ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	ONDULINE SA
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-OND-20230363-ICD1-EN
Issue date	22.03.2024
Valid to	21.03.2029

Corrugated bitumen sheets and tiles for roofing application

ONDULINE SA

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

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1. General Information

ONDULINE SA

Programme holder

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

Declaration number

EPD-OND-20230363-ICD1-EN

This declaration is based on the product category rules:

Corrugated bitumen materials for roofing and external wall cladding, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

22.03.2024

Valid to

21.03.2029

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

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

Corrugated bitumen sheets and tiles for roofing application

Owner of the declaration

ONDULINE SA
Quai Gallieni 24
92150 SURESNES
France

Declared product / declared unit

1m² corrugated bitumen sheets for roofing application

Scope:

This Life Cycle Assessment study is relevant for corrugated bitumen sheets and tiles produced in the manufacturing plants of Onduline-SA located in Brazil, Malaysia, Poland, Spain and Turkey. This EPD represents an average EPD, where a weighted average product (with an average grammage of 3.15 kg/m²) is formed based on data provided by the above-mentioned plants. In this study, the data collected refer to the years 2020 to 2022.
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.-Ing. Nikolay Minkov,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The products covered by this EPD are corrugated bitumen sheets and corrugated bitumen tiles, which are made from cellulose fibres and bitumen. Bitumen is used to give the products their waterproofing properties. Corrugated bitumen sheets and tiles can be produced in a variety of sizes and colours. Tiles are smaller than roofing sheets. These products are intended for roofing applications.

The sales-weighted average weight of finished sheets and tiles is 3.15kg per m².

The list of product families covered by this EPD is detailed below:
MALAYSIA:
ONDULINE CLASSIC DR and DRC / ONDULINE CLASSIC 235 / ONDUCASA (ONDUTILE 57) / ONDULINE TILE / ONDULINE TILE IDN / ONDULINE EASYLINE / ONDUVILLA TILES
BRAZIL:
ONDULINE CLASSIC SR and DR and DRC / ONDULINE MAIS / ONDULINE CLASSIC 8 / TAPUME / ONDUVILLA / ONDULINE STILO
POLAND:
ONDULINE CLASSIC range / ONDULINE EASYFIX / ONDULINE EASYFIX VERNIS / ONDULINE EASYFIX COMPACT / ONDULINE EASYFIX COMPACT VERNIS / ONDULINE EASYFIX COMPACT S9 / ONDULINE EASYSTYLE / ONDULINE EASYLINE / ONDULINE BASE 9 / ONDULINE BASE 9 VERNIE / ONDULINE BASE STANDARD ECO 10 / ONDULINE BASE STANDARD ECO 9 / ONDULINE DURO SX 35 / ONDULINE DIY 8 / BITULINE / ONDULINE 8 / ONDEVER 63 / ONDALUX ECO VERNIE
SPAIN:
ONDULINE CLASSIC range / ONDULINE DR 32 / ONDULINE BASE STANDARD 9 / ONDULINE ECO 10 / G76/K11 and K11S / ONDULINE U 18 / G95 / ONDULINE CLASSIC 235 / BT 190 SPANISH EXPORT / ONDULINE U21 / ONDUVILLA
TURKEY:
ONDULINE CLASSIC HR SR and DR / ONDULINE ZIGANA and ZIGANA X-TREME/ ONDULINE BASE STANDARD ECO 10 / ONDULINE BASE STANDARD ECO 9 / ONDURA HR 10 / ONDURA HR 9 / ONDURA HALF / ONDULINE ANDROMEDA / ONDUVILLA / ONDULINE XHR / ONDULINE FIT / ONDULINE HR-B / ONDURA ZIGANA

For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011 (CPR)* applies. The corrugated bitumen sheets need a declaration of performance taking into consideration *NF EN 534+A1* May 1, 2010 Corrugated bitumen sheets - Product specification and test methods and the CE-marking. Whereas the corrugated bitumen tiles need a declaration of performance taking into consideration *ETA-10/0018/* and the CE-marking.

2.2 Application

Corrugated bitumen sheet and tile's main function is to provide water tightness on pitched roofs and walls. They can be applied on wooden or metallic battens and purlins but also on full decks. The type of substructure has to be chosen according to the shape of the roof. They should be laid onto the substructure staggered and overlapped. They can be combined with several insulation systems.

2.3 Technical Data

Onduline SA's Corrugated Bitumen Sheets and Tiles are produced and delivered according to the requirements of the standard *EN 534*.
For further details, see Technical Data Sheets at http://www.onduline.com.

Constructional data

Name	Value	Unit
Length	970 - 2015	mm
Width	400 - 1070	mm
Thickness	2.1 - 3.5	mm
Grammage	2.58 - 3.98	kg/m^2

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 534 + A1*, May 2010, Corrugated bitumen sheets - Product specification and test methods. ONDUVILLA tiles are under European Technical Assessment/*ETA-10/0018*.

