported thermal energy

Note: The values in module B6 refer to a period of use of one year. When using the values in the building, they must be scaled to the building service life time.

6. LCA: Interpretation

Production (A1-A3)
The manufacturing of main materials cushion and aluminium frame are most important for the environmental profile of the TEXLON® system. The main influence of the cushion is visible in the categories global warming (**GWP**), ozone depletion (**ODP**), fossil resource depletion (**ADPf**) and primary energy consumption (**PENRT**). Relevant influence is visible in all other categories.
Aluminium frame is of significant influence in acidification (**AP**), eutrophication (EP) and abiotic resource depletion (**ADPe**) and of relevant influence in most of the considered impact categories (**GWP, POCP, ADPF** and **PENRT**). Minor or even negligible influence is given with regard to **ODP**.
All other processes and materials are of minor importance and show impact shares < 10% with the exception of -14% ODP-result during TEXLON production, which is caused by benefits related to ETFE recycling. Worth mentioning is cleaning of printed areas prior to welding of the ETFE foil by means of bio-ethanol, which causes a minor effect on **POCP**. Transport has some importance regarding **EP** and **AP**. The loads from energy consumption are of minor importance in **GWP** and the energy related categories **ADPf** and **PENRT**.

Whole life cycle
The main contributors - valid for all impact categories considered - are the preliminary processes (pre-chain) in A1 to 3, most notably the manufacturing of the cushion and aluminum profiles. Neither transport to site, energy consumption during installation, nor transport to disposal are of mentionable relevance.
It must be noted that the use stage impact (B6) relate to the effort per year. Assuming a service life of 25 years the impact of B6 would increase to 5 to 9% relating to the manufacturing impact (A1-A3). Potential benefits by means of energy and materials in module D do provide significant influence. Two scenarios are presented for the End of Life:

1. Energy recovery of the cushion
2. Material recycling of the cushion

The aluminium frame is recycled in both cases. Benefits are incurred for both scenarios but are higher for material recycling.

7. Requisite evidence

7.1 VOC emissions

Inspection of the AGC Fluon® ETFE FILM for VOC emissions in accordance with the AgBB scheme /AgBB 2015/ was carried out in September 2017 by the Environmental Institute Bremen (Bremer Umweltinstitut – Gesellschaft für Schadstoffanalysen und Begutachtung mbH).

Measurement conditions:

- Temperature: 23°C
- Area specific air flow rate: 0.36 m³/(m²h)
- Loading: 1.4 m²/m³

AgBB Results (28 days)

Name	Value	Unit
TVOC (C6 - C16)	18	µg/m³
Sum SVOC (C16 - C22)	< 1	µg/m³
R (dimensionless)	0.016	-
VOC without NIK	< 5	µg/m³
Carcinogenic Substances	< 1	µg/m³

Detection limit: 1 µg/m³

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/EN 15804/
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REACH: Registration, Evaluation, Authorization and Restriction of Chemicals, 2006

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ENVIRONMENTAL PRODUCT DECLARATION

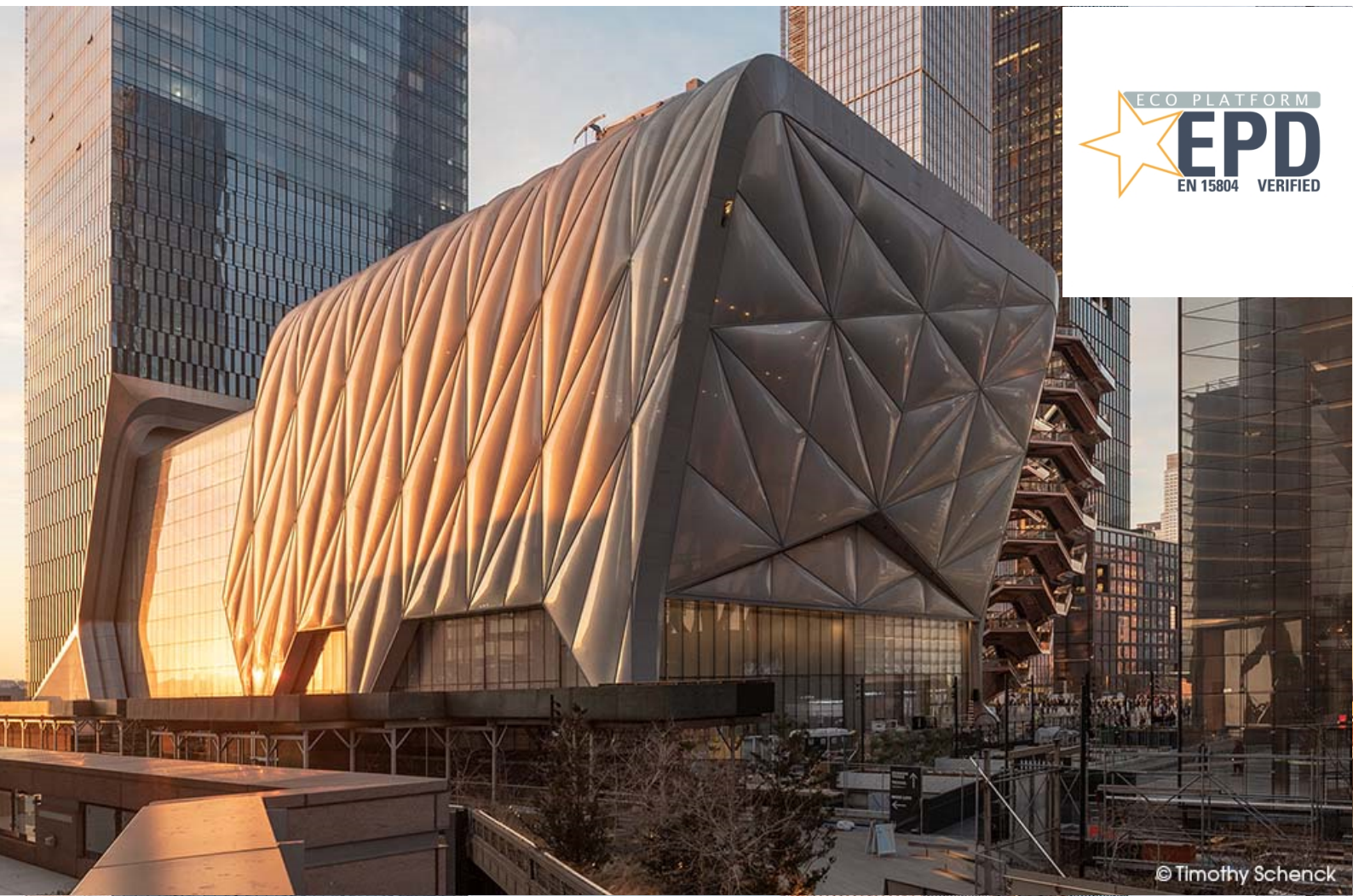
as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Vector Foiltec GmbH; Nowofol Kunststoffprodukte GmbH & Co. KG; Dyneon GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-DVN-20210122-IBJ2-EN
Issue date	19-07-21
Valid to	18-07-26

Texlon®-System

Vector Foiltec GmbH
Nowofol Kunststoffprodukte GmbH & Co. KG
Dyneon GmbH

www.ibu-epd.com | https://epd-online.com



1. General Information

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Nowofol Kunststoffprodukte GmbH & Co. KG
Dyneon GmbH

Texlon®-System

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Declaration number
EPD-DVN-20210122-IBJ2-EN

Declared product / declared unit
1 m² of a standard TEXLON®-System, with a weight per unit area of 3.89 kg/m².

This declaration is based on the product category rules:
ETFE construction element, 04.01.2019
(PCR checked and approved by the SVR)

Scope:
This EPD refers to individual building elements manufactured from ethylene tetrafluoroethylene (ETFE). It is valid for German production facilities. The building elements are manufactured by Vector Foiltec GmbH and traded under the brand trade name Texlon®.
The entire product chain associated with manufacturing the ETFE building elements includes the following companies:
Dyneon GmbH (ETFE granulate)
NOWOFOL Kunststoffprodukte GmbH & Co. KG (ETFE foil)
Vector Foiltec GmbH (ETFE cushions)

Texlon® foil cushions with frames are planned and produced on a project-specific basis. This EPD calculates the life cycle analysis (LCA) for a representative product.

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*.

Issue date
19-07-21

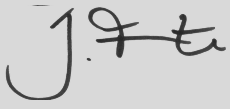
Valid to
18-07-26

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2010*
☐ internally ☒ externally

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

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))



Juliane Franze
(Independent verifier)

2. Product

2.1 Product description/Product definition

The Texlon®-System is based on the following principle:
Pneumatically stabilised foil elements are fixed to a sub-structure by means of a high-quality aluminium frame system. Depending on the building physics, the system can consist of between 2 and 5 layers of ETFE foil (ethylene tetrafluoroethylene). The g-values and U-values of the Texlon®-System are determined by the number of layers and also the type of coating used.

According to the structural engineering of the Texlon® system, the ETFE foil thickness varies between 80µm and 350µm.
The individual layers are welded together at the edges and stabilised to approximately 220 Pa (220 N/m²) by means of a low-pressure air system. This EPD is based on a typical 3-layer system with the following build up:

- Inner foil: 200 µm
- Middle foil: 100 µm
- Outer foil: 200 µm

The LCA for a representative product is calculated in this EPD.
The national regulations applicable in the place of use are also applicable to the use of the product. In Germany, for example, the building regulations of the relevant Federal State, and the technical provisions based on these regulations.

2.2 Application

Texlon®-cushions are building elements used for the construction of roofs and façades. The Texlon® system is suitable for new buildings and refurbishment projects.

2.3 Technical Data

This data refers to an ETFE foil with a thickness of 200 µm.

Constructional data

Name	Value	Unit
Melting range in accordance with ASTM D 4591-07	265±10	°C
Grammage in accordance with DIN EN ISO 536	0.35	kg/m²
Tensile strength in accordance with DIN EN ISO 527-1	> 40	N/mm²
Tensile stress at 10% strain in accordance with DIN EN ISO 527-1	> 18	N/mm²
Tensile stress at break in accordance with DIN EN ISO 527-1	> 300	%
Tear Resistance in accordance with DIN 53363	> 300	N/mm
Total energy transmittance in accordance with ISO 15099 (3-Lagen ETFE 200µm/100µm/200µm)	75±5	%
Weld strength in accordance with DIN 527-1	≥ 33	N/mm²
Weathering resistance in accordance with ISO 4892-1 sowie ISO 4892-2 (3-Lagen ETFE 200µm/100µm/200µm)	No changes to mechanical values	-

Performance values of the product in relation to its characteristics pursuant to the relevant technical regulation (no CE marking).

2.4 Delivery status

From an economic and technical perspective, maximum ETFE cushion dimensions of 3.7 metres (width) by 40 metres (length) are recommended. The cushion area should not exceed 120 m².
The large cushions are each folded into a strip which is approx. 30 cm wide and 2.5 m long, and wrapped in a protective film made of polyethylene. The foil package is delivered in a wooden box, with three to six other cushions.
The other components for the whole project (aluminium profiles, piping, seals, screws) are delivered as a complete package.

2.5 Base materials/Ancillary materials

The essential base products are Nowoflon® ET foil, frame material (F16.2 aluminium frame) and sealing materials. The following table shows the mass composition of the average product in 2019.

Composition of Texlon® System

Material	Mass percentage rate
Aluminium frame	64.9 %
ETFE foil	23.1 %
Silicone gasket	11.4 %
PP (piping) ropes	0.5 %
ETFE valves	0.05 %

Nowoflon®-ET-foil: Nowoflon® ET foil is a flexible and strong fluorinated copolymer foil. These foils are transparent over the entire solar range. They can be transparent, printed or dyed.

ETFE valves: These valves are small parts made of the same base material as the foil (ETFE), but they are not transparent and display a lower purity level (recycled).

Aluminium frame: The aluminium frame comprises an extruded base element, a cap and a channel rail.

Polypropylene (piping) ropes: The cord edge welding comprises flexible polypropylene (piping) ropes with a diameter of 6 mm to 8 mm.

Silicone seals: Silicone seals are made of a waterproof rubber-like silicone material.

1) The product contains substances which appear on the ECHA list of Substances of Very High Concern (SVHC) (as at 15.04.2021) in a mass proportion exceeding 0.1%: **no.**

2) The product contains additional CMR substances from category 1A or 1B, which are not on the candidate list, the mass proportion of which exceeds 0.1% in at least one part of the product: **no.**

3) Biocidal products have been added to this construction product, or it has been treated with biocidal products (and is therefore a treated product within the meaning of the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012)): **no.**

2.6 Manufacture

Manufacture of ETFE granulate:
Raw materials and monomers: Mineral fluorspar and natural gas are used to manufacture R22 (chlorine-di-fluoromethane), which is delivered by special road tankers. This is used to manufacture the perfluorinated monomers, such as tetrafluoroethylene (TFE), hexafluoropropylene (HFP) and perfluoro (propyl vinyl ether). These are in turn freed of ancillary products by means of distillation.

Polymerisation: These monomers, together with ethene, are converted to a thermoplastic dispersion by

means of emulsion polymerisation. Non-converted monomers and polymerisation auxiliaries such as emulsifiers are returned to the monomer plant after distillation and re-used.

Recycling (Reprocessing): The degassed thermoplastic dispersion is precipitated and the ensuing powder is dried. The low pourability of this powder means that it is difficult to process, and so it is melted to granulate prior to shipping. The granulate is subjected to quality control to determine whether the product complies with customer requirements.

Production of Nowoflon® ET foils:
ETFE foils are manufactured by cast film extrusion, whereby the granulate is fed into the extruder via a funnel. The granulate is melted in the extruder where it is also homogenised.
A downstream extrusion tool, known as a fishtail nozzle, extrudes the melted plastic onto a chill roller from which it is peeled off. The next stage involves an in-line inspection of the foil thickness and trimming of the foil edges. These trimmings are immediately ground down and redirected to the extrusion process by means of the funnel. The last step of the foil extrusion process involves winding the foil onto a cardboard roll.

Foil waste that cannot be directly recycled passes through a second stage on a regeneration machine before being processed into foil. The application of the recycled material is always subject to a so-called “down-cycling” process.

Fabrication of the foil cushions:
The foil rolls are produced in 1550 mm (width) and – depending on the foil thickness – a length of approximately 200 metres. The individual cushion sections are cut to size on a cutting plotter. The positions of other components, such as valves, are also drawn.

In order to create larger areas the individual sheets are welded together (area welding) and subsequently the valves are installed.

The welded foil sheets are placed on top of each other in two or more layers and welded in place by means of a hand-held welding tongs. Edge welding involves a polypropylene (piping) rope being welded along the edges of the cushions in order to seal the cushions (edge welding).

2.7 Environment and health during manufacturing

The appropriate measures are taken in accordance with the current state of the art.

The Texlon® quality management system was created for the purpose of internal monitoring. It is based on *ISO 9001* and the provisions for admission or approval in individual cases.

In addition, Nowofol's energy management is *ISO 50001* certified.

Within the framework of the Occupational Health and Risk Management System (OHRIS), Dyneon is certified under register number 09-00015 (*OHRIS 2009*)).

2.8 Product processing/Installation

The Texlon® System is installed on the basis of the procedural instructions for the installation of Texlon® Systems, and includes the following work steps:

- The client or their construction management team approves the construction site for the installation
- Pre-installation of seals, hammer head screws, safety nets and profiles on the site, in coordination with the steel construction company responsible for the primary structure
- Creation of safe access to work stations (mobile lifting platforms, safety nets and lines for access, etc.)
- Inspection of the primary structure and elevations for dimensional accuracy. Reporting to the project management team
- Installation of base profiles and stretch strips
- Checking for dimensional accuracy and quality
- Installation of the air supply system
- Installation of Texlon® ETFE panels, with the help of special pulling devices (pullers), to apply the necessary pre-tension
- Final assembly of the profile caps and the Man Safe Systems
- Handover of the test certificates and acceptance by the client
- Site clearance

Before installing the roof surfaces, a risk assessment must be carried out in accordance with Section 5 of the Occupational Safety and Health Act (ArbSchG)

2.9 Packaging

The foil cushions which have been folded for transport are wrapped in polyethylene foil for protection. The individual foil packs are put into wooden boxes of 4-6 foil packs, depending on the size of the cushions. The remaining components are delivered to the construction site either in Euro pallets or in wooden boxes.

2.10 Condition of use

No significant changes in the product characteristics are expected during its design life. To compensate for deviations in cushion pressure caused by changing external conditions (temperature, wind pressure loads/wind suction loads), the cushions are continuously supplied by one or more inflation units. The size of the roof determines the number of inflation units required. The units are controlled by a pressure sensor, and the internal pressure is maintained within a range of between 180 Pa and 250 Pa. An average output of 60 W is required for a roof area of 1000 m².

If required, an air drier can be used in certain air/humidity conditions.

2.11 Environment and health during use

In accordance with the evidence outlined in section 7,

the emissions to air during the use phase fall below of the limit values as per the AgBB scheme.

2.12 Reference service life

When a maintenance contract is concluded, the guaranteed service life is usually 5 years. An average useful life cannot yet be specified, as the first building envelopes made with Texlon® ETFE foils over 35 years ago are still in unrestricted use.

2.13 Extraordinary effects

Fire

Reaction to fire

In accordance with *EN 13501-1,* Nowoflon® ET foil is specified as a B-s1-d0 material as follows:

Fire protection

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s1
FIGRA transparent	0 kW/s
FIGRA printed	0 kW/s
SMOGRA transparent	14,8 m²/s²
SMOGRA printed	26,4 m²/s²

The reaction to fire of the Texlon® System as a building envelope is determined by the so-called "Small Room Test" in accordance with *ISO 13784-1*. Both a system structure with a three-layer transparent ETFE film and a system structure with three-layer cushions – the outer film layer of which had a highly reflective print on the inside – were tested. The results are recorded in *RISE Report 9P00808*, produced by the testing institution. Because the calculation of the FIGRA (Fire Growth Rate) and the SMOGRA (Smoke Development Rate) is not part of *ISO 137841*, these properties were calculated separately by RISE (RISE 2019-06-24) pursuant to *ISO 9705-1*. Neither burning droplets, nor fire spread, nor the escape of flames through the door opening were observed. The addition of the ETFE building envelope to the fire was below the detection limit (max. heat release rate – HRR – not detectable without burner). Accordingly, FIGRA must be set to zero. SMOGRA is defined as the quotient of the maximum smoke development over a period of 60 sec., and the time required for this. If this is less than 0.3 m^2/s, the SMOGRA is set to zero. The SMOGRA of the Texlon® System is shown in the table above.

Water

Nowoflon® ET foil is not affected by water. This was confirmed by a leaching test in Norway - *PD/CEN TS 16637*.

Mechanical destruction

The foils and cushions are extremely resistant to exterior pressure and tensile loads owing to their extraordinary elongation properties.
In the case of fire, explosions or even extreme hailstones, the system is extremely fault-tolerant and is resistant to consequential damage. The cushions can, however, be damaged by direct mechanical influences with sharp or pointed items. Destruction of the exterior layer of foil does not lead to system failure. For example if the upper foil of a 3-layer system is damaged, a 2-layer system is retained and the interior chamber remains protected from environmental influences.
Minor damage can be easily repaired using Texlon® tape.

2.14 Re-use phase

As a general rule, the aluminium caps and base profiles of the Texlon® System can be re-used for new buildings and/or refurbishment projects. These components are usually recycled (statistic value for buildings: 85%).
Nowoflon® ET foils and valves – as well as ETFE offcuts – are recycled by external companies and made into valves and other small parts that can be used in new Texlon® cushions.
Recycling is currently only carried out in Europe, but will be extended to other regions in future. Waste is thermally recycled in other countries.

2.15 Disposal

The waste incurred can be allocated to the following waste codes:

17 02 03: Plastic
17 04 02: Aluminium
17 09 04: Mixed construction and demolition waste with the exception of waste covered by 17 09 01, 17 09 02 and 17 09 03.