2.4 Delivery status

Onduline Corrugated Bitumen Sheets are delivered on pallets only. They are packaged by 100 or 150 or 300 or 420 sheets per pallets. Onduline Corrugated Bitumen Tiles are packaged in bundles (7, 10 or 15 pieces of tiles per bundle). Bundles are delivered on pallets, 81 bundles per pallet (10 tiles).

2.5 Base materials/Ancillary materials

Name	Value	Unit
Waste paper / cardboard (post-consumer recycled material content)	43-53	%
Bitumen	38*-48	%
Resin	1-4	%
Others	approx. 2.3	%

**: 38 % in case of thick additional coating.*

The product components are waste paper/cardboard, bitumen, resin, pigment, binder, paint loads, drainage agent, antifoaming agent/defoamer, dispersing agent, biocide and pH regulator. The sales-weighted average weight of finished sheets and tiles is 3.15kg per m².

The products covered by this EPD do not contain substances listed in the 'Candidate List of Substances of Very High Concern for Authorisation' (date: 14/06/2023) exceeding 0.1 percentage by mass. These construction products are not a substance or mixture under the chemical law (REACH).

The products covered by this EPD do not contain other CMR substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1 percentage by mass.

Coating additives have been added and remain on the references covered by this EPD:

- Octylisothiazolinone (OIT), biocide (CAS number: 26530-20-1),
- Terbutryn, biocide (CAS number: 886-50-0),
- Zinc pyrithione, biocide (CAS number: 13463-41-7),
- Polyethylenimine, hydrophobic agent (CAS number: 9002-98-6).

Octylisothiazolinone (2-octyl-isothiazol-3(2H)-one) is a chemical compound belonging to the isothiazolinone class of broad-

spectrum microbiocides.

Octyl refers to the octyl group, which is a functional group consisting of 8 carbon atoms. Isothiazolinone is a type of heterocycle containing a five-membered ring composed of three carbon atoms, one nitrogen atom and one sulphur atom.

Terbutryn is an aromatic heteromonocyclic compound containing a methylthio-1,3,5-triazine and a diamino-1,3,5-triazine.

Zinc pyrithione is a coordination complex of zinc : zinc ; 1-oxidopyridin-1-ium-2-thiolate.

No other ancillary materials or additives remain on the products.

2.6 Manufacture

Corrugated bitumen materials as sheets and tiles are made mainly from a single layer of natural cellulose fibres (secondary material) that are recycled from all sources of wastepaper and cardboard, pre-pigmented with resin and colouring, and impregnated with bitumen, under pressure and heat.

The production stage contains A1 (extraction, processing, production of raw materials), A2 (Transport to the manufacturer and internal transport) and A3 (Manufacturing processes) modules.
Manufacturing steps of corrugated bitumen sheets and tiles are defined in detail as follows. The production process is the same for all sites. For both, the manufacturing process is composed of two main sections:

- Cardboard production section:
  The incoming wastepaper is sorted, turned into pulp and drained. All along, processes of degassing and impurity separation are realised. Afterwards, the pulp made of fibres of cellulose and fillers is shaped and coloured. It undergoes primary coating (application of colour, resin and pigment-based) and corrugation processes. Cardboards are then heated and completely dried by natural gas. The cardboards are cut into required dimensions and passed onto the impregnation stage.

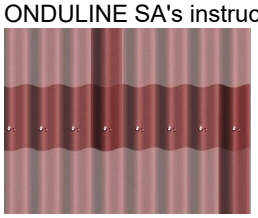
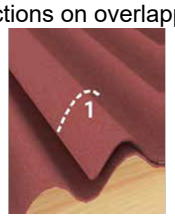
- Impregnation Section:
  In this section, cardboard gains its waterproofing property. It is completely saturated with bitumen at high temperatures. After impregnation, the sheets undergo curing and cooling operations –corrugated bitumen tiles are cut to dimensions.
  For the packaging process, the finished products are put onto pallets and then shrink-wrapped with Polypropylene stretch foil.

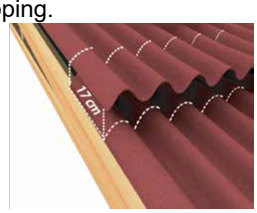
2.7 Environment and health during manufacturing

ONDULINE SA's plants are certified *ISO 14001 : 2004* (Environmental management systems — Requirements with guidance for use). Moreover, ONDULINE SA's plant located in Turkey is certified *ISO 45001:2018* (Occupational health and safety management systems — Requirements with guidance for use.

2.8 Product processing/Installation

During assembly, finished product packaging as well as installation scraps are sent to waste treatment, electric screwdrivers are used to install roofing sheets and tiles and their fixings. This stage also induce overlapping losses. As a matter of fact, when laying Onduline corrugated bitumen sheets, the manufacturer requires the sheets to be overlapped to ensure that the roof is watertight. These overlaps mean that more than 1sqm of sheet is needed to properly cover 1sqm of roof, which is what we call "overlapping losses". See below for ONDULINE SA's instructions on overlapping.



2.9 Packaging

The final products are put onto wooden pallets and then shrinkwrapped with polypropylene stretch foil and necessary registrations are done before the products are stored in the warehouse.

Possible reuse, recycling, energy recovery, and disposal routes of packaging materials :

- For polypropylene stretch foil, it is considered that ratios are: 28,2% landfill, 50,4% incineration with energy recovery, 21,4% recycling and 0% re-use. A generic distance of 50km is considered between dismantling site and waste treatment sites.
- For woodden pallets, it is considered that ratios are: 20% landfill, 31% incineration with energy recovery, 7% recycling and 42% re-use. It is also considered that the transport distance from the dismantling site to the reuse site equals 200 km, whereas the transport distance to every other waste treatment sites (landfill, incineration and recycling) is considered to be 50km.

2.10 Condition of use

During use, erosion causes 10 % of the roofing sheet weight loss.

2.11 Environment and health during use

The erosion during the use phase induces the dispersion of 5 % of bitumen and 5 % of cardboard by rainwater.

2.12 Reference service life

Service life has been declared by the manufacturer in line with the BBSR table, the PCR (Part B, 2.12) and 15804+A2. It is also based on the experience of roofing sheets and tiles manufacture and supply. The service life is set at 25 years for roofing applications.

A service life in accordance with the BBSR table is not a reference service life (RSL) according to ISO 15686.

The service life declared by the manufacturer only applies for the declared service life conditions.

This means that the product will meet its functional requirements for 25 years before replacement.

2.13 Extraordinary effects

Fire

For all corrugated bitumen sheets and tiles manufactured by ONDULINE SA, the class of fire performance is E. External fire performance according to *EN 13501-5* is Froof for every product except ONDULINE HR B and ONDULINE ZIGANA Xtrem that are Broof (t1).

Fire protection

Name	Value
Building material class	E
Burning droplets	d2
Smoke gas development	-

Water
As already mentionned above, rainwater induces erosion of 10 % of the roofing corrugated bitumen sheets and tiles.

Mechanical destruction
In the event of an accidental fire, fumes are released (soot, CO, CO2, etc.).

2.14 Re-use phase
Reuse, recycling and incineration with energy recovery are possible practices but have not been considered because they are not representative of the practices of ONDULINE SA's customers.

2.15 Disposal
ONDULINE SA confirmed that a 100% landfill scenario shall be considered. After an internal survey carried out by ONDULINE SA, it has been shown that when dismantling their roofs, clients would send their corrugated bitumen sheets and tiles directly to the waste collection site to be buried. Corrugated bitumen sheets & tiles are classified: 17 03 02 (bituminous mixtures).

2.16 Further information
For further information, please contact ONDULINE SA through its website at http://www. onduline.com

3. LCA: Calculation rules

3.1 Declared Unit
This EPD refers to a functional unit defined as follows: 1m² corrugated bitumen sheets for roofing application to ensure waterproofing and weather protection for a minimum slope of 9% over 25 years.

The environmental profile is based on a weighted average, as the LCA results refer to the specified functional unit.

Declared unit and mass reference

Name	Value	Unit
Grammage (weighted average value between 2020 and 2022)	3.15	kg/m^2
Declared unit	1	m^2
Layer thickness (weighted average value between 2020 and 2022)	0.0029	m

This study aims to find the environmental impacts generated by ONDULINE SA products throughout their life cycle. For this, the standards *ISO 14040, ISO 14044, EN 15804* have been complied with regarding the quality of data for the following criteria:

- Time factor – LCI data are based on:
  - Where available, data collected specifically for this study at ONDULINE SA production sites in Spain, Brazil, Malaysia, Poland and Turkey. These data correspond to the average production based on the study of data from the years 2020-2021-2022.
  - In the absence of specific data, generic data from the *Ecoinvent database 3.8* Allocation, cut-off by Classification (2022). This database is regularly updated and is representative of current processes.
- Geographical factor:
  - Specific data come from the manufacturer's production sites in Spain, Brazil, Malaysia, Poland and Turkey.
  - Generic data from the Ecoinvent database representing European or Rest of the World processes have been used for manufacturing stages where available, otherwise global data are used.
- Technological factor – material shaping technology data are based on:
  - Technologies used by the manufacturer for the production processes of their products.
  - European or Global technologies depending on the production site considered in the case of generic data.

The EPD covers individual products, which are grouped by type of application and product families. To evaluate the impacts of the group of products, each product has been evaluated individually. For all typologies, the created average product according to the distribution of global sales is used as a reference for the EPD.

This declaration is classified as an 'average product' as calculated from overall production in several of the manufacturer's plants according to PCR Part A : Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804+A2:2019 (version 1.3), 31 August 2021; www.bau-umwelt.de.

3.2 System boundary
The system boundary covers the entire life cycle of the product from extraction of raw materials to the disposal of the product (cradle to grave). It also includes the module D.

3.3 Estimates and assumptions
All raw materials used by ONDULINE SA have been approximated by datasets found on Ecoinvent 3.8 database. For a more detailed study, an on-site collection of data (i.e. a collection of data on the production sites of ONDULINE SA's suppliers) would be required to acquire detailed information on the products identified as having a high level of impact.