The packaging materials (wooden crates, PE foil) are thermally recycled. The waste incurred can be allocated to the following waste codes (*AVV 2017*):
15 01 03 Wood
15 01 02 Plastic
Silicone seals are thermally recycled.
Recycling possibilities are currently being examined
Polypropylene is recyclable but is usually thermally recycled.

2.16 Further information

Further information can be found on the Vector Foiltec website, at www.vector-foiltec.com.

3. LCA: Calculation rules

3.1 Declared Unit

The declaration refers to an average TEXLON® System of 1 m² with a weight per unit area of 3.89 kg/m².

Declared unit

Name	Value	Unit
Declared unit	1	m^2
conversion factor [Mass/Declared Unit]	3.89	-

The weight per unit area of an average ETFE foil cushion is 0.88 kg/m².

3.2 System boundary

The declaration type represents a “cradle-to-gate with options”. For the life cycle assessment of an average ETFE component (TEXLON®), not only production, but also installation, energy consumption during use, and disposal are considered. All relevant life cycle phases are therefore represented.

There are two possible scenarios for the disposal of foil cushion waste:

1. Recycling
2. Waste incineration

Waste processing is considered for scenario 1. In both cases, the seal is incinerated while the aluminium frame is recycled.

The life cycle stages are explained in detail below:

- Product stage (**A1 - A3**): including the upstream chain associated with manufacturing of preliminary products, transport thereof to the respective plant, and expenses involved in producing granulate, foil and foil cushions
- Transport to the construction site (**A4**): average distances by HGV or ship
- Installation on the construction site (**A5**): energy for inflating foil cushions as well as disposal of packaging
- Operational energy use (**B6**): energy consumption for maintaining the interior cushion pressure
- De-construction (**C1**): manual dismantling of the system
- Transport to disposal (**C2**)
- Waste processing (**C3**): Scenario 1: processing foil waste; Scenario 2: incineration of foil waste; incineration of seals
- Benefits and loads beyond the system boundaries (**D**): from energy for the treatment of packaging waste (A5) and the silicone seals, recycling of aluminium profiles and expenses associated with their processing (re-melting), as well as the credit for recycling of ETFE as material under scenario 1, and the credit for the thermal recycling of ETFE under scenario 2.

3.3 Estimates and assumptions

Estimates need to be made for the following cases:

- Frame: The manufacturer has provided a certificate for the aluminium frame, which shows a share of approx. 45% of post-consumer secondary material. This value is used for the EPD.
- Recycling ETFE material (scenario 1): The recycled EFTE granulate cannot be used to produce new ETFE foils, but is used to produce valves and flexible connecting hoses that are required for the operation of cushions.

3.4 Cut-off criteria

All data from operational data collation at Vector Foiltec, Nowofol and Dyneon has been taken into consideration, i.e. all base materials used in accordance with the recipe formula. Transport is recorded for all essential preliminary products, transporting the products to the site, and in the End-of-Life scenario. In the LCA, the production waste generated directly during production, as well as the electrical and thermal energy required and the packaging materials, were taken into account.

The machinery, systems and infrastructure required in production, as well as the costs of transporting the packaging materials, were neglected.

This means that material and energy flows with a share of <1% were also taken into account.

3.5 Background data

The GaBi 6 software was used to model the life cycle of the Texlon® ETFE system. The basic data in the GaBi database is applied for energy, transport, auxiliary products and preliminary products.

The headquarters of the respective companies are in Germany, so the LCA is prepared with Germany as the reference country. Transport to construction sites is modelled internationally. The power consumption for installation and utilization phases relates to Europe, and can be adapted for other countries if required.

3.6 Data quality

Overall, the data quality can be rated as very good. The data quality of the foreground data is very good, as current, specific primary data relating the manufacture of ETFE components was collected.

The data quality of the background data is also very good, as current data relating to foils and granulate production was also collected. The background database used has also been updated.

The background data used was last reviewed in 2019.

3.7 Period under review

The data for this Life Cycle Assessment is based on records from 2019 for each of the three companies. The volumes of raw materials, energy, and auxiliary materials used are considered as average annual values for the respective plant.

3.8 Allocation

Aluminium profiles with a post-consumer recycling share of 45% are modelled as scrap input (open-loop recycling) in A1 - A3, based on a certificate provided by the supplier.

In the case of combustion processes (C3), an MVA and the resulting benefits (D) for electrical and thermal energy are determined, taking into account the elementary composition and the heating value.

When recycling the ETFE foils (C3), an adjustment factor of 55% was estimated for the material recycling potential, based on an economic allocation.

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 background database used is GaBi CUP 2020.2.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon
The product itself does not contain any biogenic carbon, only the product packaging (wooden crates): 0.11 kg carbon per square metre.

The following technical information serves as the basis for the declared modules, or can be used to develop specific scenarios in the context of a building assessment if modules are not declared (MND).

Transport to site (A4)
Average distance per mode of transport in relation to global international transport data (2019).

Name	Value	Unit
Transport distance HGV	244	km
Transport Distanz Ship	4842	km

Installation process (A5)

Name	Value	Unit
Electricity consumption per m²	0.00018	kWh

Reference service life
The referenced average service life is 25 years. A lifespan of 50 years is possible.

Name	Value	Unit
Reference service life	25 - 50	a

Betriebliche Energie (B6)

Name	Value	Unit
Electricity consumption pro a*m²	0.274	kWh
Other energy carriers	0	MJ

End of life (C1–C4)
Conservative estimate for transport to EoL: 1,000 km for transport in Europe (material recycling is currently only performed in Europe). Shorter transport distance for thermal recycling.

Name	Value	Unit
Collected separately (total product)	3.89	kg
Recycling aluminium frame	2.395	kg
For thermal recycling of seals	0,422	kg
For recycling szenario 1: Foil cushion	0,875	kg
For thermal recycling szenario 2: Foil cushion	0,875	kg
For recycling small steel parts	0,196	kg
	-	
	-	

Collection and recycling rates were estimated at 100%. Processing losses were taken into account with 5% for aluminium and 2% for ETFE foils.

Reuse, recovery and recycling potential (D), relevant scenario information Module D contains benefits from incineration process involving packaging waste (A5), seals, and foil cushions (scenario 2), as well as benefits from the recycling of aluminium frames, small steel parts and foil cushions (Scenario 1) (C3). A waste incineration plant with an R1 value>0.6 was assumed.

5. LCA: Results

The following includes the results of the indicators of the impact assessment, the use of resources, as well as waste and other output flows relating to a 1 m2 Texlon® System.

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	X	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m² Texlon®-System

Core Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
GWP-total	[kg CO_2-Eq.]	3.68E+1	8.55E-1	6.63E-1	1.11E-1	0.00E+0	1.11E-1	5.62E-2	9.30E-1	1.65E+0	0.00E+0	-1.99E+1	-1.26E+1
GWP-fossil	[kg CO_2-Eq.]	3.71E+1	8.51E-1	1.68E-1	1.10E-1	0.00E+0	1.10E-1	5.58E-2	7.05E-1	1.44E+0	0.00E+0	-1.98E+1	-1.25E+1
GWP-biogenic	[kg CO_2-Eq.]	-3.43E-1	4.75E-4	4.95E-1	3.68E-4	0.00E+0	-1.88E-4	-9.53E-5	2.23E-1	2.17E-1	0.00E+0	-6.68E-2	-2.05E-2
GWP-luluc	[kg CO_2-Eq.]	3.23E-2	3.58E-3	1.15E-5	1.60E-4	0.00E+0	8.89E-4	4.52E-4	1.28E-3	8.48E-5	0.00E+0	-1.08E-2	-3.73E-3
ODP	[kg CFC11-Eq.]	2.11E-7	2.10E-16	1.30E-16	2.43E-15	0.00E+0	1.32E-17	6.70E-18	1.54E-14	6.92E-16	0.00E+0	-8.51E-8	-8.44E-15
AP	[mol H^+-Eq.]	1.15E-1	8.04E-3	1.17E-4	2.43E-4	0.00E+0	3.53E-4	1.79E-4	9.89E-4	4.42E-4	0.00E+0	-7.40E-2	-5.71E-2
EP-freshwater	[kg PO_4-Eq.]	8.65E-5	1.86E-6	1.95E-8	2.95E-7	0.00E+0	3.34E-7	1.70E-7	4.86E-6	1.34E-7	0.00E+0	-2.86E-5	-4.78E-6
EP-marine	[kg N-Eq.]	1.92E-2	4.05E-3	2.97E-5	5.41E-5	0.00E+0	1.59E-4	8.07E-5	3.31E-4	1.52E-4	0.00E+0	-1.01E-2	-7.30E-3
EP-terrestrial	[mol N-Eq.]	2.08E-1	4.46E-2	5.54E-4	5.68E-4	0.00E+0	1.78E-3	9.03E-4	3.53E-3	2.04E-3	0.00E+0	-1.10E-1	-7.95E-2
POCP	[kg NMVOC-Eq.]	6.00E-2	1.18E-2	7.82E-5	1.48E-4	0.00E+0	3.12E-4	1.58E-4	8.10E-4	4.12E-4	0.00E+0	-3.15E-2	-2.32E-2
ADPE	[kg Sb-Eq.]	1.71E-3	7.10E-8	1.85E-9	3.19E-8	0.00E+0	7.87E-9	4.00E-9	1.90E-7	1.01E-8	0.00E+0	-6.60E-4	-1.22E-6
ADPF	[MJ]	4.76E+2	1.14E+1	1.45E-1	1.94E+0	0.00E+0	1.46E+0	7.43E-1	6.46E+0	8.42E-1	0.00E+0	-2.36E+2	-1.50E+2
WDP	[m^3 world-Eq deprived]	2.81E+0	3.68E-3	6.61E-2	2.40E-2	0.00E+0	9.81E-4	4.99E-4	8.05E-2	2.18E-1	0.00E+0	-1.78E+0	-1.58E+0

Caption	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 m² Texlon®-System

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
PERE	[MJ]	1.51E+2	6.61E-1	3.34E+0	8.59E-1	0.00E+0	8.22E-2	4.17E-2	3.61E+0	1.96E-1	0.00E+0	-7.72E+1	-5.93E+1
PERM	[MJ]	3.31E+0	0.00E+0	-3.31E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.55E+2	6.61E-1	3.08E-2	8.59E-1	0.00E+0	8.22E-2	4.17E-2	3.61E+0	1.96E-1	0.00E+0	-7.72E+1	-5.93E+1
PENRE	[MJ]	4.55E+2	1.14E+1	2.19E+0	1.94E+0	0.00E+0	1.46E+0	7.43E-1	2.53E+1	1.97E+1	0.00E+0	-2.55E+2	-1.50E+2
PENRM	[MJ]	2.07E+1	0.00E+0	-2.04E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.89E+1	-1.89E+1	0.00E+0	1.89E+1	0.00E+0
PENRT	[MJ]	4.76E+2	1.14E+1	1.45E-1	1.94E+0	0.00E+0	1.46E+0	7.43E-1	6.46E+0	8.42E-1	0.00E+0	-2.36E+2	-1.50E+2
SM	[kg]	1.08E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.31E-2	3.31E-2
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	2.89E-1	5.92E-4	1.55E-3	9.94E-4	0.00E+0	9.51E-5	4.83E-5	3.59E-3	5.18E-3	0.00E+0	-1.90E-1	-1.54E-1

Caption	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 m² Texlon®-System

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
HWD	[kg]	7.46E-7	4.24E-7	1.16E-10	8.03E-10	0.00E+0	6.81E-8	3.46E-8	5.68E-9	3.68E-8	0.00E+0	-1.66E-7	-6.71E-8
NHWD	[kg]	4.27E+0	1.99E-3	4.07E-3	1.38E-3	0.00E+0	2.24E-4	1.14E-4	7.22E-2	3.36E-1	0.00E+0	-2.94E+0	-2.86E+0
RWD	[kg]	2.08E-2	1.20E-5	4.58E-6	2.94E-4	0.00E+0	1.81E-6	9.20E-7	5.30E-4	4.31E-5	0.00E+0	-1.05E-2	-8.19E-3
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.40E+0	3.40E+0	8.58E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	9.01E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.55E-1	2.30E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	2.10E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.25E+0	4.38E+0	0.00E+0	0.00E+0	0.00E+0

Caption	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; EEE = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m² Texlon®-System

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
PM	[Disease Incidence]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR	[kBq U235-Eq.]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	[CTUe]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	[-]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Caption	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

The results of the optional environmental impact indicators are not declared because the uncertainty of these results is high, or because there is only limited experience with the indicator.

Note: The results of module B6 reflect the product use of one year. When applying the results for a building LCA, they must be adapted to the total life span of the building.

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 the uncertainties on these results are high or as there is limited experienced with the indicator.

6. LCA: Interpretation

The majority of environmental impacts and the use of primary energy are caused by the upstream chain, i.e. manufacture of the preliminary products.

Particularly, manufacturing of the aluminium frame which contributes most to the overall system mass is clearly apparent during the production phase.
But also the foil cushion contributes significantly to the environmental impacts. This is particularly attributable to the production of granulate.
Production at Vector Foiltec has barely any effect on the impact categories under review (up to max. 6% of the overall production phase). The other impact categories essentially follow this breakdown for the entire production phase too.

Transport to the construction site is modelled in accordance to the international distribution of the Texlon® System and is based on average data from 2019. Transport can also be significantly less intensive for specific projects.

Neither the energy required for initial inflation of the foil cushion (Module A5) nor for maintaining the internal cushion pressure during the use phase (Module B6) contribute significantly to the overall life cycle in any of the impact categories. It must be noted that the use phase is only modelled for one year, and that this must be adapted to the intended life time of the building.

Two scenarios are presented for the End of Life:
1. Foil cushion material recycling
2. Thermal recycling of foil cushions

In both cases, the aluminium frame and small steel parts are recycled. In both scenarios, there is recovery potential, which is greater in the case of material recycling.

The environmental results were calculated for an average product made in 2019, with a weight per unit area of 3.89 kg per square metre. The weight per unit area is largely determined by the weight of the aluminium frame. In the case of systems with a higher weight per unit area (larger aluminium frame), a higher environmental impact can be assumed, and correspondingly lower environmental impacts with a lower weight per unit area (smaller aluminium frame). This means that larger cushion sizes and spans reduce the environmental impact due to a lower weight proportion of aluminium in the system.

7. Requisite evidence

7.1 VOC emissions

The analysis of the Nowoflon® ET-foil for VOC-emissions in accordance with the AgBB test- and assessment scheme (2021) has been carried out in December 2022 by the Bremer Umweltinstitut – Gesellschaft für Schadstoff-analysen und Begutachtung mbH – durchgeführt.

Measurement conditions:

Temperature	23 °C
Area-specific air flow rate	0.36 m³/(m²h)
Product loading	1.33 m²/m³
Sample surface area	0.33 m²

AgBB Result review (28 days)

Name	Value	Unit
TVOC (C6 – C16)	< 5	µg/m³
Sum SVOC (C16 – C22)	n.d.	µg/m³
R (dimensionsless)	0.000	-
VOC without NIK	n.d.	µg/m³
Cancerogenes	n.d.	µg/m³

detection limit 1 µg/m³ n.d.: not detected

7.2 Release of water-soluble substances

The review of the Nowoflon® ET-foil for the release of water-soluble hazardous substances has been carried out in December 2015 within the framework of the general building permit for Norway by SINTEF Norway in accordance with PD/CEN/TS 16637. Neither the loss of sample mass nor the release of organic components could be determined.

8. References

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Sustainability & Comfort
Working Group Tensinet

EPD 19 Taiyo

ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

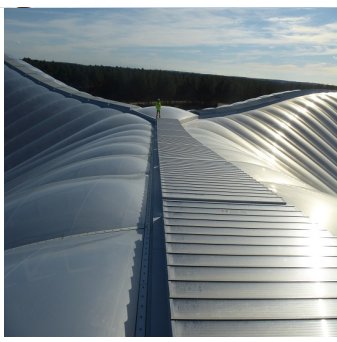
Owner of the Declaration	**Taiyo Europe GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-TAI-20190092-ICB1-EN
Issue date	05.08.2019
Valid to	04.08.2024

TensoSky® - System with Fluon® ETFE-FILM

Taiyo Europe GmbH, AGC Inc.

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com



Taiyo Europe AGC
MakMax

1. General Information

Taiyo Europe GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Declaration number
EPD-TAI-20190092-ICB1-EN

This declaration is based on the product category rules:
ETFE construction element, 07.2014
(PCR checked and approved by the SVR)

Issue date
05.08.2019

Valid to
04.08.2024

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

Dr. Alexander Röder
(Head of Board IBU)

TensoSky®-System
with Fluon®ETFE-Film

Owner of the declaration

Taiyo Europe GmbH
Muehlweg 2
82054 Sauerlach/Germany

Declared product / declared unit

1 m² Taiyo TensoSky®-System (3.93 kg/m² mass per unit area for a 3-layers-system made of FLUON® ETFE-Film (1.05 kg/m² mass per unit area) including all components, like aluminium frame.

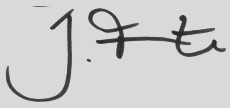
Scope:
This EPD refers to individual construction elements manufactured from ethylenetetrafluoroethylene (ETFE), aluminium and other components. The construction element is used e.g. for building envelopes, cladding roofs, skylights, canopies, curtain walls or facades. It is supplied by Taiyo Europe GmbH, under the brand trade name TensoSky®, here used with Fluon®ETFE-film from AGC Inc, Japan.

The TensoSky®-System is designed, fabricated and packaged for specific projects.This EPD declares the life cycle analysis (LCA) for a specific 3-layers system.

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.

Verification

The standard /EN 15804/ serves as the core PCR
Independent verification of the declaration and data according to /ISO 14025:2010/
☐ internally ☒ externally



Juliane Franze
(Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

The ETFE construction element with the trade brand name TensoSky® consists of AGC Inc.FLUON®ETFE-film, aluminium and further components with a minor mass proportion. It can be fixed on structural systems, e.g. made of steel, wood or reinforced concrete. The structural system is not included in this EPD. The construction element includes between 1 and 5 ETFE-film layers (ETFE = ethylene tetrafluoroethylene) dependent on building physical, statical or design requirements. The ETFE-film thickness varies between 80µm and 500 µm depending on structural requirements. The individual ETFE-films are welded together, to get a planar or curved single layer or multiple-layers system. This EPD is based on a reference 3-layers system with a film thickness of 250 µm (outer/inner layer) and 100 µm (middle layer). The values for 1-, 2-, 4- and 5-layers systems are derived from this reference project.

For the use and application of the product the respective national provisions at the place of use apply, in Germany for example the building codes of the countries and the corresponding national specifications.

2.2 Application

The TensoSky®-System is a transparent or translucent construction element, used e.g. as cladding roof, skylight, canopy, curtain wall or facade. It is suitable for new buildings and refurbishments. It can be used as a permanent, stationary, moveable, retractable or temporary structure, e.g. for leisure parcs, indoor pools, biospheres, greenhouses, infrastructure buildings, carparks, shopping malls, administration and

educational buildings, hotels, hospitals, museums, public spaces and stadia, but also for pavillons and stands on trade fairs and exhibitions.

2.3 Technical Data

The following technical data indicates the default values for the declared ETFE-film product at the time of delivery. Unless otherwise stated the following material data refer to an ETFE-film with a thickness of 200 µm:

Constructional data ETFE

Name	Value	Unit
Melting range acc. to /ASTM D4591-07/	265±10	°C
Grammage acc. to /DIN EN ISO 2286-2/	0.35	kg/m²
Tensile strength acc. to /DIN EN ISO 527-3/	>50	N/mm²
Tensile stress at 10% strain acc. to /DIN EN ISO 527-3/	>18	N/mm²
Tear Resistance acc. to /DIN 53363/	>400	N/mm
Weld strength acc. to /DIN EN ISO 527-3/	>33	N/mm²
Total energy transmittance acc. to /ISO 15099/	91±5	%
Weathering resistance acc. to /ISO 4892-4/	no optical/mechanical changes	-
Tensile strain at break acc. to /DIN EN ISO 527-3/	>350	%

Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking).