Waterproofing properties of ONDULINE SA's products depend on bitumen type (road bitumen). The grades selected by ONDULINE are such that the bitumen does not remain on the surface of the sheet, allowing the material to be waterproof and homogenous as required by *EN 534* standard. We have assumed that the dataset found on Ecoinvent 3.8 database matched the bitumen formulation purchased by ONDULINE SA. Instead of taking a global dataset, we narrowed the studied area to Europe (for factories in Poland and Spain), to Rest of the World (for factories in Malaysia and Turkey) and we took the Brazil dataset for the Brazilian factory. This limits the possible difference between averaged bitumen formulation per studied area and purchased bitumen formulations by each factory.

Whenever possible country-specific data (e.g. electricity, ...) was applied. When such data is missing, European, rest-of-the world or global datasets are preferred (e.g. resins, natural gas, etc.)

For transports: When multiple location applied to the same raw material or reference of product, weighted average of the distances were used. All raw materials, their amount, their distance between suppliers/producers and ONDULINE SA's plants were collected from each plant. All sales figures were also collected from each plant, as well as the related transport distances. All transports by lorry as well as transports by light commercial vehicle have been modelled with a calculated Global dataset. Transports by container ship were modelled with Ecoinvent Global dataset.

All the bitumen waste from disposal phase have been modelled

as going to sanitary landfill. Although some ONDULINE SA's customers do not send their corrugated bitumen sheets to landfill when they are dismantled, but rather to recycling or reuse, we have conservatively assumed that all flows went to landfill. ONDULINE SA did not have figures to give to EVEA.

3.4 Cut-off criteria

The cut-off criteria used for this study follow the guidelines set out in the PCR which conform to the *EN15804*, as follows:
- All inputs and outputs to a (unit) process are included in the calculation where the data is available.
- A maximum of 1 % of the total mass per unit process may be omitted.
- A maximum of 1 % of the total renewable and non-renewable energy for a unit process may be omitted.
- A maximum of 5 % of the total energy usage and mass per module may be omitted.

This study does not include infrastructures, production tools, factory construction, lighting, heating, cleaning, administration department or employee transport, except in the case of data included in the generic databases.

- Modules A1-A5

A1 & A2: The raw and secondary materials as well as their transport have been included in the calculation.
Packaging of waste paper (steel strapping around stacks of waste paper) as well as its transport have been included in the calculation. The other raw materials packaging and their transport were negligible and have not been included in the calculation.
A3: Energy consumption, production goods, production losses and wastes, finished product packaging and the import of fixings have been included in the calculation.
Internal transport via forklift within the factory (Forklifts employed are diesel, LPG or/and propane driven) has not been included in the calculationdue to the lack of annual fuel consumption figures and because this consumption is negligible regarding the impact of raw materials.
A4: Transport of the finished products, their fixings and their packaging to the stockist and then the construction site have been included in the calculation.
A5: Screwdriver electric consumption during installation, installation scraps (cutting scraps), installation losses (overlapping) and finished product packaging waste have been included in the calculation.

- Module B1

All input and output flows have been considered.
VOC emissions have been neglected, moreover no data was available.

- Module B2

According to the data provided by ONDULINE SA, the consumption of water used when cleaning the roofs can be omitted.

- Modules B3-B7

There are no input or output flows associated with these modules for the products considered.

- Modules C1-C4

All input and output flows have been considered.

- Module D

Module D has been considered for this report. It does not include the packaging (Polypropylene stretch foil and wood pallet).

3.5 Background data

The data used to create the model within the LCA software Simapro 9.5 has been provided by ONDULINE SA. Generic data has been taken from the Ecoinvent database 'Ecoinvent 3.8 – allocation cut-off by classification'.

3.6 Data quality

For this average EPD, geographical, technical, temporal as well as methodological representativity have been met:

- Geographical coverage is global,
- Production data are based on the years 2020 to 2022 (this study is based on 3-year averaged data, as provided by ONDULINE SA),
- Technologies used by the manufacturer for the production processes have been used in the calculation, and European or Global technologies depending on the production site have been considered when generic data where to be used,
- Data quality assessment is compliant to EN15804+A2 standard.

All data was collected by ONDULINE SA in kg per kg of product. The data was reported in kg per sqm in the Simapro tool.

Variability studies have shown that sales-weighted average products per country can have an impact of -11% to +17% regarding average GWP (the highest rates are for Malaysia and the lowest rates are for Spain). They have also shown that the references alone can have an impact of -43% to +85% regarding average GWP (highest rate is that of a Malaysian reference and lowest rates is that of a Brazilian reference).

Malaysia has the highest overall carbon footprint. This is mainly due to its electricity consumption (highest of the 5 countries studied), its energy mix, the averaged mass per square meter of finished product (2nd highest of the 5 countries) and the transport distance of the finished product (2nd highest of the 5 countries).

3.7 Period under review

The period under review for the collection of production data and the resulting averages runs from 2020 to 2022.

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

The manufacturing process does not generate any simultaneous co-products. No allocation has been made on the production data.

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. *Ecoinvent* database '*Ecoinvent 3.8* – allocation cut-off by classification' has been used.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

In this LCA, biogenic carbon content has been quantified and declared for wooden pallets (packaging) and cardboard contained in the corrugated bitumen sheets and tiles.

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO_2.

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product Cardboard	0.45	kg C
Biogenic carbon content in accompanying packaging Wooden pallet	0.47	kg C

The following is the technical scenario information used for declared modules.

Transport to the building site (A4)

The transport of the final products has been modelled by considering their precise destinations in the world. For each product family, a transport distance averaged by sales volumes for each destination has been taken. The transported mass of packaging of the finished products as well as the transported mass of fixings needed for the installation stage are included in the calculation at this stage. Lorry and container ship generic models used are globally representative. A third transport model has been created here to consider a generic distance of a 100km covered by a light commercial vehicle between the stockist and the building site. This model is also globally representative.

Name	Value	Unit
Transport distance by truck	983	km
Transport distance by container ship	1337	km
Transport distance by light commercial vehicule	100	km

Installation into the building (A5)

Distribution packaging consists of wooden pallets (2,54E-02 kg/m²) and polypropylene stretch foil (1,82E-03 kg/m²).

Electric screwdrivers are used to fix sheets and tiles to the roofing. ONDULINE SA has estimated the screwdriver's electric consumption at 0,0025 kWh per kg of installed product regardless of the reference. The electric consumption is converted in kWh per m² of product before being integrated in *SimaPro*. As ONDULINE SA products are sold all over the world, the *Ecoinvent* data is representative of the world.

Name	Value	Unit
Electricity consumption	0.008	kWh
Installation scraps	3	%

Overlapping losses depend on the reference of sheets and tiles, for sheets they are around 17-20 % and can go up to 30 % in case of small elements (ONDUVILLA tiles). They have been modelled with only a demand of overproduction to offset the losses. No waste treatment has been modelled. The scraps associated with the installation, entirely in the form of offcuts, are estimated at 3 % by ONDULINE SA. They have been modelled with overproduction to offset the scraps and with a waste treatment. According to ONDULINE SA's information, the end-of-life scenario to be considered for installation scraps is 100 % landfill. All these scraps are transported by truck to the landfill site, assumed to be 50km away. It is modelled with a global lorry data.

The waste treatment of finished product packaging (polypropylene stretch foil and wood pallets) has been modelled with generic data created by EVEA. For wooden pallets, it is considered that ratios are: 20% landfill, 31% incineration with energy recovery, 7% recycling and 42% re-use. For polypropylene stretch foil, it is considered that ratios are: 28,2% landfill, 50,4% incineration with energy recovery, 21,4% recycling and 0% re-use. A generic distance of 50km is considered between dismantling site and waste treatment sites.

Use or application of the installed product (B1)

During the use stage, erosion causes 10 % of the roofing sheet weight loss. Thus 5 % of bitumen and 5 % of cardboard are taken away with rainwater. Yet, rainwater added to cardboard induce cellulose hydrolysis which creates glucose. Erosion has been modelled with 5% petrol discharge in water and 5 % glucose discharge in water. However, glucose is not characterized in the calculation method.

Name	Value	Unit
Erosion (mass loss)	0.37	kg
Petrol discharge	0.19	kg
Glucose discharge	0.19	kg

ONDULINE SA's corrugated bitumen sheets for roofing application have 25 years of service lifetime.

Service life

The service life declared by the manufacturer (25 years) only applies for the declared service life conditions.

Name	Value	Unit
Life Span (according to BBSR)	25	years
Application	roofing	
Declared product properties (at the gate) and finishes	EN 534:2006+A1	-
Design application parameters (if instructed by the manufacturer), including the references to the appropriate practices and application codes	See ONDULINE SA technical book and instructions on reference conditions of application and use	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	See ONDULINE SA technical book and instructions on reference conditions of application and use	-
Outdoor environment, (for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature	No specific restrictions	-
Usage conditions, e.g. frequency of use, mechanical exposure	No specific restrictions	-
Maintenance e.g. required frequency, type and quality and replacement of components	No specific restrictions	-

End of life (C1-C4)

The same energy consumption as in A5 has been considered, given that electric screwdrivers are also used to remove sheets and tiles from the roof.Corrugated bitumen sheets, tiles and fixings are sent by truck to their waste treatment and their recycling sites 50 km away.
100 % of the fixings are recycled.
100 % of the corrugated bitumen sheets and tiles are landfilled.

Name	Value	Unit
Collected separately waste type (Fixings)	0.07	kg
Collected separately (Corrugated bitumen sheets)	3.362	kg
Recycling (Fixings)	0.07	kg
Landfilling (Corrugated bitumen sheets)	3.362	kg

Recycling potentials (D), relevant scenario information
The recycling of fixings is considered in module D.
Module D includes the credits of the recycling of fixings (100%) from C3, considering that 26% of the fixings contain recycled steel.