2.4 Delivery status

The TensoSky®-System is project-specific dimensioned. The single components as ETFE-film elements, aluminum frame etc. are prefabricated separately, packed and delivered to the assembly on construction site. The prefabricated ETFE-film elements are sent to the construction site folded into transportable packages, wrapped in protective polyethylene films and packed in wooden boxes.
For reasons of producability, the assembled ETFE-film elements should not exceed a length of 100 m and a width of 5 m as a rule. The surface of an individual ETFE-film element should not exceed 500 m².

2.5 Base materials / Ancillary materials

Mass Proportions

Name	Value	Unit
Aluminium (frames, air valves)	40	%
ETFE-Film (3 layers)	27	%
Mild Steel (gutter)	22	%
EPDM (gaskets)	5	%
Stainless Steel (fasteners)	3	%
other plastic materials (seals, coating, spacers)	3	%
Total	100	%

The table above shows the mass-proportions of a typical three-layer TensoSky®-System**:**

Aluminium: The system includes frames and an insignificant mass of air valves made of aluminium. The frames consist of a base-profile, a cap-profile and keder-profiles, that hold the ETFE-film elements perimeter edge. The aluminium frame is anodized in the thickness class according to /DIN 17611/, specified for the certain application and utilization.

ETFE-Film: The ETFE-film is a flexible and strong fluorinated co-polymer (ethylene-tetrafluoroethylene). The transparent film is permeable for the entire solar range of irradiation. It can be clear, printed or dyed.

Mild Steel: The system includes an optional gutter made of customary sheets of coated mild steel.

Stainless Steel: Fasteners (screws, bolts, nuts, washers) used are made of stainless steel (min. A2-50) depending on the specified strength and corrosion class.

EPDM: To hold the ETFE-film elements in the aluminum frame, an EPDM-rope (diameter approx. 5-8 mm) is used. Additionall gaskets made of EPDM are inserted in the aluminium frames.

Other plastic materials: The system includes a small mass-proportion of other plastic materials used as seal (aluminium joints), coatings (gutter), gaskets (fasteners) and plastic-spacers (to fix keder-profiles in base-profiles).
Information that product does not contain substances listed in the Candidate List of substances of very high concern /REACH/ exceeding 0.1%: This product contains substances listed in the candidate list (date:15.01.2019) exceeding 0.1 percentage by mass: **no**
This product contains other 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 (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): **no**

2.6 Manufacture

In the production facilities the individual ETFE-film sections are cut from the roll on a plotter table according to the project-specific cutting patterns. In order to create the ETFE-film elements, the individual ETFE-film sections are welded together in form of a continues seam. Subsequently the air valves are installed in the ETFE-film layers. In case of multiple layers ETFE-film elements the different layers are placed on each other and welded together circumferential of the element's edges. Along the ETFE-film elements perimeter, the edges are formed as a pocket, in which the keder rope is pulled in. The specific 3-layers system the life cycle analysis (LCA) is based on, was manufactured in Bytom/Poland. It is one of more production facilities used by Taiyo Europe. Further are located, e.g. in Bari, Italy, and Edersleben, Germany.

2.7 Environment and health during manufacturing

When manufacturing the TensoSky®-System, relevant standards and generally accepted rules of technology are complied with (e.g. /ArbSchG/, /BRUMI K5437 FM/).The owner of the EPD is certified according to

/DIN EN ISO 14011/. AGC Inc. as the manufacturer of the ETFE-resin and the extruded ETFE-film is also certified.

2.8 Product processing/Installation

The prefabricated ETFE-film elements are unfolded at the construction site and pulled, along their edge, into the aluminum clamping profiles. Subsequently, an aluminum cover profile is screwed onto the aluminum base profile, which seals the system together with EPDM seals against driving rain. In the case of multi-layered ETFE-film elements, the air supply lines are then connected and the air is blown into the chambers between the ETFE-film layers to stabilize the ETFE-film elements. For the installation of the ETFE-film elements on building site only usual tools and safety equipment related to the respective kind of works are necessary, but no machines. The works generate no extraordinary emissions, in particular noise, gasses or dust.

2.9 Packaging

The packaging consits of wooden boxes/crates, protective polyethylene films and carboards. All materials are typically thermally recycled.The waste incurred can be allocated to the following waste codes according to /AVV 2017/:

15 01 01: paper and cardboard packaging
15 01 02: plastic packaging
15 01 03: wood packaging

2.10 Condition of use

No significant changes in the product characteristics are expected during its design life. To compensate deviations in the overpressure between multiple layers ETFE-film systems caused by changing external conditions (e.g. wind and snow loads), the enclosed air volumes between the layers are continuously supplied by air blower units. The size of the roof and the intended air exchange rate determine the number and dimension of the units required. The units are controlled by a pressure sensor and internal pressure is maintained within a range between approximately 200 Pa and 1000 Pa by means of a low-pressure air inflation system. To reduce the humidity of the inflated air and to avoid condensation in multiple layers ETFE-film elements dehumidifier with a defined air exchange rate may be used.

2.11 Environment and health during use

In accordance with the evidence outlined in section 7, emissions to ambient air during the use phase are below the threshold values set by the /AgBB/ evaluation scheme.

2.12 Reference service life

The reference service life is ensured for about 25 years on average. Up to 50 years are possible. A calculation according to /ISO 15686/ is not applied.

2.13 Extraordinary effects

Fire

According to /EN13501–1/ the ETFE-film product FLUON® is classified as follows:

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s1

Water

Tests according to /ASTM D570/ are showing, that ETFE-film is not affected by water. The water absorption is evaluated to 0.03% according to /AGC FLUON® ETFE-film/.

Mechanical destruction

The TensoSky®-System is extremely resistant to tensile loads owing to the ETFE-films extraordinary elongation properties. In the case of fire, explosions or earthquakes, the system is extremely fault-tolerant and has a low risk of consequential damage. The ETFE-film can, however, be damaged by direct mechanical influences (e.g. by vandalism) with sharp or pointed objects. In case of a multiple layers ETFE-film system the destruction of the exterior layer does not lead to system failure automatically and water leakage into the interior of the building. Minor damages can be easily repaired using TensoSky® ETFE-tape with an adhesive layer on its back side. It can be applied for single-layer and multiple layers TensoSky®-Systems.

2.14 Re-use phase

As a general rule, the frame and the valves made of aluminium can be re-used for new buildings and/or refurbishment of projects. Where the application of this rule is impossible, the aluminium returns to the manufacturers. The aluminium used for the TensoSky®-System consists of 41% secondary aluminium on average.

2.15 Disposal

Components made of steel are processed as metallic scrap. Although the clear ETFE-film used is returned into the material cycle after it has been removed, the film is no longer used for architectural applications, but rather for ETFE components with lower requirements, such as electric isolators. Printed ETFE-films, EPDM materials and other materials with a very low mass fraction used can be thermally recovered. The waste after at the end of the products life can be allocated to the following waste codes according to /AVV/:

17 04 02: aluminium
17 02 03: plastic
17 09 04: mixed construction and demolition waste (excepted waste covered by 17 09 01 - 17 09 03)

2.16 Further information

Additional information is available on the Taiyo Europe webpage (www.taiyo-europe.com).

3. LCA: Calculation rules

3.1 Declared Unit

The declaration refers to 1 m² of the TensoSky®-System (3.93 kg/m² mass per unit area for all components) including 3 layers of FLUON® ETFE-film (1.05 kg/m² mass per unit area).

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Conversion factor to 1 kg	0.2545	-

To provide results for projects with 1- layer, 2-layers, 4-layers and 5-layers of FLUON® ETFE-film the EPD Annex contains the different layer scenarios:

Mass Proportions

Szenarios (number of layers) / Materials	1 layer	2 layers	3 layers	4 layers	5 layers
Aluminium (frames, air valves)	47%	42%	**40%**	38%	36%
ETFE-Film	13%	23%	**27%**	30%	33%
Mild Steel (gutter)	26%	23%	**22%**	21%	20%
EPDM (gaskets, seals, keders)	7%	6%	**5%**	5%	5%
Stainless Steel (fasteners)	4%	3%	**3%**	3%	3%
Other plastic materials (coatings, spacers)	3%	3%	**3%**	3%	3%
Complete System	100%	100%	100%	100%	100%
Weight [kg/m²]	**3,32**	**2,76**	**3,93**	**4,11**	**4,28**

3.2 System boundary

The EPD of the ETFE construction element, includes the production as well as installation, use phase and the End of Life of the product. The following life cycle phases are considered:

Production

A1-A3 – Raw material supply, production of pre-products (ETFE-film, aluminium frame, further parts) and manufacturing. Transports of raw materials (ETFE-film, aluminium…) and components/ pre-products are included in A2

Installation

A4 – Transport to building site
A5 – Initial installation into building (including packaging waste processing, energy and material for the assembly of the building element and the electricity effort for first inflation)

Use stage

B1 – Use / application: Release of substances to indoor air, soil and water
B2 – Maintenance: Cleaning, yearly check and replacement of worn and damaged parts
B6 – Operational energy use: Maintaining the cushion pressure **for a period of one year**
B7 – Operational water use

End-of-life

C1 – Deconstruction/ demolition (including only minor effort for the deconstruction of the building element)
C2 – Transport to waste processing resp. recycling material processing,
C3 – Waste processing for recovery and recycling (including the incineration of ETFE and plastics and the recycling of aluminum and steel)
C4 – Disposal (landfilling)

3.3 Estimates and assumptions

The content of secondary aluminium in the aluminium frame is 41% as weighted average percentage based on written information of the aluminium supplier.The ETFE construction elements are assembled on the construction site. All transportation distances are included in A2. In A4 no further transports are considered. The electricity consumption for installation (A5) and utilization (B6) is related to Europe as an exemplified reference region. In this study an energy consumption of 0.26 kWh/m²/a is taken into account for the air supply system.

3.4 Cut-off criteria

Packaging waste (like foil, paper) arising during production (A1-A3) is not considered in this study due to negligible amounts (<0.1%). Apart from that all available data from production process are considered. Thus, all material and energy flows contributing less than 1% of mass or energy are considered. Transport processes for packaging materials are neglected. Production of infrastructure required for manufacture are outside the scope of this assessment. The sum of the excluded flows does not exceed 5% of mass, energy or environmental relevance.

3.5 Background data

The /GaBi ts/ software was used to model the life cycle of the ETFE system. The data in the GaBi database version 8.07 is applied for energy, transport, auxiliary products and preliminary products. It had been revised in 2016.

3.6 Data quality

Overall the data quality can be described as good, as the level of completeness is very high and the collected primary data reflect current conditions (reference year 2016). To ensure consistency, all primary data are collected with the same level of detail, while all background data are sourced from the GaBi databases. Allocation and other methodological choices are made consistently throughout the model.

3.7 Period under review

The foreground data collected by the manufacturer for the production process are based on yearly production amounts and extrapolations of measurements on specific machines and plants. The production data refer to an average of the year 2016. The foreground data was collected specifically for one project by the manufacturer for the materials/components used (ETFE, EPDM, aluminium, stainless steel, mild steel and the other plastic materials).

3.8 Allocation

The overall production of Taiyo Europe GmbH comprises further products (other layer systems) beside the product considered in this study; therefore, allocation was applied for the consumption of thermal and electrical energy as well as other auxiliary materials. Allocation factors were defined based on mass.

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.

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4. LCA: Scenarios and additional technical information

The following information is the basis of the declared modules.

Transport to the building site (A4)

Name	Value	Unit
Transport distance	0	km

The assembly of the ETFE construction elements takes place at the construction site. All transports of materials and pre-products (ETFE-film, aluminium frame, further parts) are included in A2. There are no further transportation processes in module A4.

Installation into the building (A5)

Name	Value	Unit
Electricity consumption	0.00096	kWh

Use or application of the installed product (B1) see section 2.11, 2.13 and 7

Maintenance (B2)

Name	Value	Unit
Water consumption	0	m^3
Other resources	0	kg
Electricity consumption	0	kWh

No effort for cleaning and repair to maintain the ETFE construction element is needed. Its surface is considered as self-cleaning by rain and does not require, therefore, any further energy or water. Necessity of cleaning and life span depend on utilization and environmental conditions.

Reference service life

Name	Value	Unit
Life Span (expected, average)	25	a

Operational energy use (B6) and Operational water use (B7)

The values in module B6 **refer to a period of use of one year**. The table below shows the values of the water consumption and the electric energy consumption (depending on the used type of air supply system). The calculations are done for an open system with air flow (not predried, 0.26 kWh per square meter and year):

Name	Value	Unit
Water consumption	0	m^3
Electricity consumption Open system with air flow (predried)	0.84	kWh
Electricity consumption Closed loop system with air flow (predried)	0.76	kWh
Electricity consumption Open system with air flow (not predried)	0.26	kWh
Electricity consumption Closed system without air flow (not predried)	0.06	kWh

End of life (C1-C4)

Name	Value	Unit
Collected separately waste type	4	kg
Recycling	2.6	kg
Energy recovery	1.4	kg

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

Module D includes potential benefits from energy substitutions from incineration processes of packaging waste (A5), seals, and the ETFE-film elements (C3) and from recycling the aluminum frames. A waste incineration plant with an R1 value of > 0.6 is assumed.

5. LCA: Results

The following table depicts the results concerning the estimated impact, use of resources and waste and other output flows in relation to **1 m² of Taiyo Europe's TensoSky®-System** (3.93 kg/m² mass per unit area for a 3 layers-system made of FLUON® ETFE-FILM (1.05 kg/m² mass per unit area) and included aluminium frame). The EPD Annex provides results of other layer scenarios (1-layer, 2-layers, 4-layers and 5-layers) of the specific ETFE construction element. All declared modules are indicated with an "X", the modules B3, B4, B5 are marked as MNR (module not relevant). Environmental impacts were calculated with using characterisation factors of CML 2001, published in April 2013 /CML/.

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	MNR	MNR	MNR	X	X	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² Taiyo ETFE construction element

Parameter	Unit	A1-A3	A4	A5	B1	B2	B6	B7	C1	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	5.32E+1	0.00E+0	9.16E-1	0.00E+0	0.00E+0	1.08E-1	0.00E+0	0.00E+0	5.31E-2	2.25E+0	0.00E+0	-9.37E+0
ODP	[kg CFC11-Eq.]	2.67E-4	0.00E+0	1.12E-14	0.00E+0	0.00E+0	4.80E-13	0.00E+0	0.00E+0	1.45E-15	9.99E-14	0.00E+0	4.13E-11
AP	[kg SO_2-Eq.]	1.08E-1	0.00E+0	1.11E-4	0.00E+0	0.00E+0	3.06E-4	0.00E+0	0.00E+0	1.23E-4	2.11E-2	0.00E+0	-3.99E-2
EP	[kg $(PO_4)^{3-}$-Eq.]	8.07E-3	0.00E+0	2.44E-5	0.00E+0	0.00E+0	2.87E-5	0.00E+0	0.00E+0	3.13E-5	6.80E-5	0.00E+0	-2.50E-3
POCP	[kg ethene-Eq.]	9.36E-3	0.00E+0	7.37E-6	0.00E+0	0.00E+0	1.92E-5	0.00E+0	0.00E+0	-4.17E-5	3.02E-5	0.00E+0	-2.43E-3
ADPE	[kg Sb-Eq.]	1.45E-4	0.00E+0	1.30E-8	0.00E+0	0.00E+0	5.73E-8	0.00E+0	0.00E+0	4.34E-9	2.64E-7	0.00E+0	-3.63E-6
ADPF	[MJ]	4.88E+2	0.00E+0	1.98E-1	0.00E+0	0.00E+0	1.15E+0	0.00E+0	0.00E+0	7.20E-1	7.43E-1	0.00E+0	-1.00E+2

Caption	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

RESULTS OF THE LCA - RESOURCE USE: 1 m² Taiyo ETFE construction element

Parameter	Unit	A1-A3	A4	A5	B1	B2	B6	B7	C1	C2	C3	C4	D
PERE	[MJ]	6.75E+1	0.00E+0	6.06E+0	0.00E+0	0.00E+0	7.41E-1	0.00E+0	0.00E+0	3.98E-2	1.83E-1	0.00E+0	-4.41E+1
PERM	[MJ]	6.02E+0	0.00E+0	-6.02E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	7.36E+1	0.00E+0	4.17E-2	0.00E+0	0.00E+0	7.41E-1	0.00E+0	0.00E+0	3.98E-2	1.83E-1	0.00E+0	-4.41E+1
PENRE	[MJ]	4.86E+2	0.00E+0	3.81E-1	0.00E+0	0.00E+0	1.97E+0	0.00E+0	0.00E+0	7.22E-1	2.72E+1	0.00E+0	-1.19E+2
PENRM	[MJ]	2.64E+1	0.00E+0	-1.60E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.63E+1	0.00E+0	0.00E+0
PENRT	[MJ]	5.13E+2	0.00E+0	2.21E-1	0.00E+0	0.00E+0	1.97E+0	0.00E+0	0.00E+0	7.22E-1	9.23E-1	0.00E+0	-1.19E+2
SM	[kg]	8.50E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m³]	2.39E-1	0.00E+0	2.22E-3	0.00E+0	0.00E+0	1.01E-3	0.00E+0	0.00E+0	7.34E-5	6.18E-3	0.00E+0	-1.11E-1

Caption	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 – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² Taiyo ETFE construction element

Parameter	Unit	A1-A3	A4	A5	B1	B2	B6	B7	C1	C2	C3	C4	D
HWD	[kg]	1.87E-3	0.00E+0	1.84E-10	0.00E+0	0.00E+0	9.25E-10	0.00E+0	0.00E+0	4.18E-8	4.51E-8	0.00E+0	2.50E-3
NHWD	[kg]	2.90E+0	0.00E+0	2.20E-3	0.00E+0	0.00E+0	1.39E-3	0.00E+0	0.00E+0	6.05E-5	3.39E-1	0.00E+0	-1.95E+0
RWD	[kg]	1.36E-2	0.00E+0	9.42E-6	0.00E+0	0.00E+0	3.27E-4	0.00E+0	0.00E+0	9.89E-7	7.12E-5	0.00E+0	-7.50E-3
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.35E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	2.28E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.13E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	5.26E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.83E+0	0.00E+0	0.00E+0

Caption	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; EEE = Exported thermal energy

Note: The values in module B6 are related to an open system with air flow (not pre-dried). **They refer to a period of use of one year**. When using the values in the building context, they must be scaled to the specific building service life time.

6. LCA: Interpretation

Interpretation of results for the production stage (A1-A3)
The environmental profile of the production of the system is determined by the manufacturing of the components ETFE-film and aluminium frame. The main influence of ETFE-film is to find in categories **GWP, ODP, POCP** and **ADPF**. Within **AP** and **EP** the ETFE-film has relevant influence. The aluminium frame is of relevant influence in **AP, EP** and of some influence in most of the impact categories (**GWP, POCP, ADPF**).
Minor or even negligible influence is given with regard to **ODP** and **ADPE**. The environmental impact of mild steel is significant only in the category **ADPE**.
All other processes and materials are of minor importance and are showing impact shares < 10% with the exception of 17% **ADPE** of the stainless steel fasteners.Transport has only some importance regarding **EP** and little importance regarding **AP**.
The energy consumption (electricity) and packaging are not significant and have negligible influence.

Interpretation of the results within the entire life cycle
The main contributors - valid for **all impact categories** considered - are the preliminary processes (upstream) in A1 to A3, most notably the manufacturing of the ETFE-film and of the aluminum profiles. Neither transport to the site (A2), energy consumption during installation and use (A5 and B6), nor transport to disposal (C2) are of mentionable relevance. The results for the use stage impact B6 is declared with the effort per year in chapter 5. Assuming a service life of 25 years the impact of B6 would increase to 5% to 16% relating to the manufacturing impact (A1-A3).