Onduline
Lightweight roofing systems

5. LCA: Results

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

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m² of roof covered by corrugated bitumen sheets for minimum slopes of 9% and a lifespan of 25 years

Parameter	Unit	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	-1.53E+00	1.29E-01	1.52E+00	1.22E+00	5.67E-01	1.26E-02	0	0	0	0	0	0	5.65E-03	2.92E-02	5.51E-03	3.27E+00	-4.68E-02
GWP-fossil	kg CO_2 eq	1.12E+00	1.29E-01	1.42E+00	1.22E+00	8.95E-01	0	0	0	0	0	0	0	5.63E-03	2.92E-02	5.5E-03	4.29E-01	-4.69E-02
GWP-biogenic	kg CO_2 eq	-2.66E+00	3.82E-05	9.96E-02	6.38E-04	-3.31E-01	1.26E-02	0	0	0	0	0	0	1.53E-05	8.67E-06	8.52E-06	2.84E+00	6.29E-05
GWP-luluc	kg CO_2 eq	8.55E-03	5.42E-05	4.46E-03	6.95E-04	3.03E-03	0	0	0	0	0	0	0	1.35E-05	1.22E-05	4.3E-06	4.13E-05	3.37E-05
ODP	kg CFC11 eq	1.05E-06	2.9E-08	1.14E-07	2.6E-07	3.17E-07	0	0	0	0	0	0	0	1.94E-10	6.58E-09	9.95E-10	1.08E-08	-1.41E-09
AP	mol H^+ eq	1.06E-02	5.72E-04	5.54E-03	7.19E-03	5.35E-03	0	0	0	0	0	0	0	2.92E-05	1.21E-04	2.58E-05	5.44E-04	-2.01E-04
EP-freshwater	kg P eq	2.26E-05	1.04E-06	5.49E-05	1.35E-05	2.19E-05	0	0	0	0	0	0	0	3.01E-07	2.36E-07	9.59E-08	6.47E-07	-1.75E-07
EP-marine	kg N eq	1.36E-03	1.66E-04	1.33E-03	2.06E-03	1.12E-03	0	0	0	0	0	0	0	4.89E-06	3.55E-05	6.43E-06	4.32E-04	-7.43E-06
EP-terrestrial	mol N eq	1.69E-02	1.83E-03	1.06E-02	2.29E-02	1.17E-02	0	0	0	0	0	0	0	5.48E-05	3.92E-04	7.85E-05	1.16E-03	-5.24E-04
POCP	kg NMVOC eq	5.8E-03	5.53E-04	3.53E-03	7.03E-03	3.8E-03	0	0	0	0	0	0	0	1.48E-05	1.2E-04	2.13E-05	4.57E-04	-2.83E-04
ADPE	kg Sb eq	1.06E-05	4.54E-07	4.41E-06	1.15E-05	6.03E-06	0	0	0	0	0	0	0	2.69E-08	1.03E-07	2.37E-08	1.28E-07	-1.5E-06
ADPF	MJ	7.4E+01	1.93E+00	2.02E+01	1.8E+01	2.51E+01	0	0	0	0	0	0	0	7.5E-02	4.37E-01	7.92E-02	8.57E-01	-3.96E-01
WDP	m^3 world eq deprived	7.17E-01	6.38E-03	3.47E-01	7.61E-02	2.64E-01	0	0	0	0	0	0	0	9.37E-04	1.45E-03	4.45E-04	3.65E-02	1.28E-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 of roof covered by corrugated bitumen sheets for minimum slopes of 9% and a lifespan of 25 years

Parameter	Unit	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	7.24E-01	2.35E-02	2.03E+00	3.37E-01	1.29E+00	0	0	0	0	0	0	0	9.72E-03	5.36E-03	3.35E-03	1.71E-02	-5.51E-02
PERM	MJ	3E+01	0	1.35E+00	0	5.54E+00	0	0	0	0	0	0	0	0	0	0	0	0
PERT	MJ	3.07E+01	2.35E-02	3.38E+00	3.37E-01	6.82E+00	0	0	0	0	0	0	0	9.72E-03	5.36E-03	3.35E-03	1.71E-02	-5.51E-02
PENRE	MJ	1.23E+01	1.93E+00	1.96E+01	1.8E+01	1.18E+01	0	0	0	0	0	0	0	7.47E-02	4.37E-01	7.92E-02	8.56E-01	-3.96E-01
PENRM	MJ	6.8E+01	0	5.93E-01	0	1.46E+01	0	0	0	0	0	0	0	0	0	0	0	0
PENRT	MJ	8.02E+01	1.93E+00	2.02E+01	1.8E+01	2.64E+01	0	0	0	0	0	0	0	7.47E-02	4.37E-01	7.92E-02	8.56E-01	-3.96E-01
SM	kg	1.61E+00	0	2.26E-02	0	3.53E-01	0	0	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	m^3	1.78E-02	2E-04	2.04E-02	2.5E-03	9.38E-03	0	0	0	0	0	0	0	4.4E-05	4.56E-05	1.62E-05	8.84E-04	5.3E-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 of roof covered by corrugated bitumen sheets for minimum slopes of 9% and a lifespan of 25 years