7. Requisite evidence

7.1 VOC emissions

Inspection of Fluon® ETFE-fIlm for Volatile Organic Compound (VOC) emissions in accordance with the evaluation scheme /AgBB/ was carried out in September 2017 by the Environmental Institute Bremen (Bremer Umweltinstitut - Gesellschaft für Schadstoffanalysen und Begutachtung mbH /BRUMI K5437FM/) in accordance with the principles of the "Deutsches Institut für Bautechnik (DIBt)" for the health assessment of construction products in interiors (DIBt-Grundsätze für die gesundheitliche Bewertung von Bauprodukten). The results of the test are based on the NIK-list from February 2015.

Measurement conditions
Temperature: 23 °C
Area specific air flow rate: 0.36 m³/(m³h)
Loading: 1.4 m²/m³

AgBB overview of results (28 days)

Name	Value	Unit
TVOC (C6 - C16)	18	µg/m³
Sum SVOC (C16 - C22)	< 5	µg/m³
R (dimensionless)	0.016	-
VOC without NIK	< 5	µg/m³
Carcinogenic Substances	< 1	µg/m³

Detection limit: 1 µg/m³

Trichloroethylene, Benzene, DEHP and DBP could not be detected. According to /BRUMI K5437 FM/ the sample fulfilled the requirements of **category A + of the French VOC regulations**.

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Sustainability & Comfort
Working Group TensiNet

EPD 20 – Novum

ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	Novum Membranes GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-NMG-20170152-IBC1-EN
ECO EPD Ref. No.	
Issue date	18.10.2017
Valid to	17.10.2023

Novum AFP-System

Novum Membranes GmbH

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com

ECO PLATFORM EPD VERIFIED

1. General Information

Novum Membranes GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
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10178 Berlin
Germany

Declaration number
EPD-NMG-20170152-IBC1-EN

This Declaration is based on the Product Category Rules:
ETFE construction element, 07.2014
(PCR tested and approved by the SVR)

Issue date
18.10.2017

Valid to
17.10.2023

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

Dr. Burkhart Lehmann
(Managing Director IBU)

Novum AFP-System

Owner of the Declaration
Novum Membranes GmbH
Im Voigtstedter Feld 6
06528 Edersleben

Declared product / Declared unit
The declared unit is one (1) representative square metre (m²) of Novum AFP cushion system including the proportionate framing and packaging materials

Scope:
This EPD refers to individual elements of building envelopes which are made of ethylene tetrafluoro-ethylene (ETFE) material. It is valid for the production location of Edersleben. The building elements are marketed by the Novum Membranes GmbH company.

Foil cushions are planned and made project-specifically. Thus EPD calculates the lifecycle analysis (LCA) for a representative product.

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.

Verification

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

Matthias Schulz
(Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

The Novum AFP-System (Air Filled Pillow Membrane System) is based on the following principle: pneumatically stabilised foil elements are attached to a substructure by means of a special aluminium section system. Depending on physical, structural or creative requirements and specification, the systems can be formed from 2 to 4 layers of foil made of ethylene tetrafluoroethylene (ETFE). The U-values (heat transmission coefficient) and g-values (energy transmittance) of the Novum system are specified by the number of layers used and the type of colouring and printing. The ETFE foil thicknesses vary between 100 µm and 500 µm depending on structural constructive requirements. The individual layers are welded together at the edges and stabilised by a low-pressure support air system at approximately 250 Pa (250 N/m²).
This EPD is based on a typical three-layer system with the following structure:

- Upper foil: 250 µm
- Middle foil: 100 µm
- Lower foil: 200 µm

The LCA for a representative product is calculated in this EPD.

The product is not subject to any EU harmonisation legislation. The respective national regulations at the location of use apply to the use of the product.

2.2 Application

Novum cushions are building elements used both for the cladding of roofs and complete facades. The Novum system is suitable for both new buildings and refurbishment projects. Well-known examples are:

- Entertainment Center: National Arena Scotland Glasgow, Great Britain
- Artificial biospheres: Eden Project in Cornwall, Great Britain
- Zoological gardens: London Zoo, Chester Zoo, Great Britain
- Atria: Marr College Troon, Great Britain

- Passage: Mall of Africa, Randburg, South Africa
- Railway stations: Crystal Palace Station, London, Great Britain
- Hospitals: Edinburgh Royal Hospital, Edinburgh, Great Britain·
- Hotels: Center Parcs Longleat Wiltshire Great Britain

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2.3 Technical Data

Constructional data

Name	Value	Unit
Melting range in accordance with /ASTM D 4591-07/	265±10	°C
Grammage (ETFE foil)	0.4375	kg/m²
Tensile strength in accordance with /DIN EN ISO 527-1/ (ETFE foli)	> 55	N/mm²
Tensile stress at 10% strain in accordance with /DIN EN ISO 527-1/ (ETFE foil)	> 23	N/mm²
Tensile stress at break in accordance with /DIN EN ISO 527-1/ (ETFE-foil)	> 55	%
Tear Resistance in accordance with /DIN 53363/ (ETFE-Folie)	> 400	N/mm
Weld strength in accordance with /DIN 527-1/ (ETFE foil)	> 33	N/mm²
Minimum total energy transmittance on accordance with /ISO 15099/	< 80	%
Minimum total energy transmittance Novum AFP 3-layer /ISO 15099/	> 10	%
Weathering resistance in accordance with /ISO 4892-1/ and /ISO 4892-2/	No change in mechanical values	

The product is not subject to any EU harmonisation legislation. The respective national regulations at the location of use apply to the use of the product.

2.4 Delivery status

The Novum AFP system is dimensioned for specific projects. From an economic and technical perspective a length of 50 m and a width of 4 m should generally not be exceeded. The cushion area should not exceed 200 m².

2.5 Base materials / Ancillary materials

The main base products are ETFE foil, aluminium frame, sealing materials and air pipes. The supporting air blower system is not part of the EPD.
The accumulated rounded mass % of the input materials for 1m² of a representative Novum AFP system is shown below.

Materials	Share in mass %
Aluminium	54
ETFE	25
EPDM	4
Steel	7
PVC	2
Silicone	3
Cardboard	2
PE foil	4

The four largest (mass-based) input materials are explained in more detail below:

ETFE: ETFE foil

ETFE foils are highly flexible, high-strength partly fluorinated copolymer foils. The foils are permeable for a large part of the solar spectrum. They can be transparent, printed or coloured.
Aluminium: Aluminium section system
The aluminium section system consists of an extruded base element, a cover profile and two support rails for the cord edging.
Aluminium: Aluminium connectors
The connectors to attach the air hoses are small aluminium parts.
EPDM: EPDM seal (ethylene propylene dien rubber)
The profile system has extruded EPDM sealing elements to seal the ETFE.
EPDM: Keder
The foil cushion is joined form-fitted to the profile system with a cord edging. The cord edging consists of a flexible round EPDM cord. It normally has a diameter of 6 mm.
Stahl: Stainless steel screws
Stainless steel screws are used to connect the individual parts of the AFP profile system and to attach the substructure.

2.6 Manufacture

Manufacture of ETFE granulate

Raw materials and monomers
Mineral fluorspar and natural gas are used to manufacture R22 (chlorine difluoromethane) via interim steps which is delivered by road tankers. This is used to manufacture perfluorated monomers such as tetrafluoroethylene (TFE), hexafluoropropylene (HFP) and perfluoro (propyl vinyl ether) by thermal conversion which are in turn freed of ancillary products by means of distillation.
Polymerisation: Together with ethene, these monomers are converted in water into a thermoplastic dispersion. Monomers which are not converted and polymerisation auxiliaries such emulsifiers are returned to the monomer plant and re-used after distillation.
Recycling (Reprocessing):
The degassed thermoplastic dispersion is precipitated and the ensuing powder is dried. Since this is difficult to process due to its low flowability, it is melted to granulate before shipping. This is followed by quality control which determines whether the product meets customer requirements.

Manufacture of ETFE foil:
ETFE foils are manufactured via cast film extrusion. The granulate is fed into the extruder through a funnel. In the extruder itself, the granulate is melted and the

melt homogenised. The plastic melt is then extruded out on a chill roll and detached via a downstream extrusion tool, a sheet extrusion die. This is followed by a thickness check of the foil using an inline process and edge trimming. These trimmings are directly ground down and returned to the extrusion process via the funnel using the inline process. The last step of the foil extrusion process is the rolling up of the foil on a cardboard roll.
Foil waste which cannot be re-used directly passes through a second stage on a regeneration machine before also being reprocessed into foil. The application of the recycling material is always subjected to a downcycling process.
The foils are produced in 1550 mm widths and cut to length in consultation with the customer. Depending on the foil thickness, a roll contains approximately 200 metres of foil.

Fabrication of the foil cushions:
The individual cushion pieces are cut to size on a CNC cutter.
At the same time, the positions of all further components to be installed, such as valves, are also drawn. Individual sheets are welded together to produce larger areas (area welding) and the valves are fitted. The welded foil sheets are placed on top of one another in two or more layers and welded together with an ultrasonic stapler (tacking). Keder (rope) is then welded along the edges of the foil in order to close the cushions (keder welding).
The large cushion is folded into a sheet approximately 30 cm wide and 2.5 m long and wrapped in protective polyethylene foil. The foil package is then prepared for shipping in a cardboard box together with three other cushions. The remaining project components (aluminium sections, keder, gaskets, screws and supporting air blower system) are packaged separately for shipping.

2.7 Environment and health during manufacturing
The appropriate measures according to the current state of technology are taken for manufacturing.
To date, no environmental pollution is known to be caused by processing the declared products in accordance with the generally recognised rules of technology.
The Novum Membranes GmbH quality management system was set up with the purpose of internal monitoring. It fulfils the requirements of /DIN EN ISO 9001/:2015.
In addition to safety-related supervision and education and also risk assessment by the employers' liability insurance association, Novum Membranes GmbH commissions an external consultant to train and educate employees on safety and occupational health and safety issues.
Measurements of hazardous substances in the atmosphere in work areas on 07/05/2014 taken by the German statutory accident insurance authority's Institute for Occupational Safety as part of prevention measures confirmed compliance with limits for hazardous substances and found that protective measures were adequate.
Novum Membranes GmbH is aiming for certification with the EMAS quality seal for a sustainable environmental management system.
At Nowofol, the main health protection focus during the manufacture of fluoropolymer foil is on assessing gases and vapours, for which reason TÜV SÜD was commissioned to determine the concentration of smoke, fluorides and fluorocarbons and volatile organic compounds at the workplace during the extrusion of fluoropolymers in line with the workplace exposure limits specified in /TRGS 900/ in 2011. The exposure measurements confirmed that protective measures (extraction for the purpose of air purification) are sufficient.
Dyneon is certified under register number 0900015 in accordance with /OHRIS 2009/ under the Occupational Health and Risk Management System (Ohris).

No substances are used to manufacture Novum cushions which appear on the SVHC candidate list or in Appendix XIV of the /REACH/ directive (as of 13/06/2017) (EU Directive No. 143/2011: Appendix XIV of the /REACH/ directive of 17th February 2011 and the amendment to this directive of 24/02/2011 (Official Legal Gazette L 49/52), EU Directive No. 125/2012: Amendment to Appendix XIV of the /REACH/ directive of 14th February 2012, EU Directive No. 348/2013 of 17/04/2013, EU Directive No. 895/2014 of 14/08/2014 or EU Directive No. 2017/999 of 13/06/2017).
No flame retardants, softening agents or biocides are used.

2.8 Product processing/Installation
Before roof surfaces are installed, a risk assessment must be drawn up in accordance with Section 5 of the German Occupational Safety Act (/ArbSchG/):
a Environment-related risks

- Mechanical hazards
- Electrical hazards
- Hazardous substances
- Biological hazards
- Fire and explosion hazards
- Thermal hazards
- Hazards due to specific physical influences
- Hazard/exposure due to work-environment conditions
- Physical strain
- Other hazards/exposure
- Psychological strain

b Planning access technology

c Site-related instruction
In areas where there is a risk of falling, trained personnel is equipped with personal protective equipment (PPE) and working and safety ropes. Hazard areas below the installation site are secured against falling tools or materials.
The Novum AFP system is transported to the site from Edersleben and screwed and fitted together there. The cushion is then inflated with a compressor.

2.9 Packaging
Packaging materials (cardboard boxes and PE foil) are thermally recycled. The waste incurred can be allocated to the following waste codes (/AVV 2016/):

- /15 01 01/: Paper and cardboard
- /15 01 02/: Plastic packaging
- /15 01 06/: Mixed packaging
- /17 09 04/: Mixed construction and demolition waste with the exception of waste covered by /17 09 01/ to /17 09 03/

- /20 03 01/: Mixed municipal waste

The wooden Euro pallets used for delivery are re-used.

2.10 Condition of use

No significant changes in the product's characteristics are expected during its design life. In order to compensate for fluctuations in cushion pressure due to changing external conditions (temperature, wind pressure or wind suction loads) the cushions are continuously supplied by one or more inflation units depending on the size of the roof. The inflation units are controlled by a pressure sensor. The cushion inner pressure is maintained within the range of 180 Pa and 250 Pa. An average output of approximately 19 kWh is required for a roof area of 1 m² across the entire service life of 25 years.

2.11 Environment and health during use

In accordance with the evidence outlined in Section 7, emissions to air during the use phase are below the limit values in accordance with the /AgBB/ scheme.

2.12 Reference service life

The guaranteed service life is 25 years on average (up to 50 years are possible)

2.13 Extraordinary effects

Fire

EFTE foil is specified as follows in accordance with /EN 13501 – 1/:

Fire protection

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s1

Water

The ETFE cushion is not affected by water.

Mechanical destruction

Due to their extraordinary stretch properties, foils and foil cushions are extremely resistant to external pressure and tensile loads.

In case of fire, explosions or even extreme hailstones the system is extremely fault-tolerant and resistant to consequential damage. However, the cushions can be damaged by direct mechanical influences with sharp or pointed objects. Even complete destruction of the exterior foil layer of a three-layer system does not lead to system failure since a two-layer system still remains and inner spaces are still protected against environmental influences.
Minor damage can be easily repaired with ETFE adhesive tape.

2.14 Re-use phase

Generally, the aluminium frames and base sections as well as the air piping systems can be re-used for new buildings and/or refurbishment projects with the Novum AFP system.
These components are usually recycled (statistical value for buildings: 85 %).
Like the EFTE cuttings, ETFE foils are recycled by an external company into valves and other small parts. This recycling is currently carried out within Europe. An extension is planned in future. Waste is thermally recycled in other countries

2.15 Disposal

The waste accrued can be allocated to the following waste codes:

- /17 02 03/: Plastic
- /17 04 02/: Aluminium
- /17 09 04/:Mixed construction and demolition waste with the exception of waste covered by /17 09 01/, /17 09 02/ und /17 09 03/.

Silicone seals, EPDM and PVC are thermally recycled. Alternative recycling possibilities are currently being examined.
(Steel) screws are recycled.
Packaging materials (polyethylene and cardboard) are recyclable but are generally also recycled thermally.

2.16 Further information

Further information is available from the Novum Membranes GmbH home page (www.novummembranes.de), Nowofol Produktions GmbH (www.nowofol.de) and Elnic GmbH (www.elnic.de).

3. LCA: Calculation rules

3.1 Declared Unit

This declaration refers to the production of 1 m² of a representative foil cushion (3-layer ETFE foil) complete with framing and packaging materials.

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Product weight	4,82	kg
Packaging material	0,38	kg
Conversion factor to 1 kg	5.2	-
Total weight	5,20	kg

3.2 System boundary

In addition to production, this LCA also considers installation and energy consumption during use and disposal and thus includes the cradle to plant gate with options.
The ETFE foil is also recycled like the aluminium and the steel used.
The remaining materials are recycled thermally the lifecycle sections are explained in more detail below:

- Production (A1 - A3) including the upstream chain for producing the pre-products used, their transport to the respective works and expenses involved the manufacture of granulate, foil and foil cushions.
- Transport to the construction site (A4): average distances by truck and ship.
- Installation on the construction site (A5): disposal of packaging and the initial inflation of the foil.

- Energy consumption during use (B6): power requirements to maintain the interior cushion pressure
- Transport to disposal (C2): average distances by truck.
- Waste treatment for recycling (C3): processing of materials for recycling and incineration of other materials.
- Credits (D): from energy from treatment of packaging waste (A5) and thermally recycled materials in C3. Credits also from the reprocessing value of the recycled materials (a value report based on the selling price of fresh and recycled ETFE was used as a basis here).

3.3 Estimates and assumptions

- When recycling ETFE foils, 60 % of the incoming mass in Module D is regained as fresh ETFE. The reduced quantity is based on an evaluation report in accordance with the different market prices for fresh and recycled ETFE. Recycled ETFE costs approximately 40 % less than fresh ETFE.
- The aluminium frame contributes a secondary material share of 48.3 % based on existing certificates.
- A secondary material share of 13.5% in accordance with worldsteel data was applied for steel screws and clamps.
- The composition of the solvent-based varnish for the ETFE foil is estimated (the mass portion for this is significantly below 1 %).

3.4 Cut-off criteria

All operational data collected for the base materials used has been included.
Transport is recorded for all major pre-products including transport of the products to the building site and in the end-of-life scenario.
The LCA considers production waste which accumulates directly during production and the necessary electrical and thermal energy and packaging materials.

Machinery, plant and infrastructure and also transport of the packaging materials are ignored.
The pallets used for transport in A4 are not included in the LCA as they have a negligible influence and are re-used up to 25 times.
With the exception of the pallets, all materials and energy flows are included, including those with a share of less than 1 %).

3.5 Background data

The GaBi 7.3 software system was used to model the lifecycle for the production of ETFE building components. The basic data in the GaBi database was used for energy, transport and auxiliary materials and also for pre-products.
Since the company's headquarters are in Edersleben, the LCA was prepared with reference data for Germany. The only exception is the production of the aluminium frame which is made in England and is therefore modelled with European aluminium data.
Transport to the building site is modelled globally. The power consumption for installation and use relate to Europe. Disposal and the formation of credits are also produced with European data.

3.6 Data quality

The data collected on the manufacture of ETFE building components originates from data collections from the three companies responsible for ETFE foil cushions and foil granulate. Information from external manufacturers was collected for estimates for the colouring and printing process and also for the remaining materials.
All the data used originates from the GaBi database and apart from the data for the cardboard packaging (2002) is not more than 10 years old.
The data quality can therefore be classified as being extremely good.

3.7 Period under review

The data for this lifecycle assessment is based on records from 2016.

3.8 Allocation

For incineration processes, the credits for electrical and thermal energy (in Modules A5 and C3) are evaluated by taking the elementary composition and calorific value into account.
For ETFE recycling, economic allocation is carried out in line with market prices.
Aluminium and steel recycling can be 100% recycled (after deduction of the secondary material) and credited in Module D as values for potentials and loads avoided.

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.
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4. LCA: Scenarios and additional technical information

Transport to building site (A4)

Name	Value	Unit
Truck		
Total kg diesel	0,09	kg
Transport distance	522	km
Capacity utilisation (including empty runs)	50	%

Train		
Total kg diesel	0,002	kg
Electicity (el.)	0,14	MJ
Transport distance	357	km
Capacity utilisation (including empty runs)	80	%

Installation process (A5)

Name	Value	Unit
Auxiliary	0	kg
Water consumption	0	m^3
Other resources	0	kg
Electricity consumption	0.0005	kWh
Other energy carriers	0	MJ
Material loss	0	kg
Output substances following waste treatment on site	0	kg
Dust in the air	0	kg
VOC in the air	0	kg

Reference service life

The guaranteed service life is on average 25 years, although 50 years are possible

Name	Value	Unit
Reference service life (according to BBSR) Code no. 353.414	25	a
Service life according to manufacturer specifications	25-50	a

Operational energy (B6) and use of water (B7)

The power consumption in B6 relates to a period of one year.

Name	Value	Unit
Electricity consumption	0.756	kWh

End of life (C1-C4)

Name	Value	Unit
Collected separately	4.82	kg
Recycling	4.34	kg
Energy recovery	0.48	kg

re-use, recovery and recycling potential (D), relevant scenario information

Module D contains credits from incineration processes of packaging waste (A5), seals, hoses and EPDM keder rope as well as credits for recycling of foil cushions, aluminium and steel (C3). A waste incineration plant with an R1 value > 0.6 is assumed.

5. LCA: Results

The following table shows the results of the indicators concerning the estimated impact, use of resources and waste and other output flows in relation to 1m² of a representative Novum AFP system from Novum Membranes.

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MNR	MNR	MNR	X	MND	MND	X	X	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1m² Novum AFP-System

Parameter	Unit	A1-A3	A4	A5	B6	C2	C3	D
GWP	[kg CO_2-Eq.]	6.34E+1	3.24E-1	9.65E-1	3.35E-1	7.45E-2	2.59E+0	-1.87E+1
ODP	[kg CFC11-Eq.]	7.47E-7	4.10E-14	7.48E-14	1.49E-11	9.44E-15	9.99E-9	-2.30E-7
AP	[kg SO_2-Eq.]	2.70E-1	8.06E-4	1.01E-4	9.60E-4	3.11E-4	2.74E-3	-8.11E-2
EP	[kg $(PO_4)^{3-}$-Eq.]	1.74E-2	1.92E-4	2.16E-5	8.68E-5	7.71E-5	2.77E-4	-5.02E-3
POCP	[kg ethene-Eq.]	1.63E-2	-2.48E-4	4.80E-7	6.12E-5	-1.28E-4	2.08E-4	-5.01E-3
ADPE	[kg Sb-Eq.]	2.10E-3	3.36E-8	9.47E-9	1.34E-7	7.74E-9	1.42E-6	-6.49E-4
ADPF	[MJ]	8.23E+2	4.39E+0	1.68E-1	3.58E+0	1.01E+0	1.65E+1	-2.39E+2

Caption	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

RESULTS OF THE LCA - RESOURCE USE: 1m² Novum AFP-System

Parameter	Unit	A1-A3	A4	A5	B6	C2	C3	D
PERE	[MJ]	2.72E+2	2.90E-1	2.11E+0	2.01E+0	6.68E-2	2.02E+0	-8.05E+1
PERM	[MJ]	2.08E+0	0.00E+0	-2.08E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	2.74E+2	2.90E-1	2.96E-2	2.01E+0	6.68E-2	2.02E+0	-8.05E+1
PENRE	[MJ]	9.20E+2	4.40E+0	1.09E+1	5.89E+0	1.01E+0	3.21E+1	-2.68E+2
PENRM	[MJ]	2.80E+1	0.00E+0	-1.08E+1	0.00E+0	0.00E+0	-1.29E+1	-4.37E+0
PENRT	[MJ]	9.48E+2	4.40E+0	1.88E-1	5.89E+0	1.01E+0	1.91E+1	-2.72E+2
SM	[kg]	1.30E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.27E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	7.16E-1	3.38E-4	2.21E-3	2.86E-3	7.79E-5	6.69E-3	-2.21E-1

Caption	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 – OUTPUT FLOWS AND WASTE CATEGORIES: 1m² Novum AFP-System

Parameter	Unit	A1-A3	A4	A5	B6	C2	C3	D
HWD	[kg]	1.05E-6	2.77E-7	2.38E-9	2.39E-9	6.39E-8	8.71E-9	-2.00E-7
NHWD	[kg]	1.22E+1	3.21E-4	5.47E-3	3.88E-3	7.39E-5	5.38E-1	-3.58E+0
RWD	[kg]	4.96E-2	5.06E-6	7.74E-6	9.16E-4	1.16E-6	1.08E-3	-1.32E-2
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.34E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	1.68E+0	0.00E+0	0.00E+0	1.17E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	4.05E+0	0.00E+0	0.00E+0	2.72E+0	0.00E+0

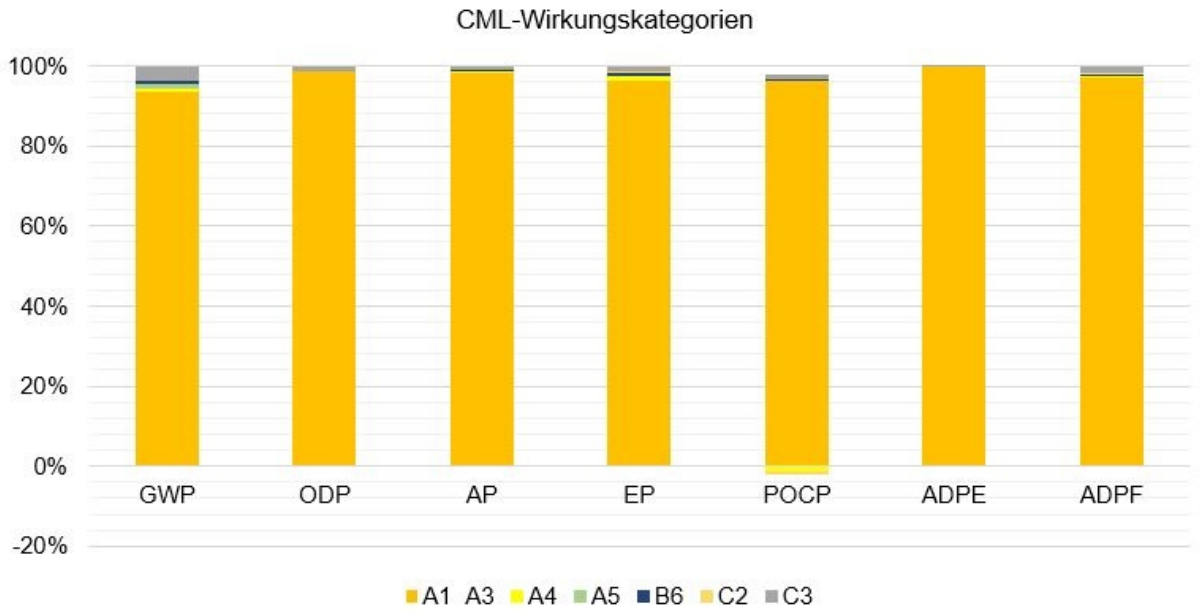
Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EEE = Exported thermal energy

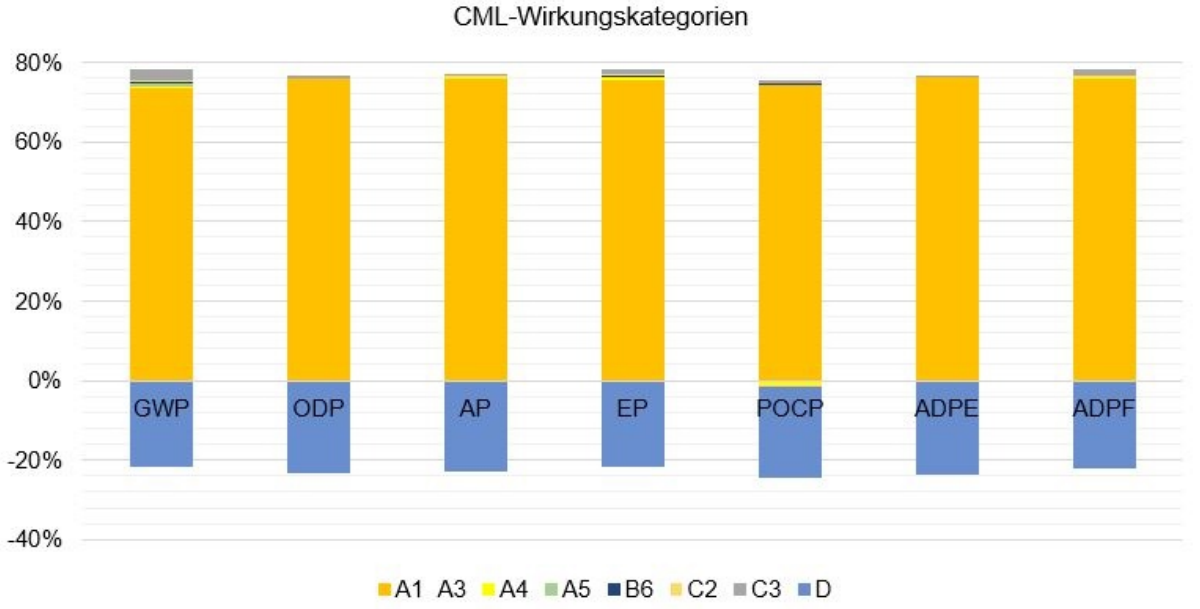
Note: the values in Module B6 relate to a use period of one year.

6. LCA: Interpretation

All CML indicators are significantly dominated by the production stage and its material and energy-related upstream chains (Module A1-A3). The main causes of environmental impacts lie in ETFE foil and aluminium production. These also represent the largest share of the overall product.
The disposal phase (Module C3) has no significant influence as the largest material flows as regards quantities are recycled in an energy-saving manner instead of being incinerated.

The environmental impact from transport (Modules A4 and C2) and installation (A5) are not significant in any of the categories. The use phase (in relation to one year) is also negligible. If the entire use period of 25 years is regarded, B6 represents approximately 10 % of the overall emissions in the categories of GWP, AP, EP, POCP and ADPF. Nitrogen monoxide emissions produced during transport have a negative influence on the **POCP** (formation potential for tropospheric ozone), which leads to credits.





If Module D is included in the LCA it is discernable that the values for potentials and avoided impacts outside of the system boundary across all environmental impact categories amount to approximately 25-30 % of the total emissions in A1-C3.

7. Requisite evidence

VOC Emissionen
VOC emissions
Testing of the Nowoflon ETFE foil for VOC emissions in accordance with the AgBB scheme /AgBB 2010/ was carried out in December 2009 by the Bremen-based Umweltinstitut - Gesellschaft für Schadstoffanalysen und Begutachtung mbH.

Measurement conditions:
Temperature: 23°C
Area-specific air flow rate: 0,5m³/(m²h)
Loading: 2 m²/m³

Name	Value	Unit
TVOC (C6 - C16)	27	µg/m³
Sum SVOC (C16 - C22)	< 5	µg/m³
R (dimensionless)	0	-
VOC without NIK	27	µg/m³
Carcinogenic Substances	ND	µg/m³

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trapezoidal test specimen with incision.

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DIN EN ISO 4892-2:2013-06: Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 4892-2:2013); German version EN ISO 4892-2:2013.

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TRGS 900: Technical Rules for Hazardous Substances 900, Workplace Limit Values, January 2006 edition, last modified and supplemented on 06/04/2017.

Institut Bauen und Umwelt
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Generation of Environmental Product Declarations (EPDs);
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for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2015/10
www.ibu-epd.de

/ISO 14025/

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

/EN 15804/

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

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Sustainability & Comfort
Working Group TensiNet

EPD 21 - Vector Foiltec

ENVIRONMENTAL PRODUCT DECLARATION

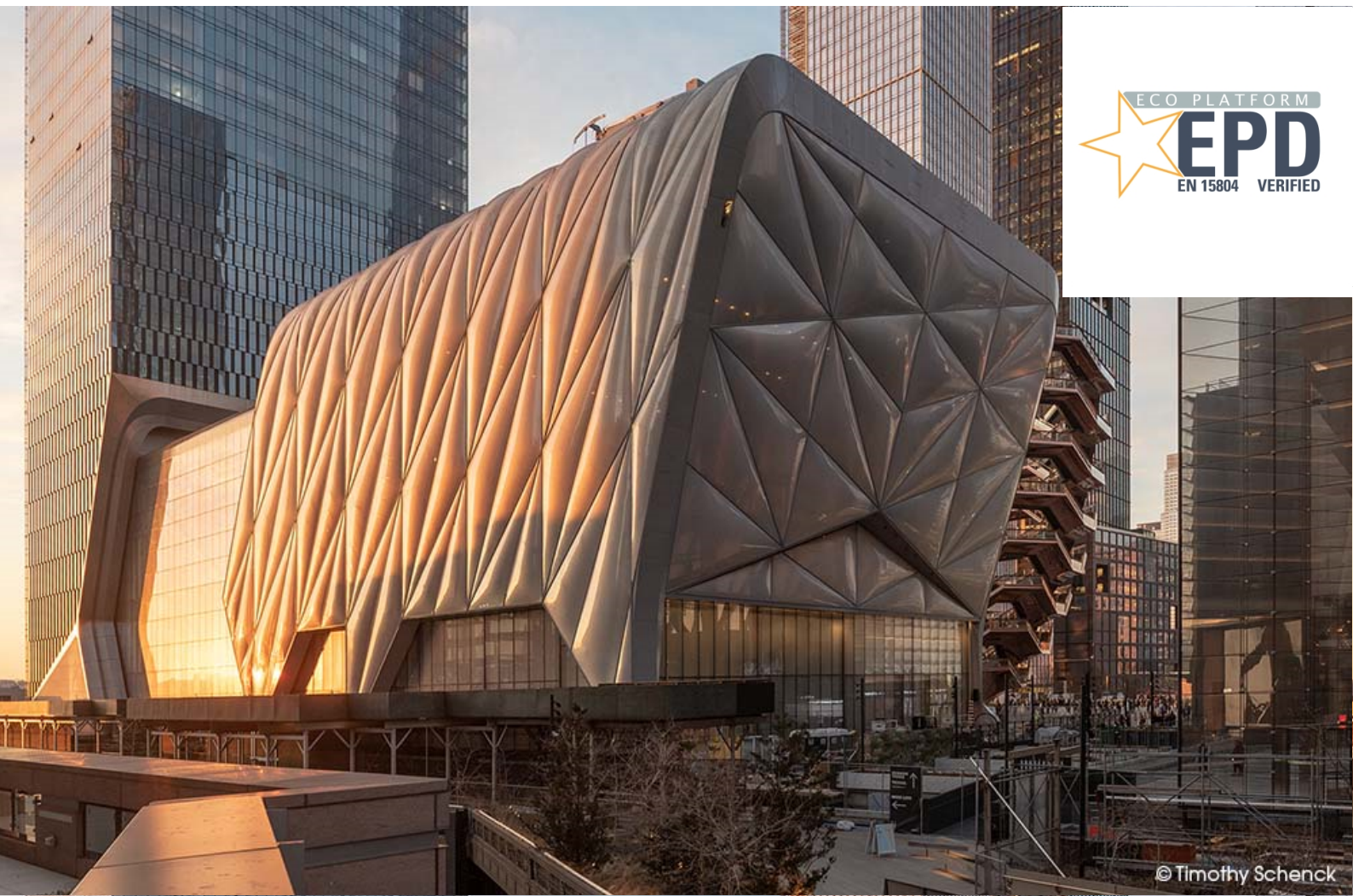
as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Vector Foiltec GmbH; Nowofol Kunststoffprodukte GmbH & Co. KG; Dyneon GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-DVN-20210122-IBJ2-EN
Issue date	19-07-21
Valid to	18-07-26

Texlon®-System

Vector Foiltec GmbH
Nowofol Kunststoffprodukte GmbH & Co. KG
Dyneon GmbH

www.ibu-epd.com | https://epd-online.com



1. General Information

Vector Foiltec GmbH
Nowofol Kunststoffprodukte GmbH & Co. KG
Dyneon GmbH

Texlon®-System

Programme holder
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Owner of the declaration
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Breslauer Str. 15, 83313 Siegsdorf
Dyneon GmbH,
Industrieparkstr. 1, 84508 Burgkirchen

Declaration number
EPD-DVN-20210122-IBJ2-EN

Declared product / declared unit
1 m² of a standard TEXLON®-System, with a weight per unit area of 3.89 kg/m².

This declaration is based on the product category rules:
ETFE construction element, 04.01.2019
(PCR checked and approved by the SVR)

Scope:
This EPD refers to individual building elements manufactured from ethylene tetrafluoroethylene (ETFE). It is valid for German production facilities. The building elements are manufactured by Vector Foiltec GmbH and traded under the brand trade name Texlon®.
The entire product chain associated with manufacturing the ETFE building elements includes the following companies:
Dyneon GmbH (ETFE granulate)
NOWOFOL Kunststoffprodukte GmbH & Co. KG (ETFE foil)
Vector Foiltec GmbH (ETFE cushions)

Texlon® foil cushions with frames are planned and produced on a project-specific basis. This EPD calculates the life cycle analysis (LCA) for a representative product.

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*.

Issue date
19-07-21

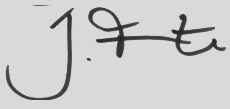
Valid to
18-07-26

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2010*
☐ internally ☒ externally

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

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))



Juliane Franze
(Independent verifier)

2. Product

2.1 Product description/Product definition

The Texlon®-System is based on the following principle:
Pneumatically stabilised foil elements are fixed to a sub-structure by means of a high-quality aluminium frame system. Depending on the building physics, the system can consist of between 2 and 5 layers of ETFE foil (ethylene tetrafluoroethylene). The g-values and U-values of the Texlon®-System are determined by the number of layers and also the type of coating used.

According to the structural engineering of the Texlon® system, the ETFE foil thickness varies between 80µm and 350µm.
The individual layers are welded together at the edges and stabilised to approximately 220 Pa (220 N/m²) by means of a low-pressure air system. This EPD is based on a typical 3-layer system with the following build up:

- Inner foil: 200 µm
- Middle foil: 100 µm
- Outer foil: 200 µm

The LCA for a representative product is calculated in this EPD.
The national regulations applicable in the place of use are also applicable to the use of the product. In Germany, for example, the building regulations of the relevant Federal State, and the technical provisions based on these regulations.

2.2 Application

Texlon®-cushions are building elements used for the construction of roofs and façades. The Texlon® system is suitable for new buildings and refurbishment projects.

2.3 Technical Data

This data refers to an ETFE foil with a thickness of 200 µm.

Constructional data

Name	Value	Unit
Melting range in accordance with ASTM D 4591-07	265±10	°C
Grammage in accordance with DIN EN ISO 536	0.35	kg/m²
Tensile strength in accordance with DIN EN ISO 527-1	> 40	N/mm²
Tensile stress at 10% strain in accordance with DIN EN ISO 527-1	> 18	N/mm²
Tensile stress at break in accordance with DIN EN ISO 527-1	> 300	%
Tear Resistance in accordance with DIN 53363	> 300	N/mm
Total energy transmittance in accordance with ISO 15099 (3-Lagen ETFE 200µm/100µm/200µm)	75±5	%
Weld strength in accordance with DIN 527-1	≥ 33	N/mm²
Weathering resistance in accordance with ISO 4892-1 sowie ISO 4892-2 (3-Lagen ETFE 200µm/100µm/200µm)	No changes to mechanical values	-

Performance values of the product in relation to its characteristics pursuant to the relevant technical regulation (no CE marking).

2.4 Delivery status

From an economic and technical perspective, maximum ETFE cushion dimensions of 3.7 metres (width) by 40 metres (length) are recommended. The cushion area should not exceed 120 m².
The large cushions are each folded into a strip which is approx. 30 cm wide and 2.5 m long, and wrapped in a protective film made of polyethylene. The foil package is delivered in a wooden box, with three to six other cushions.
The other components for the whole project (aluminium profiles, piping, seals, screws) are delivered as a complete package.

2.5 Base materials/Ancillary materials

The essential base products are Nowoflon® ET foil, frame material (F16.2 aluminium frame) and sealing materials. The following table shows the mass composition of the average product in 2019.

Composition of Texlon® System

Material	Mass percentage rate
Aluminium frame	64.9 %
ETFE foil	23.1 %
Silicone gasket	11.4 %
PP (piping) ropes	0.5 %
ETFE valves	0.05 %

Nowoflon®-ET-foil: Nowoflon® ET foil is a flexible and strong fluorinated copolymer foil. These foils are transparent over the entire solar range. They can be transparent, printed or dyed.