Parameter	Unit	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	4.87E-02	1.76E-03	8.59E-02	2.45E-02	4.45E-02	0	0	0	0	0	0	0	2.53E-04	4E-04	1.11E-03	1.22E-03	-2.48E-02
NHWD	kg	5.73E-01	1.11E-01	9.68E-01	9.57E-01	7.05E-01	0	0	0	0	0	0	0	3.92E-03	2.54E-02	4.85E-03	3.38E+00	-6.78E-02
RWD	kg	4.9E-04	1.27E-05	2.59E-05	1.17E-04	1.41E-04	0	0	0	0	0	0	0	2.31E-07	2.87E-06	4.6E-07	5.02E-06	2.96E-07
CRU	kg	0	0	0	0	4.09E-02	0	0	0	0	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	8.32E-03	0	0	0	0	0	0	0	0	0	7.02E-02	0	0
MER	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	5.24E-02	0	0	0	0	0	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	1.09E-01	0	0	0	0	0	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 of roof covered by corrugated bitumen sheets for minimum slopes of 9% and a lifespan of 25 years

Parameter	Unit	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	Disease incidence	7.85E-08	1.1E-08	3.64E-08	1.16E-07	5.56E-08	0	0	0	0	0	0	0	2.18E-10	2.51E-09	4.48E-10	6.27E-09	-2.58E-09
IR	kBq U235 eq	3.02E-01	8.04E-03	2.74E-02	7.63E-02	9.13E-02	0	0	0	0	0	0	0	3.35E-04	1.82E-03	3.28E-04	3.33E-03	7.04E-04
ETP-fw	CTUe	2.13E+01	6.88E-01	5.19E+00	6.37E+00	7.51E+00	5.69E+00	0	0	0	0	0	0	1.85E-02	1.56E-01	2.86E-02	7.47E-01	8.65E-02
HTP-c	CTUh	4.71E-09	4.94E-11	1.8E-09	1.25E-09	2.31E-09	0	0	0	0	0	0	0	1.66E-12	1.11E-11	2.6E-12	2.83E-11	4.68E-10
HTP-nc	CTUh	1.55E-08	1.59E-09	1.45E-08	1.92E-08	1.29E-08	1.37E-11	0	0	0	0	0	0	6E-11	3.63E-10	6.75E-11	4.41E-10	2.83E-09
SQP	SQP	9.35E+00	1.3E+00	1.72E+01	1E+01	9.06E+00	0	0	0	0	0	0	0	1.21E-02	2.98E-01	5.9E-02	2E+00	-1.93E-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.

As no RSL is declared according to ISO 15686, the LCA results of the modules B1-B2 and B6-B7 refer to a period of one year.

This EPD was created using a software tool.

6. LCA: Interpretation

For all products, the stages with the greatest environmental impacts are: the raw materials supply stage (A1), the manufacturing stage (A3), the delivery transport stage (A4), the installation stage (A5), the end of life – disposal phase (C4).

The raw material supply is responsible for over 20% of the impact for following indicators: Climate change – fossil, Climate change - land use and change, Ozone depletion, Acidification, Eutrophication (freshwater, marine and terrestrial), Photochemical ozone formation, Resource use (minerals, metals and fossils), Water use, Particulate matter, Ionising radiation, Human toxicity (cancer and non-cancer), Total non-renewable primary energy, Net use of fresh water, Hazardous waste disposed, Radioactive waste disposed, Interm. & low-level radioactive waste, Exported energy and Total primary energy. It is mostly always due to the supply of bitumen, for some indicators, it is also due to the supply of resin and for a few indicators it is partly due to the supply of pigments.

The raw material supply is also responsible for over 70% of the impact for following indicators: Renewable primary energy used as RM, Total renewable primary energy, Non-renewable

primary energy used as RM and Use of secondary material. It is always due to the supply of cardboard, except for the indicator 'Non-renewable primary energy used as RM', for which it is due to the supply of bitumen.