ETFE valves: These valves are small parts made of the same base material as the foil (ETFE), but they are not transparent and display a lower purity level (recycled).

Aluminium frame: The aluminium frame comprises an extruded base element, a cap and a channel rail.

Polypropylene (piping) ropes: The cord edge welding comprises flexible polypropylene (piping) ropes with a diameter of 6 mm to 8 mm.

Silicone seals: Silicone seals are made of a waterproof rubber-like silicone material.

1) The product contains substances which appear on the ECHA list of Substances of Very High Concern (SVHC) (as at 15.04.2021) in a mass proportion exceeding 0.1%: **no.**

2) The product contains additional CMR substances from category 1A or 1B, which are not on the candidate list, the mass proportion of which exceeds 0.1% in at least one part of the product: **no.**

3) Biocidal products have been added to this construction product, or it has been treated with biocidal products (and is therefore a treated product within the meaning of the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012)): **no.**

2.6 Manufacture

Manufacture of ETFE granulate:
Raw materials and monomers: Mineral fluorspar and natural gas are used to manufacture R22 (chlorine-di-fluoromethane), which is delivered by special road tankers. This is used to manufacture the perfluorinated monomers, such as tetrafluoroethylene (TFE), hexafluoropropylene (HFP) and perfluoro (propyl vinyl ether). These are in turn freed of ancillary products by means of distillation.

Polymerisation: These monomers, together with ethene, are converted to a thermoplastic dispersion by

means of emulsion polymerisation. Non-converted monomers and polymerisation auxiliaries such as emulsifiers are returned to the monomer plant after distillation and re-used.

Recycling (Reprocessing): The degassed thermoplastic dispersion is precipitated and the ensuing powder is dried. The low pourability of this powder means that it is difficult to process, and so it is melted to granulate prior to shipping. The granulate is subjected to quality control to determine whether the product complies with customer requirements.

Production of Nowoflon® ET foils:
ETFE foils are manufactured by cast film extrusion, whereby the granulate is fed into the extruder via a funnel. The granulate is melted in the extruder where it is also homogenised.
A downstream extrusion tool, known as a fishtail nozzle, extrudes the melted plastic onto a chill roller from which it is peeled off. The next stage involves an in-line inspection of the foil thickness and trimming of the foil edges. These trimmings are immediately ground down and redirected to the extrusion process by means of the funnel. The last step of the foil extrusion process involves winding the foil onto a cardboard roll.

Foil waste that cannot be directly recycled passes through a second stage on a regeneration machine before being processed into foil. The application of the recycled material is always subject to a so-called “down-cycling” process.

Fabrication of the foil cushions:
The foil rolls are produced in 1550 mm (width) and – depending on the foil thickness – a length of approximately 200 metres. The individual cushion sections are cut to size on a cutting plotter. The positions of other components, such as valves, are also drawn.

In order to create larger areas the individual sheets are welded together (area welding) and subsequently the valves are installed.

The welded foil sheets are placed on top of each other in two or more layers and welded in place by means of a hand-held welding tongs. Edge welding involves a polypropylene (piping) rope being welded along the edges of the cushions in order to seal the cushions (edge welding).

2.7 Environment and health during manufacturing

The appropriate measures are taken in accordance with the current state of the art.

The Texlon® quality management system was created for the purpose of internal monitoring. It is based on *ISO 9001* and the provisions for admission or approval in individual cases.

In addition, Nowofol's energy management is *ISO 50001* certified.

Within the framework of the Occupational Health and Risk Management System (OHRIS), Dyneon is certified under register number 09-00015 (*OHRIS 2009*)).

2.8 Product processing/Installation

The Texlon® System is installed on the basis of the procedural instructions for the installation of Texlon® Systems, and includes the following work steps:

- The client or their construction management team approves the construction site for the installation
- Pre-installation of seals, hammer head screws, safety nets and profiles on the site, in coordination with the steel construction company responsible for the primary structure
- Creation of safe access to work stations (mobile lifting platforms, safety nets and lines for access, etc.)
- Inspection of the primary structure and elevations for dimensional accuracy. Reporting to the project management team
- Installation of base profiles and stretch strips
- Checking for dimensional accuracy and quality
- Installation of the air supply system
- Installation of Texlon® ETFE panels, with the help of special pulling devices (pullers), to apply the necessary pre-tension
- Final assembly of the profile caps and the Man Safe Systems
- Handover of the test certificates and acceptance by the client
- Site clearance

Before installing the roof surfaces, a risk assessment must be carried out in accordance with Section 5 of the Occupational Safety and Health Act (ArbSchG)

2.9 Packaging

The foil cushions which have been folded for transport are wrapped in polyethylene foil for protection. The individual foil packs are put into wooden boxes of 4-6 foil packs, depending on the size of the cushions. The remaining components are delivered to the construction site either in Euro pallets or in wooden boxes.

2.10 Condition of use

No significant changes in the product characteristics are expected during its design life. To compensate for deviations in cushion pressure caused by changing external conditions (temperature, wind pressure loads/wind suction loads), the cushions are continuously supplied by one or more inflation units. The size of the roof determines the number of inflation units required. The units are controlled by a pressure sensor, and the internal pressure is maintained within a range of between 180 Pa and 250 Pa. An average output of 60 W is required for a roof area of 1000 m².

If required, an air drier can be used in certain air/humidity conditions.

2.11 Environment and health during use

In accordance with the evidence outlined in section 7,

the emissions to air during the use phase fall below of the limit values as per the AgBB scheme.

2.12 Reference service life

When a maintenance contract is concluded, the guaranteed service life is usually 5 years. An average useful life cannot yet be specified, as the first building envelopes made with Texlon® ETFE foils over 35 years ago are still in unrestricted use.

2.13 Extraordinary effects

Fire

Reaction to fire

In accordance with *EN 13501-1,* Nowoflon® ET foil is specified as a B-s1-d0 material as follows:

Fire protection

Name	Value
Building material class	B
Burning droplets	d0
Smoke gas development	s1
FIGRA transparent	0 kW/s
FIGRA printed	0 kW/s
SMOGRA transparent	14,8 m²/s²
SMOGRA printed	26,4 m²/s²

The reaction to fire of the Texlon® System as a building envelope is determined by the so-called "Small Room Test" in accordance with *ISO 13784-1*. Both a system structure with a three-layer transparent ETFE film and a system structure with three-layer cushions – the outer film layer of which had a highly reflective print on the inside – were tested. The results are recorded in *RISE Report 9P00808*, produced by the testing institution. Because the calculation of the FIGRA (Fire Growth Rate) and the SMOGRA (Smoke Development Rate) is not part of *ISO 137841*, these properties were calculated separately by RISE (RISE 2019-06-24) pursuant to *ISO 9705-1*. Neither burning droplets, nor fire spread, nor the escape of flames through the door opening were observed. The addition of the ETFE building envelope to the fire was below the detection limit (max. heat release rate – HRR – not detectable without burner). Accordingly, FIGRA must be set to zero. SMOGRA is defined as the quotient of the maximum smoke development over a period of 60 sec., and the time required for this. If this is less than 0.3 m^2/s, the SMOGRA is set to zero. The SMOGRA of the Texlon® System is shown in the table above.

Water

Nowoflon® ET foil is not affected by water. This was confirmed by a leaching test in Norway - *PD/CEN TS 16637*.

Mechanical destruction

The foils and cushions are extremely resistant to exterior pressure and tensile loads owing to their extraordinary elongation properties.
In the case of fire, explosions or even extreme hailstones, the system is extremely fault-tolerant and is resistant to consequential damage. The cushions can, however, be damaged by direct mechanical influences with sharp or pointed items. Destruction of the exterior layer of foil does not lead to system failure. For example if the upper foil of a 3-layer system is damaged, a 2-layer system is retained and the interior chamber remains protected from environmental influences.
Minor damage can be easily repaired using Texlon® tape.

2.14 Re-use phase

As a general rule, the aluminium caps and base profiles of the Texlon® System can be re-used for new buildings and/or refurbishment projects. These components are usually recycled (statistic value for buildings: 85%).
Nowoflon® ET foils and valves – as well as ETFE offcuts – are recycled by external companies and made into valves and other small parts that can be used in new Texlon® cushions.
Recycling is currently only carried out in Europe, but will be extended to other regions in future. Waste is thermally recycled in other countries.

2.15 Disposal

The waste incurred can be allocated to the following waste codes:

17 02 03: Plastic
17 04 02: Aluminium
17 09 04: Mixed construction and demolition waste with the exception of waste covered by 17 09 01, 17 09 02 and 17 09 03.

The packaging materials (wooden crates, PE foil) are thermally recycled. The waste incurred can be allocated to the following waste codes (*AVV 2017*):
15 01 03 Wood
15 01 02 Plastic
Silicone seals are thermally recycled.
Recycling possibilities are currently being examined
Polypropylene is recyclable but is usually thermally recycled.

2.16 Further information

Further information can be found on the Vector Foiltec website, at www.vector-foiltec.com.

3. LCA: Calculation rules

3.1 Declared Unit

The declaration refers to an average TEXLON® System of 1 m² with a weight per unit area of 3.89 kg/m².

Declared unit

Name	Value	Unit
Declared unit	1	m^2
conversion factor [Mass/Declared Unit]	3.89	-

The weight per unit area of an average ETFE foil cushion is 0.88 kg/m².

3.2 System boundary

The declaration type represents a “cradle-to-gate with options”. For the life cycle assessment of an average ETFE component (TEXLON®), not only production, but also installation, energy consumption during use, and disposal are considered. All relevant life cycle phases are therefore represented.

There are two possible scenarios for the disposal of foil cushion waste:

1. Recycling
2. Waste incineration

Waste processing is considered for scenario 1. In both cases, the seal is incinerated while the aluminium frame is recycled.

The life cycle stages are explained in detail below:

- Product stage (**A1 - A3**): including the upstream chain associated with manufacturing of preliminary products, transport thereof to the respective plant, and expenses involved in producing granulate, foil and foil cushions
- Transport to the construction site (**A4**): average distances by HGV or ship
- Installation on the construction site (**A5**): energy for inflating foil cushions as well as disposal of packaging
- Operational energy use (**B6**): energy consumption for maintaining the interior cushion pressure
- De-construction (**C1**): manual dismantling of the system
- Transport to disposal (**C2**)
- Waste processing (**C3**): Scenario 1: processing foil waste; Scenario 2: incineration of foil waste; incineration of seals
- Benefits and loads beyond the system boundaries (**D**): from energy for the treatment of packaging waste (A5) and the silicone seals, recycling of aluminium profiles and expenses associated with their processing (re-melting), as well as the credit for recycling of ETFE as material under scenario 1, and the credit for the thermal recycling of ETFE under scenario 2.

3.3 Estimates and assumptions

Estimates need to be made for the following cases:

- Frame: The manufacturer has provided a certificate for the aluminium frame, which shows a share of approx. 45% of post-consumer secondary material. This value is used for the EPD.
- Recycling ETFE material (scenario 1): The recycled EFTE granulate cannot be used to produce new ETFE foils, but is used to produce valves and flexible connecting hoses that are required for the operation of cushions.

3.4 Cut-off criteria

All data from operational data collation at Vector Foiltec, Nowofol and Dyneon has been taken into consideration, i.e. all base materials used in accordance with the recipe formula. Transport is recorded for all essential preliminary products, transporting the products to the site, and in the End-of-Life scenario. In the LCA, the production waste generated directly during production, as well as the electrical and thermal energy required and the packaging materials, were taken into account.

The machinery, systems and infrastructure required in production, as well as the costs of transporting the packaging materials, were neglected.

This means that material and energy flows with a share of <1% were also taken into account.

3.5 Background data

The GaBi 6 software was used to model the life cycle of the Texlon® ETFE system. The basic data in the GaBi database is applied for energy, transport, auxiliary products and preliminary products.

The headquarters of the respective companies are in Germany, so the LCA is prepared with Germany as the reference country. Transport to construction sites is modelled internationally. The power consumption for installation and utilization phases relates to Europe, and can be adapted for other countries if required.

3.6 Data quality

Overall, the data quality can be rated as very good. The data quality of the foreground data is very good, as current, specific primary data relating the manufacture of ETFE components was collected.

The data quality of the background data is also very good, as current data relating to foils and granulate production was also collected. The background database used has also been updated.

The background data used was last reviewed in 2019.

3.7 Period under review

The data for this Life Cycle Assessment is based on records from 2019 for each of the three companies. The volumes of raw materials, energy, and auxiliary materials used are considered as average annual values for the respective plant.

3.8 Allocation

Aluminium profiles with a post-consumer recycling share of 45% are modelled as scrap input (open-loop recycling) in A1 - A3, based on a certificate provided by the supplier.

In the case of combustion processes (C3), an MVA and the resulting benefits (D) for electrical and thermal energy are determined, taking into account the elementary composition and the heating value.

When recycling the ETFE foils (C3), an adjustment factor of 55% was estimated for the material recycling potential, based on an economic allocation.

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 background database used is GaBi CUP 2020.2.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon
The product itself does not contain any biogenic carbon, only the product packaging (wooden crates): 0.11 kg carbon per square metre.

The following technical information serves as the basis for the declared modules, or can be used to develop specific scenarios in the context of a building assessment if modules are not declared (MND).

Transport to site (A4)
Average distance per mode of transport in relation to global international transport data (2019).

Name	Value	Unit
Transport distance HGV	244	km
Transport Distanz Ship	4842	km

Installation process (A5)

Name	Value	Unit
Electricity consumption per m²	0.00018	kWh

Reference service life
The referenced average service life is 25 years. A lifespan of 50 years is possible.

Name	Value	Unit
Reference service life	25 - 50	a

Betriebliche Energie (B6)

Name	Value	Unit
Electricity consumption pro a*m²	0.274	kWh
Other energy carriers	0	MJ

End of life (C1–C4)
Conservative estimate for transport to EoL: 1,000 km for transport in Europe (material recycling is currently only performed in Europe). Shorter transport distance for thermal recycling.

Name	Value	Unit
Collected separately (total product)	3.89	kg
Recycling aluminium frame	2.395	kg
For thermal recycling of seals	0,422	kg
For recycling szenario 1: Foil cushion	0,875	kg
For thermal recycling szenario 2: Foil cushion	0,875	kg
For recycling small steel parts	0,196	kg
	-	
	-	

Collection and recycling rates were estimated at 100%. Processing losses were taken into account with 5% for aluminium and 2% for ETFE foils.

Reuse, recovery and recycling potential (D), relevant scenario information Module D contains benefits from incineration process involving packaging waste (A5), seals, and foil cushions (scenario 2), as well as benefits from the recycling of aluminium frames, small steel parts and foil cushions (Scenario 1) (C3). A waste incineration plant with an R1 value>0.6 was assumed.

5. LCA: Results

The following includes the results of the indicators of the impact assessment, the use of resources, as well as waste and other output flows relating to a 1 m2 Texlon® System.

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	X	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m² Texlon®-System

Core Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
GWP-total	[kg CO_2-Eq.]	3.68E+1	8.55E-1	6.63E-1	1.11E-1	0.00E+0	1.11E-1	5.62E-2	9.30E-1	1.65E+0	0.00E+0	-1.99E+1	-1.26E+1
GWP-fossil	[kg CO_2-Eq.]	3.71E+1	8.51E-1	1.68E-1	1.10E-1	0.00E+0	1.10E-1	5.58E-2	7.05E-1	1.44E+0	0.00E+0	-1.98E+1	-1.25E+1
GWP-biogenic	[kg CO_2-Eq.]	-3.43E-1	4.75E-4	4.95E-1	3.68E-4	0.00E+0	-1.88E-4	-9.53E-5	2.23E-1	2.17E-1	0.00E+0	-6.68E-2	-2.05E-2
GWP-luluc	[kg CO_2-Eq.]	3.23E-2	3.58E-3	1.15E-5	1.60E-4	0.00E+0	8.89E-4	4.52E-4	1.28E-3	8.48E-5	0.00E+0	-1.08E-2	-3.73E-3
ODP	[kg CFC11-Eq.]	2.11E-7	2.10E-16	1.30E-16	2.43E-15	0.00E+0	1.32E-17	6.70E-18	1.54E-14	6.92E-16	0.00E+0	-8.51E-8	-8.44E-15
AP	[mol H^+-Eq.]	1.15E-1	8.04E-3	1.17E-4	2.43E-4	0.00E+0	3.53E-4	1.79E-4	9.89E-4	4.42E-4	0.00E+0	-7.40E-2	-5.71E-2
EP-freshwater	[kg PO_4-Eq.]	8.65E-5	1.86E-6	1.95E-8	2.95E-7	0.00E+0	3.34E-7	1.70E-7	4.86E-6	1.34E-7	0.00E+0	-2.86E-5	-4.78E-6
EP-marine	[kg N-Eq.]	1.92E-2	4.05E-3	2.97E-5	5.41E-5	0.00E+0	1.59E-4	8.07E-5	3.31E-4	1.52E-4	0.00E+0	-1.01E-2	-7.30E-3
EP-terrestrial	[mol N-Eq.]	2.08E-1	4.46E-2	5.54E-4	5.68E-4	0.00E+0	1.78E-3	9.03E-4	3.53E-3	2.04E-3	0.00E+0	-1.10E-1	-7.95E-2
POCP	[kg NMVOC-Eq.]	6.00E-2	1.18E-2	7.82E-5	1.48E-4	0.00E+0	3.12E-4	1.58E-4	8.10E-4	4.12E-4	0.00E+0	-3.15E-2	-2.32E-2
ADPE	[kg Sb-Eq.]	1.71E-3	7.10E-8	1.85E-9	3.19E-8	0.00E+0	7.87E-9	4.00E-9	1.90E-7	1.01E-8	0.00E+0	-6.60E-4	-1.22E-6
ADPF	[MJ]	4.76E+2	1.14E+1	1.45E-1	1.94E+0	0.00E+0	1.46E+0	7.43E-1	6.46E+0	8.42E-1	0.00E+0	-2.36E+2	-1.50E+2
WDP	[m^3 world-Eq deprived]	2.81E+0	3.68E-3	6.61E-2	2.40E-2	0.00E+0	9.81E-4	4.99E-4	8.05E-2	2.18E-1	0.00E+0	-1.78E+0	-1.58E+0

Caption	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 m² Texlon®-System

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
PERE	[MJ]	1.51E+2	6.61E-1	3.34E+0	8.59E-1	0.00E+0	8.22E-2	4.17E-2	3.61E+0	1.96E-1	0.00E+0	-7.72E+1	-5.93E+1
PERM	[MJ]	3.31E+0	0.00E+0	-3.31E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.55E+2	6.61E-1	3.08E-2	8.59E-1	0.00E+0	8.22E-2	4.17E-2	3.61E+0	1.96E-1	0.00E+0	-7.72E+1	-5.93E+1
PENRE	[MJ]	4.55E+2	1.14E+1	2.19E+0	1.94E+0	0.00E+0	1.46E+0	7.43E-1	2.53E+1	1.97E+1	0.00E+0	-2.55E+2	-1.50E+2
PENRM	[MJ]	2.07E+1	0.00E+0	-2.04E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.89E+1	-1.89E+1	0.00E+0	1.89E+1	0.00E+0
PENRT	[MJ]	4.76E+2	1.14E+1	1.45E-1	1.94E+0	0.00E+0	1.46E+0	7.43E-1	6.46E+0	8.42E-1	0.00E+0	-2.36E+2	-1.50E+2
SM	[kg]	1.08E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.31E-2	3.31E-2
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	2.89E-1	5.92E-4	1.55E-3	9.94E-4	0.00E+0	9.51E-5	4.83E-5	3.59E-3	5.18E-3	0.00E+0	-1.90E-1	-1.54E-1

Caption	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 m² Texlon®-System

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
HWD	[kg]	7.46E-7	4.24E-7	1.16E-10	8.03E-10	0.00E+0	6.81E-8	3.46E-8	5.68E-9	3.68E-8	0.00E+0	-1.66E-7	-6.71E-8
NHWD	[kg]	4.27E+0	1.99E-3	4.07E-3	1.38E-3	0.00E+0	2.24E-4	1.14E-4	7.22E-2	3.36E-1	0.00E+0	-2.94E+0	-2.86E+0
RWD	[kg]	2.08E-2	1.20E-5	4.58E-6	2.94E-4	0.00E+0	1.81E-6	9.20E-7	5.30E-4	4.31E-5	0.00E+0	-1.05E-2	-8.19E-3
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	3.40E+0	3.40E+0	8.58E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	9.01E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	5.55E-1	2.30E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	2.10E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.25E+0	4.38E+0	0.00E+0	0.00E+0	0.00E+0

Caption	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; EEE = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m² Texlon®-System

Indicator	Unit	A1-A3	A4	A5	B6	C1	C2/1	C2/2	C3/1	C3/2	C4	D/1	D/2
PM	[Disease Incidence]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR	[kBq U235-Eq.]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	[CTUe]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	[CTUh]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	[-]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Caption	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

The results of the optional environmental impact indicators are not declared because the uncertainty of these results is high, or because there is only limited experience with the indicator.