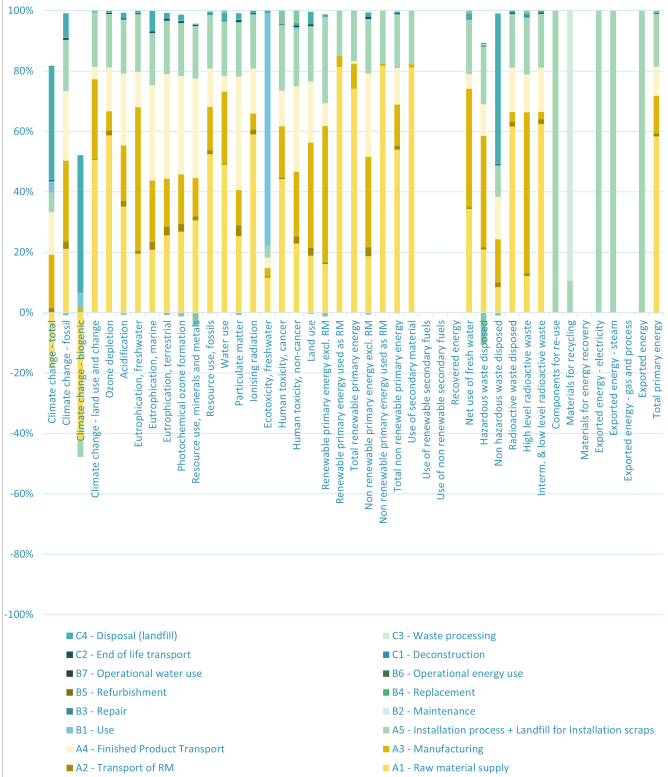
The manufacturing stage is responsible for over 30% of the impact for following indicators:

- Climate change - land use and change, Eutrophication (freshwater), Net use of fresh water and High-level radioactive waste, due to the electric consumption,
- Land use and Renewable primary energy excl. RM, due to the supply of wood pallets,
  Climate change – fossil and Non-renewable primary energy excl. RM, due to the consumption of natural gas,
- Hazardous waste disposed, due to the supply of fixings.

The transport stage (finished product transport – A4) is responsible for over 25% of the impact for following indicators: Eutrophication (marine and terrestrial), Photochemical ozone formation, Resource use (minerals and metals), Particulate matter, Human toxicity (non-cancer), Non-renewable primary energy excl. RM, always and overwhelmingly due to the delivery by light commercial vehicle from stockist to worksite.

The installation stage (A5) is responsible for over 15% of the impact for all the indicators studied in EN15804 standard (except Climate change – biogenic and total, Use of renewable secondary fuels, Use of non-renewable secondary fuels, Non-hazardous waste disposed, Materials for recycling, Materials for energy recovery, Exported energy - gas and process), mainly due to the overproduction needed to offset the overlapping rates and for a few indicators, it is also due also to the end of life of the wooden pallets.

Finally, the disposal stage (C4) is responsible for over 40% of the impact for following indicators: Climate change – total, Climate change – biogenic, Non-hazardous waste disposed, due to the landfilling of waste bitumen sheets.



Distribution of impacts for the sales weighted average product (roofing application, LCA results over the full service life)

Variability studies have shown that sales-weighted average products per country can have an impact of -11% to +17% regarding average GWP (the highest rates are for Malaysia and the lowest rates are for Spain). They have also shown that the references alone can have an impact of -43% to +85% regarding average GWP (highest rate is that of a Malaysian reference and lowest rates is that of a Brazilian reference).

Considering the high results variability, the environmental profile of a sub-group of products or individual products are available upon request.

7. Requisite evidence

External fire performance and reaction to fire of the roofing systems (sheets + tiles) have been tested according to EN 13501-1, EN 13501-5 and test method NBN CEN/TS 1187 (test 1).

Test standard: CEN/TS 1187-T1
Classification standard: EN 13501-1:2016 and EN 13501-5:2016
Measuring agency: Warrington fire, WFRGENT nv
Results of the measurement: Class of external fire performance is Froof for every product, except ONDULINE HR B and ONDULINE ZIGANA Xtrem that are Broof. Class of fire reaction is E for every product.

8. References

EN 534:2006+A1:2010
Corrugated bitumen sheets-Product specification and test method

EN 13501-1:2016
BS EN 13501-1:2016, Fire classification of construction products and building elements - Part1: Classification using data from reaction to fire tests

EN 13501-5
NBN EN 13501-5, Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests
Test method NBN CEN/TS 1187 (test 1).

EN 14964:2006
Rigid underlays for discontinuous roofing – type OL - Definitions and characteristics

EN 15804
EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

ETA-10/0018
Corrugated Bitumen Tiles – Onduvilla: 2015

ISO 9001 : 2008
Quality management systems — Requirements

ISO 14001 : 2004
Environmental management systems — Requirements with guidance for use.

ISO 45001:2018
Occupational health and safety management systems — Requirements with guidance for use.

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

ISO 14040-44
DIN EN ISO 14040:2006: Environmental management - Life cycle assessment - Principles and framework (ISO 14040:2006) and Requirements and guidelines (ISO 14044:2006)

Regulation (EU) No. 305/2011 (CPR)
Harmonised conditions for the marketing of construction products

Database Ecoinvent
Ecoinvent v3.8 (2022 - Ecoinvent Centre)

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
www.ibu-epd.com

PCR Part A
Institut Bauen und Umwelt e.V., Berlin (pub.): 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 (version 1.3), 31 August 2021; www.bau-umwelt.de

PCR Part B
Institut Bauen und Umwelt e.V., Berlin (pub.): 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 corrugated bitumen materials for roofing and external wall cladding, 1 June 2021, www.bau-umwelt.de

Software Simapro
SimaPro 9.5 (2023 - Pré consultant)

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