Note: The results of module B6 reflect the product use of one year. When applying the results for a building LCA, they must be adapted to the total life span of the building.

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 the uncertainties on these results are high or as there is limited experienced with the indicator.

6. LCA: Interpretation

The majority of environmental impacts and the use of primary energy are caused by the upstream chain, i.e. manufacture of the preliminary products.

Particularly, manufacturing of the aluminium frame which contributes most to the overall system mass is clearly apparent during the production phase.
But also the foil cushion contributes significantly to the environmental impacts. This is particularly attributable to the production of granulate.
Production at Vector Foiltec has barely any effect on the impact categories under review (up to max. 6% of the overall production phase). The other impact categories essentially follow this breakdown for the entire production phase too.

Transport to the construction site is modelled in accordance to the international distribution of the Texlon® System and is based on average data from 2019. Transport can also be significantly less intensive for specific projects.

Neither the energy required for initial inflation of the foil cushion (Module A5) nor for maintaining the internal cushion pressure during the use phase (Module B6) contribute significantly to the overall life cycle in any of the impact categories. It must be noted that the use phase is only modelled for one year, and that this must be adapted to the intended life time of the building.

Two scenarios are presented for the End of Life:
1. Foil cushion material recycling
2. Thermal recycling of foil cushions

In both cases, the aluminium frame and small steel parts are recycled. In both scenarios, there is recovery potential, which is greater in the case of material recycling.

The environmental results were calculated for an average product made in 2019, with a weight per unit area of 3.89 kg per square metre. The weight per unit area is largely determined by the weight of the aluminium frame. In the case of systems with a higher weight per unit area (larger aluminium frame), a higher environmental impact can be assumed, and correspondingly lower environmental impacts with a lower weight per unit area (smaller aluminium frame). This means that larger cushion sizes and spans reduce the environmental impact due to a lower weight proportion of aluminium in the system.

7. Requisite evidence

7.1 VOC emissions

The analysis of the Nowoflon® ET-foil for VOC-emissions in accordance with the AgBB test- and assessment scheme (2021) has been carried out in December 2022 by the Bremer Umweltinstitut – Gesellschaft für Schadstoff-analysen und Begutachtung mbH – durchgeführt.

Measurement conditions:

Temperature	23 °C
Area-specific air flow rate	0.36 m³/(m²h)
Product loading	1.33 m²/m³
Sample surface area	0.33 m²

AgBB Result review (28 days)

Name	Value	Unit
TVOC (C6 – C16)	< 5	µg/m³
Sum SVOC (C16 – C22)	n.d.	µg/m³
R (dimensionsless)	0.000	-
VOC without NIK	n.d.	µg/m³
Cancerogenes	n.d.	µg/m³

detection limit 1 µg/m³ n.d.: not detected

7.2 Release of water-soluble substances

The review of the Nowoflon® ET-foil for the release of water-soluble hazardous substances has been carried out in December 2015 within the framework of the general building permit for Norway by SINTEF Norway in accordance with PD/CEN/TS 16637. Neither the loss of sample mass nor the release of organic components could be determined.

8. References

PCR Part A
Product category rules for building-related products and services from the programme for environmental product declarations of Institut Bauen und Umwelt e.V. (IBU), Part A: Calculation rules for the life cycle assessment and requirements for the project report. Version 1.8, 07/2019, www.ibu-epd.com

PCR: ETFE building elements
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Sustainability & Comfort
Working Group TensiNet

EPD 22 – Pfeifer

ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	PFEIFER Seil- und Hebetechnik GmbH
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-PFE-20220207-IBC2-EN
Issue date	20.03.2023
Valid to	19.03.2028

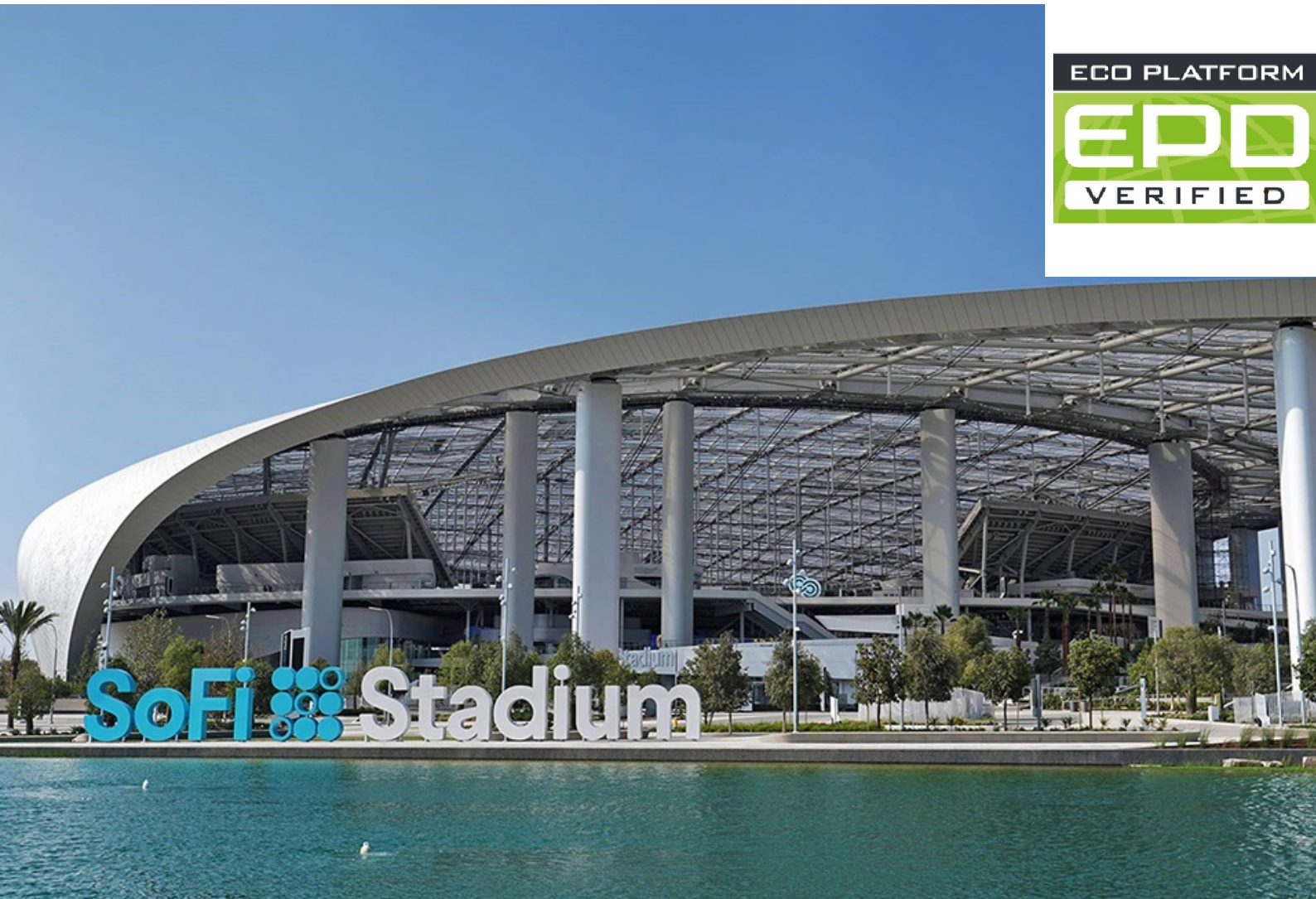
ETFE-Membrane

PFEIFER Seil- und Hebetechnik GmbH

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

www.ibu-epd.com | https://epd-online.com



1. General Information

PFEIFER Seil- und Hebetechnik GmbH

Programme holder

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

Declaration number

EPD-PFE-20220207-IBC2-EN

This declaration is based on the product category rules:

ETFE construction element, 01.01.0001
(PCR checked and approved by the SVR)

Issue date

20.03.2023

Valid to

19.03.2028

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

Dipl.-Ing. Hans Peters
(Managing Director Institut Bauen und Umwelt e.V.)

ETFE-Membrane

Owner of the declaration

PFEIFER Seil- und Hebetechnik GmbH
Dr. Karl-Lenz-Straße 66
87700 Memmingen
Germany

Declared product / declared unit

1 m² ETFE-Membrane supplied by PFEIFER Seil- und Hebetechnik GmbH

Scope:

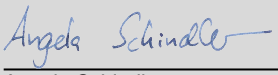
This document refers to an average EPD of roof modules made of ETFE-Membranes supplied by the company PFEIFER Seil- und Hebetechnik GmbH, manufactured in Shanghai, China. The declared unit refers to an average roof module made of ETFE-Membranes with 1 m² nominal roof surface area which can be used in a single-layer or multi-layer system. Data were collected at the plant level with current annual data for 2019. The owner of the declaration is responsible for the underlying data and their verification.
The owner of the declaration is liable for the basic information and supporting evidence; any liability of the IBU in relation to manufacturer's information, LCA data and supporting evidence is excluded.

This EPD was compiled in accordance with the requirements of EN 15804+A2. This standard is herein referred to in simplified form as EN 15804.
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*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally



Angela Schindler,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The PFEIFFER structures EFTE-Membrane consists of flour-based polymers. Its functional characteristics are: lightness, transparency, resistance to high temperatures, chemicals and weather conditions. In addition, the material is a stron electric insulant and has non-stick properties. The disposal of ETFE film is subject to local conditions.
Where appropriate recycling systems are available, the film can be subjected to full feedstock recycling. In this document, we will assume that the film will be subjected to thermal recycling.

The ETFE systems are attached to a substructure in a stabilising aluminium frame system. The system may consist of a single or a multiple film layers which are fused along the edges. The edges will typically be locked by means of a piping or by folding. The connection to the supporting structure is established via a multiple-unit, aluminium frame profile (piping profile).

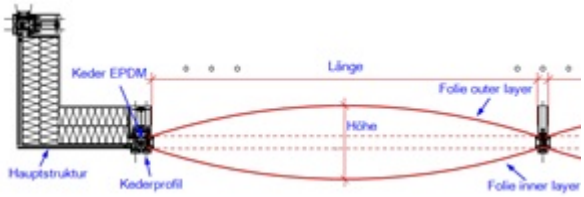
ETFE-Membranes vary in size, colour and shapes. In principle, it is possible to created even large span widths by joining several lengths of material. As a rule, the maximum size of a single film element is limited by structural planning requirements and the method of assembly used.

ETFE thicknesses vary between 80 µm and 900 µm, subject to static and design requirements. The individual layers are fused with one another along the edges and are kept constant at a defined level of e.g. 220 Pa (20 N/m²) using a low-pressure air system.

For the purpose of this EPD, a single-layer and a multi-layer (cushion) system were averaged.

The chosen modalities can be used as a suitable reference for construction engineering purposes. For energetic reasons, ETFE cushion systems play a critical role especially when it comes to enveloping heated or air-conditioned inside spaces.

The figure below depicts a horizontal section of an exemplary cushion structure of a façade system.



No hamonised standards exist at European and global level for ETFE products. The design and building of the work are covered by the relevant national and technical specifications. The fabrication and mechanical requirements of the individual components including film, piping profiles, piping, and fasteners are defined or drafted in view of the specific application. The respective national regulations apply to the use of the product at the location of use, for example the building regulations of the federal states in Germany and the technical regulations based on these regulations.

2.2 Application

PFEIFER ETFE films are used in different works: façade, roof structures or building envelopes.

2.3 Technical Data

The following technical specifications apply to the ETFE Membrane. Products are tested in application of a range of standards.

Constructional data

Name	Value	Unit
Melting range acc. to ASTM D 4591-07	260 - 280	°C
Specific density acc. to ASTM D 792	1,75	g/cm³
Transparency acc. to DIN EN 410	>91	%
Color rendering index acc. to DIN EN 410	98,8	
Grammage (ETFE-foil)	0.14 - 0.88	kg/m²
Tensile strength acc. to DIN EN ISO 527-1 (ETFE-foil)	>50	N/mm²
Tensile stress at 10% strain acc. to DIN EN ISO 527-1 (ETFE-foil)	>18	N/mm²
Tensile stress at break acc. to DIN EN ISO 527-1 (ETFE-foil)	>350	%
Tear Resistance acc. to DIN 53363 (ETFE-foil)	>350	N/mm
Weld strength acc. to DIN 527-1 (ETFE-foil)	≥ 33	N/mm²
Total energy transmittance acc. to ISO 15099 (Multiple-layer foil cushion)	75 ± 5	%
Weathering resistance acc. to ISO 4892-1 (Multiple-layer foil cushion)	keine mechanischen oder optischen Veränderungen	-
Thermal operating range	-200 – 150	°C
Shrinkage at 150°C/10min	0-5	%

Performance values of the product in relation to product properties under the relevant technical regulation (no CE marking).

2.4 Delivery status

The ETFE-Membrane comes fully prefabricated; no further assembly work is required at the site of installation. When folded, the films have usual component sizes of 1 or 2 metres. Typically, the films are placed on oversized pallets or in wooden crates for transport. The cardboard boxes used are exclusively made from recycled paper materials to avoid creasing of the film. Packing units are kept as compact as possible for delivery.

The proportion of packaging is high and may be subject to substantial variations, depending on the project in question. Due to lack of data, this study does not consider the product packaging for transportation to the installation site, in deviation from EPD standard requirements.

2.5 Base materials/Ancillary materials

PFEIFER ETFE-film systems consist of:

- ETFE film: approx. 6 mass % - 30 mass %.
- Piping (EPDM): 8 mass % - 16 mass %
- Aluminum profile: approx. 13 mass % - 68 mass %
- Stainless steel screws and nuts: appro. 5 mass %

The product/at least one subproduct contains materials included in the ECHA list of substances of very high concern (SVHC)(27/06/2018) at a mass % of more than 0.1: no.

The product or at least one subproduct contains further CMR Category 1A or 1B substances which are not included in the candidate list in doses or more than 0.1 mass % in at least one subproduct: no.

Biocidal products were added to this construction product or it was treated with biocidal products (it therefore a processed product as per the EU Biocide Directive no. 528/2012: no.

2.6 Manufacture

The entire PFEIFER group of companies has implemented a certified quality management in accordance with DIN EN ISO 9001:2015.

The manufacture of the product systems discussed herein begin with the project-specific design and production of the required components.
All component are obtained from the respective suppliers in the form of prefabricated precursors and are delivered to the production plant in Shanghai. Precursors includes the prewelded aluminium profiles, ETFE film, EPDM piping, and stainless steel screws/nuts. Due to lack of data precursor modelling is mostly based on generic assumption with inventories from LCIA database ecoinvent 3.8

The precursors are inspected at the production site and subjected to the final processing steps (e.g., bores in the profile frame).

2.7 Environment and health during manufacturing

The process of fabricating of an ETFE-Membrane is basically an operation which is not expected to produce much contamination or dust.

Occpational health requirements are met throughout in the country of manufacture.

By only employing relevant structural element and statically utilising the element use vs other types on construction practised in the building industry, the amount of building material used is minimised. Another favourable environmental effect is the high transfluency of the film structures and hence the greater portion of usable daylight.

cushion structures with photovoltaic, solar or shading elements and indirect lighting options embedded in the air-filled chambers are currently under development as well.

2.8 Product processing/Installation

Installation must be performed by trained Staff following the manufacturer's defined assembly instructions. The manufacturer's specifications must be complied with.

Installation comprise three steps:

1) Trimming: The films are trimmed to size at the factory.

2) Fusing: The films are fused to produce the final membrane and packed.

3) Construction site: The piping profiles, rope bags and air inlets/outlets are incorporated at the site of installation and assembled of the basis of a modular principle.

2.9 Packaging

The roof systems are picked in disassembled condition and prepared for transport to the construction site. A number of different packaging and transport systems are used for transport, depending on the order being processed. As a rule, the ETFE-Membranes are packed in PE film and in a cardboard box. In the next step , they are placed on a pallet in a wooden crate for transport to the construction site.

The packaging material is easily separable and can be reused if utilised properly. Other packaging components can be correctly sorted, collected and sorted to the local recycling firm. Waste materials must be disposed of in compliance with the applicable national regulations.

2.10 Condition of use

The physical composition of PFEIFER Seil- und Hebetechnik GmbH's ETFE-Membrane stay constant throughout their service life.

2.11 Environment and health during use

The processing and installation of the products creates no environmental burden. No special environmental protection measures need to be taken.

As far as is known today, air and soil hasard are out of the questionas long as the products described are used properly and as intended.

Vapor and/or age-related dissociation of microparticles endangering the ground water are not known.

2.12 Reference service life

Its was not possible to determine the reference service life as per ISO 15686. According to the service life of component for life cyle analyses under the nachhaltiges Bauen (sustainable Construction, BBSR 2017) assessment system, the products have a service life of at least 25 years.
Structures exist with a known service life of more thas 30 years. Description of the influences on the ageing of the product when applied in accordance with the rules of technology.

2.13 Extraordinary effects

Fire

The ETFE-Membrane declared herein meets the fire classification B according to EN 13501.

Water

No ingredients hazardous to water are washed out.

Mechanical destruction

The EPDM piping profiles are recyclable. However, elements once installed in other works are rarely reused directly, due to the safety concept followed in the building industry.

The destruction of cushion structures by extreme weather events cannot be ruled out. This does not pose an immediate risk to the environment, however, because the leftovers are large-size elements that will not degrade into very small elements.

2.14 Re-use phase

The complete roof system or individual components are not intended for reuse.
The aluminum profiles and stainless steel screws can be subjected to feedstock recycling. The EPDM piping and ETFE-Membranes can be subjected to thermal recycling.

2.15 Disposal

The Waste keys under the waste Index Ordinance (Abfallverzeichnis-Verordnung, AVV) 2020 are: 07 02 03: plastic, 17 04 02: aluminium, 17 09 04: mixed construction and demolition waste except material covered by 17 09 01, 17 09 02 and 17 09 03.

2.16 Further information

Detailed processing guidance, product data sheets, and other technical information can be downloaded from the PFEIFER Structures website: Lightweight Structures Specialty Contractors | PFEIFER Structures (pfeifer-structures.com)

3. LCA: Calculation rules

3.1 Declared Unit

The declaration covers the manufacture of 1m^2 of an average EFTE-Membrane system including an aluminium frame structure and stainless steel screws with a total weight of 3.36 kg/m^2.
The product constitutes the average of a PFEIFER Structures single-layer and a multi-layer system for 2019.

Declared unit

Name	Value	Unit
Declared unit	1	m^2
Layer thickness	3.36	m
Grammage	0.29761	kg/m^2

For IBU core EPDs (in which Chapter 3.6 is not declared): For average EPDs, an estimation of the robustness of the LCA values has to be made, for example with regard to the variability of the production process, the geographical representativeness, and the influence of the background data and precursors compared to the environmental effects which are caused by the actual production.

3.2 System boundary

The LCA considers the system boundaries "from cradle to the factory gate - with options" and follows the modular layout defined in EN 15804. The LCA considers the following modules:

- A1: Frabrication of the precursors (e.g., ETFE films, alumunium frames) and project-specific prefrabrication of individual components (e.g., welding of aluminum frames)
- A2: Transport to manufacturer: transport of precursors to the production site.
- A3: Manufacturing processes and expenses: Inspection and project-specific picking of individual components into a complete roof system
- C1: Dismantling of roof modules
- C2: Transport to waste management
- C3: Waste management for reuse, recovery and/or recycling
- C4: Disposal
- D: Reuse, recovery, or recycling potential as net flows and credits or charges.

3.3 Estimates and assumptions

PFEIFER Seil- und Hebetechnik GmbH has provides all plant- and process specific to the LC assessor. Missing data were substituted by estimates based on comparable substitutes or data taken from the secondary literature. Data sets missing from the database were modelled by the LC assessor.
Estimates were used especially in the following cases:

- Aluminum frames: The frames were obtained in prefabricated conditions. Due to the lack of supplier data, generic data taken from the background database were used for the processing and associated material losses.
- ETFE film: The film used is obtained as a precursor from a supplier for which no specific production data could be provided. In this case, the estimate is based on generic data taken from the background database used.

3.4 Cut-off criteria

All relevant data, i.e. all starting materials used in production and all electric energy were gleaned from an operating data record for the lifecycle inventory. The actual transport distances were used or estimated applying documented rules for the inputs and outputs included.
Material and energy flows with a portion of < 1 % were included.
The aggregate of the excluded processes is below 5 % of the effect categories. The expenditures for provision of infrastructure (machines, buildings, etc.) from the entire foreground system were not inlcuded. The packaging of the precursors and finished product are not included.

3.5 Background data

All background data relevant for the LCA model were taken from the database *ecoinvent 3.8*.
Missing specific data from upstream processes were taken from the database *ecoinvent 3.8*.

3.6 Data quality

Background data records are based on the database *ecoinvent 3.8*. Missing specific data for precursors (e.g. fabrication of the aluminum frame) were modeled using generic *ecoinvent 3.8* data and in consideration of country-specific conditions. The share of primary data in the foreground system is low due to the low vertical range of manufacture.
Pfeifer Stuctures membrane systems are sold at the global scale, which was addressed by keeping assumptions about recycling as generic as possible in the end of life.

The technological, geographical and temporal representativeness were subjected to a quality assessment. Given the low availability of specific data on precursor production, the quality of the data must be seen as not better than mediocre.

3.7 Period under review

The quantities of raw materials and energy used as well as the volume of waste apply to the year 2019. Being state of the art, they are representative of the period under review.

3.8 Geographic Representativeness

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

3.9 Allocation

Allocation in the foreground system

No co-products are generated in the production process. The software model used does not provide for any allocations.

Allocation and waste

Due to a lack of data, this study does not consider the product packaging for transport to the installation site, in deviation from the EPD standard requirements.
Production waste generated in the upstream chain (e.g. aluminum and stainless steel offcuts) are allocated in the model on a closed-loop basis (A1).

In-productionoffcuts and plastic waste (A3) are subjected to thermal recycling, and the resulting energy gains are offset against production energy requirements. Waste incineration plant emissions are calculated on the basis of the specific composition of the material incinerated. A waste incineration plant with an R1 value of over 0.6 is taken as basis.

The environmental impact caused by the incineration of the product in the end-of-life scenario is allocated to the appropriate module (C3); the resulting energy gain for thermal and electric energy is reflected in module D. The environmental impacts avoided is included as per the global average data for generation of electric and thermal energy.

A cumulative loss of 5% is expected in the end-of-life scenario, which is reflected as landfill process in module C4 of the present LCA. The remaining 95% of the metal are subjected to feedstock recycling in the Module C3.
The resulting scrap for reuse in another product systems, is declared as avoided environmental impact, minus 5% recycling loss, in the Module D. The net flow was calculated for the primary and secondary metals in the aluminium and stainless steel used.

3.10 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 database has to be mentioned.

Comparability
In principe, a comparison or the evaluation of EPD data is only possible if the data to be compared was compiled in accordance with EN 15804 and the building context or product-specific performance characteristics are included. The background database *ecoinvent 3.8* was used.

4. LCA: Scenarios and additional technical information

Characteristic product properties biogenic carbon
The share of biogenic carbon in the product is less than 5% of the product's total mass so that it was not included in this EPD.

The following technical informations forms the basis of the declared modules, or it can be use to develop specific scenarios in the context of a building assessment.
It was not possible to determine the reference service life as per ISO 15686. The service life is taken from the table *BBSR 2017*, Service lives of components for- lifecycle analyses according to the Sustainable Construction Assessement System (Bewertungssystem Nachhaltiges Bauen, BNB).
Due to lack of data, this study does not consider the product packaging for transportation to the installation site, in deviation from the EPD standard requirements.

Where a **reference service life** according to the applicable ISO standards is declared, the assumptions and conditions of use which underlie the determined RSL must be declared. Furthermore, it must be stated that the declared RSL only applies in the reference use conditions specified. The same applies to a life span declared by the manufacturer.

Reference service life

Name	Value	Unit
Reference service life (according to ISO 15686-1, -2, -7 and -8)	-	a
Life Span (according to BBSR)	25	a

End of life (C1-C4)

Name	Value	Unit
Collected separately Aluminium	1.59	kg
Collected seperately Steel	0,14	kg
Recycling Aluminium (95%)	1.51	kg
Steel recycled (95 %)	0,13	kg
Aluminium sent to landfill (recycling loss 5 %)	0,08	kg
Steel sent to landfill (recycling loss 5 %)	0,01	kg

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

Name	Value	Unit
End-of-life net aluminium scrap	0,53	kg
End-of-life net steel scrap	0,06	kg

This scenario is based on a recycling rate of 95 % for both metals.

5. LCA: Results

The following table summarises the LCA results. The impact assessment results do not allow any conclusion as to the endpoints of the effect categories, exceedance of threshold values, safety margins or risks. Long-term emissions (>100 years) are not included in the impact assessment. The impact assessment is based on the evaluation method according to 15804+A2, SimaPro.

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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m² ETFE membrane

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Global Warming Potential total (GWP-total)	kg CO_2 eq	2.07E+02	6.49E-04	1.88E-02	3.8E+00	2.83E-02	-5.83E+00
Global Warming Potential fossil fuels (GWP-fossil)	kg CO_2 eq	2.05E+02	6.45E-04	1.87E-02	3.8E+00	1.85E-02	-5.75E+00
Global Warming Potential biogenic (GWP-biogenic)	kg CO_2 eq	3.15E-01	3.58E-06	1.45E-05	3.28E-04	9.68E-03	-1.41E-02
Global Warming Potential luluc (GWP-luluc)	kg CO_2 eq	1.08E-01	1.18E-06	7.05E-06	3.23E-05	6.73E-05	-6.75E-02
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq	4.46E-03	2.13E-11	4.26E-09	1.04E-08	4.15E-09	-3.99E-07
Acidification potential of land and water (AP)	mol H^+ eq	3.21E-01	3.18E-06	9.54E-05	6.92E-04	1.18E-04	-5.29E-02
Eutrophication potential aquatic freshwater (EP-freshwater)	kg P eq	2.27E-02	3.03E-07	1.37E-06	1.11E-05	3.22E-06	-1.68E-03
Eutrophication potential aquatic marine (EP-marine)	kg N eq	5.03E-02	6.08E-07	3.23E-05	3.87E-04	4.01E-05	-5.99E-03
Eutrophication potential terrestrial (EP-terrestrial)	mol N eq	5.37E-01	6.08E-06	3.54E-04	3.35E-03	4.31E-04	-6.33E-02
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg NMVOC eq	1.56E-01	1.64E-06	1.05E-04	8.33E-04	1.32E-04	-2.13E-02
Abiotic depletion potential for non fossil resources (ADPE)	kg Sb eq	5.06E-03	8.38E-10	4.31E-08	2.96E-07	6.45E-08	-2.64E-05
Abiotic depletion potential for fossil resources (ADPF)	MJ	5.22E+02	8.4E-03	2.89E-01	5.44E-01	3.32E-01	-5.25E+01
Water use (WDP)	m^3 world eq deprived	1.24E+01	1.03E-04	1.11E-03	9.84E-03	-7.91E-03	-1.83E+00

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m² ETFE membrane

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Renewable primary energy as energy carrier (PERE)	MJ	5.65E+01	9.64E-04	3.2E-03	2.82E-02	6.3E-03	-3.81E+01
Renewable primary energy resources as material utilization (PERM)	MJ	0	0	0	0	0	0
Total use of renewable primary energy resources (PERT)	MJ	5.65E+01	9.64E-04	3.2E-03	2.82E-02	6.3E-03	-3.81E+01
Non renewable primary energy as energy carrier (PENRE)	MJ	5.05E+02	8.4E-03	2.89E-01	1.76E+01	3.32E-01	-5.25E+01
Non renewable primary energy as material utilization (PENRM)	MJ	1.7E+01	0	0	-1.7E+01	0	0
Total use of non renewable primary energy resources (PENRT)	MJ	5.22E+02	8.4E-03	2.89E-01	5.44E-01	3.32E-01	-5.25E+01
Use of secondary material (SM)	kg	1.02E+00	0	0	0	0	5.9E-01
Use of renewable secondary fuels (RSF)	MJ	0	0	0	0	0	0
Use of non renewable secondary fuels (NRSF)	MJ	0	0	0	0	0	0
Use of net fresh water (FW)	m^3	4.25E-01	4.68E-06	3.62E-05	5.69E-04	-1.69E-04	-1.89E-01

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m² ETFE membrane

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed (HWD)	kg	1.56E-02	2.93E-09	7.1E-07	8.34E-06	7.25E-07	-3.11E-05
Non hazardous waste disposed (NHWD)	kg	7.65E+00	4.38E-05	2.68E-02	7.07E-02	9.73E-01	0
Radioactive waste disposed (RWD)	kg	1.27E-03	2.61E-08	1.91E-06	1.23E-06	1.92E-06	-1.42E-04
Components for re-use (CRU)	kg	0	0	0	0	0	0
Materials for recycling (MFR)	kg	0	0	0	0	0	0
Materials for energy recovery (MER)	kg	0	0	0	0	0	0
Exported electrical energy (EEE)	MJ	0	0	0	1.94E+00	0	0
Exported thermal energy (EET)	MJ	0	0	0	3.02E+00	0	0

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m² ETFE membrane

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Incidence of disease due to PM emissions (PM)	Disease incidence	3.1E-06	2.41E-11	2.21E-09	4.44E-09	3.69E-09	-7.92E-07
Human exposure efficiency relative to U235 (IR)	kBq U235 eq	3E+00	9.53E-05	1.36E-03	2.46E-03	1.45E-03	-1.91E-01

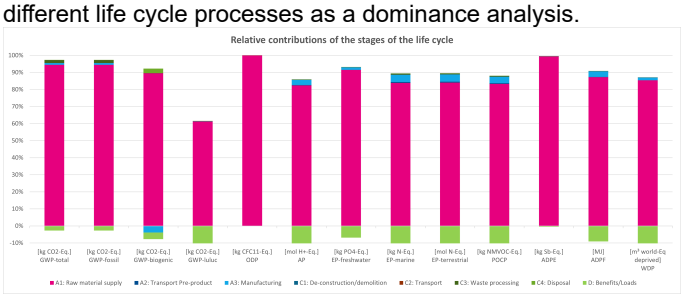
Comparative toxic unit for ecosystems (ETP-fw)	CTUe	2.18E+03	1.14E-02	2.42E-01	3.7E+00	5.18E+00	-1.83E+02
Comparative toxic unit for humans (carcinogenic) (HTP-c)	CTUh	2.34E-07	1.44E-13	6.3E-12	2.41E-10	2.76E-11	-4.78E-08
Comparative toxic unit for humans (noncarcinogenic) (HTP-nc)	CTUh	1.52E-06	5.52E-12	2.5E-10	8.05E-09	5.57E-10	-2.37E-07
Soil quality index (SQP)	SQP	1.43E+02	1.24E-03	3.27E-01	1.66E-01	4.62E-01	1.6E+01

Restriction notice 1 - applies to indicator "potential effects on human exposure to U235 (Ionising Radiation Potential - IRP)". This effect category mainly addresses the potential impact of low-dose ionising radiation on human health accross the nuclear fuel cycle. It does not take into account effects which are attributable to possible nuclear accidents and occupational exposure or to the disposal of radioactive waste in underground facilities. The potential ionising radiation emanating the from soil, radon and some building materials is also not measured by this indicator.

Restriction notice 2 - applies to indicators Potential for abiotic depletion-non-fossil resources (ADPE), Potential for the abiotic depletion-fossil fuels (ADPF), Water deprivation Potential (WDP), Potential toxicity comparison unit for ecoxystem (ETP-fw), Potential toxicity comparison unit for humans - carcinogenic effect (HTP-c), Potential toxicity comparison unit for humans- non-carcinogenic effect (HTP-nc), Potential soil quality index (SQP). The results of this environmental impact indicator should be used with care, as they are fraught with great uncertainty or becauce experience with the respective indicator is limited..

6. LCA: Interpretation

The following figure reflects the relevant contributions of different life cycle processes as a dominance analysis.



The distribution of environmental impacts throughout the lifecycle within the lifecycle phases has a similar effect accross all effect categories.

For the product lifecycle yield credits (-5.83 kgCO2e) and charges in the EoL for subsequent product systems which follow from the net flow calculation for the product scrap utilised.

The effect categories along the life cycle are mainly determined by the supply of raw materials. The main driver in this context is, first and foremost, the use of aluminum and ETFE film which taken together make up approx. 98% of the Global warming potential (GWP) of the production (A1-A3).

The potential for depletion of stratospheric ozone (ODP) is determined completly by the supply of raw materials. 95% of the acidifcation potential (AP) and tropospheric ozone (POCP) are determined by the use of aluminum and ETFE film.

The Potentiol for depletion of abiotic ressources- non fossil ressource (ADPe) and the potential for depletion of abiotic ressource- fossil fuels (ADPf) are entirely determined by the use of aluminum and ETFE film, which make up more than 95% of the effect on the indicators.

To model the product, estimates and approximations were made for certain base materials which may affect the result. Uncertainties in the results also follow for the use of lifecycle inventory analyses in the databases. Industry or segment data are unfortunately few and far between for certain supply chains and precursors. The uncertainties impacting the result mean that the lifecycle inventory analysis data (LCI) used in drawing up this EPD as required by EN 15804+A2 is of mediocre or even poor quality.

Two different product configurations (single- layer and multi-layer systems) which are comparable in term of production and physical composition were included in the creation of the averaged EPD.
However, the impact assessment may be subject to significant variations. To determine the possible variation widths, two reference systems were therefore calculated.

Taking the reference product as a basis, the individual effect categories may show substancial variations in the results of the environmental impacts (- 80%/ +20%), subject to the product system selected which, however, can be scaled by approximation by using the differing product weight (approx. -70%/ + 24%) and the factor deviations on a case-by-case basis. The table below gives an overview of the underlying model value of the average declaration, as well as specific data of the selected effect categories for single-layer and multi-layer systems.

Kategorie	Einheit	Modelldaten der Ökobilanz	Single Layer (einlagig)			Multi Layer (mehrlagig)		
			Min	Avg	Max	Min	Avg	Max
Nominale Dachoberfläche	rel.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Dachöffnung (Fläche)	rel.	1.00	1.52	1.30	1.41	0.81	0.70	0.76
Produktgewicht	rel.	1.00	0.29	0.56	0.84	0.64	0.94	1.24
GWP Total	rel.	1.00	0.20	0.58	0.96	0.66	0.92	1.14
GWP-fossil	rel.	1.00	0.20	0.58	0.96	0.66	0.92	1.14
GWP-biogenic	rel.	1.00	0.25	0.44	0.64	0.73	1.11	1.17
GWP-luluc	rel.	1.00	0.27	0.45	0.63	0.71	1.06	1.10
ADPE	rel.	1.00	0.27	0.43	0.60	0.72	1.07	1.09
ADPF	rel.	1.00	0.27	0.53	0.79	0.67	0.98	1.10
PERT	rel.	1.00	0.26	0.49	0.73	0.70	1.03	1.12
PENRT	rel.	1.00	0.27	0.53	0.79	0.67	0.98	1.10

7. Requisite evidence

irrelevant
7.1 VOC emissions for products used in interior spaces.

Test procedure as per AgBB scheme with indication of the measurement point, date and result as range of values. The following minimum information is to be declared:

8. References

AVV 2020
Ordinance on the European Waste Catalogue (Waste catalogue Ordinance . AVV, Abfallsverzeichnis-Verordnung), construction and demolition waste (including dredge spoil from

contaminated sites), 2020.

BBSR 2017
Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR, Bundesinstitut für Bau-, Stadt und Raumforschung): Nutzungsdauern von Bauteilen. Nutzungsdauern von Bauteilen für Lebenszyklusanalysen nach Bewertungssystem Nachhaltiges Bauen (BNB). Federal Ministry for the Environment, Natur Conservation and Nuclear safety (ed), 2017.

Ordinance on Biocidal Products
Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22nd May 2012 on the provision on the market and use of Biocidal products, in: Official Journal of the European Union L 167/I, 2012.

EN 15804
DIN EN 15804:2022-03, Building Sustainability of construction works- Environmental Product Declarations - Core Rules for the Product Category of construction Products. German version EN 15804:2012+A2:2019 + AC:2021.

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

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

ISO 14040
DIN EN ISO 14040:2021-02 Environmental management — Life cycle assessment - Principles and framework.

ISO 14044
DIN EN ISO 14044:2021-02 Environmental management — Life cycle assessment - Requirements and guidelines.

ECHA-List
European Chemical Agency (ECHA): CMR substances as per Annex VI to the CLP Regulation which are registered according to the REACH and/or CLP, in: https://echa.europa.eu/candidatelist.table, 2020.

ecoinvent 3.8
ecoinvent V. 3.8 (2021): the lifecycle inventory database, version 3.8, maintained by the Swiss Centre for Lifecycle inventories, Dübendorf. www.ecoinvent.ch.

ISO 9001
DIN EN ISO 9001:2015-11,
Quality management systems - Requirements.

ISO 15686-1
ISO 15686-1:2011-05, Buildings and constructed assets - Service life planning - Part 1: General principles and framework.

ISO 2022
Institut Bauen und Umwelt e.V. (eD): Die Erstellung von Umwelt-Produktdeklaration (EPD). General EPD-programme instructions of the institut Bauen und Umwelt e.V. (IBU), version 2.1, 2022.

SimaPro
LCA calculation Software: Prè sustainability : SimaPro version 9.4.0.1, 2022.

Ökobilanz (LCA)
Grundlagen für ökobilanzielle Berechnungen: Walter, K/ Grahl, B.: Ökobilanz (LCA). Ein Leitfaden für Ausbildung und Beruf, Wiley (Hrsg.), 2009.

PCR Part A
Institut Bauen und Umwelt e.V. (Ed): Produktkategorie-Regeln für gebäudebezogene Produkte und Dienstleistungen. Part A: Rechenregeln für die Ökobilanz und Anforderungen an Projektbericht nach EN15804+A2:2019, Version 1.3., 2022.

PCR: ETFE Bauelement
Institut Bauen und Umwelt e.V.: PCR-Anleitungstexte für gebäudebezogene Produkte und Dienstleistungen. Part B: Anforderungen an die EPD für EFTE Bauelement, Version 1.7., 2019.

The Literature referenced in the environmental product declaration must be cited in full, using the following references as a basis. Standards and norms for supporting evidence and/or technical properties which are already fully cited in the EPD need not to be mentioned here.

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