ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	DuPont de Nemours (Luxembourg) s.à r.l.
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-DUP-20150236-IBE1-EN
Issue date	08.06.2016
Valid to	07.06.2022

DuPont™ Tyvek® Monolayer 80 (1580B, 2480B)

DuPont de Nemours (Luxembourg) s.à r.l.

Institut Bauen und Umwelt e.V.

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

DUPONT

Tyvek.

1. General Information

DuPont de Nemours (Luxembourg) s.à r.l.

DuPont™ Tyvek® Monolayer 80 (1580B, 2480B)

Programme holder
IBU - Institut Bauen und Umwelt e.V.
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Owner of the Declaration
DuPont de Nemours (Luxembourg) s.à r.l.
Rue Général Patton
L-2984 Contern
Luxembourg

Declaration number
EPD-DUP-20150236-IBE1-EN

Declared product / Declared unit
1 m² DuPont™ Tyvek® Monolayer 80 (1580B, 2480B)

This Declaration is based on the Product Category Rules:
False ceiling and underlay sheeting, 07.2014
(PCR tested and approved by the SVR)

Scope:
This document applies to DuPont™ Tyvek® 1580B and 2480B monolayer high density polyethylene (HDPE) membranes manufactured by DuPont in L-2984 Contern and printed in Germany, with a declared unit weight of 81 g/m². The LCA data were compiled using production data from the year 2013 by DuPont Luxembourg s.à r.l. The declaration holder is responsible for the underlying data and its verification. 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.

Issue date
08.06.2016

Valid to
07.06.2022

Verification

The CEN Norm /EN 15804/ serves as the core PCR

Independent verification of the declaration according to /ISO 14025/

☐ internally ☒ externally

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

Dr. Burkhart Lehmann
(Managing Director IBU)

Christina Bocher
(Independent verifier appointed by SVR)

2. Product

2.1 Product description

DuPont™ Tyvek® is a nonwoven material made of HDPE, which is diffusion open but watertight. It is used as a roof and wall underlay.

2.2 Application

Tyvek® underlays are used in roofs and walls. They constitute the second water shedding layer and at the same time protect the insulation from trapped moisture, wind penetration, dust and insects. Insulation installed below Tyvek® is kept dry and performs as designed.

2.3 Technical Data

The following chapter comprises technical data for the characteristics listed in the Declaration of Performance according to the harmonized technical specifications /EN 13859-1:2010/ and /EN 13859-2:2010/.

Technical Data

Name	Value	Unit
Length acc. to EN 1848-2	50m standard	m
Width acc. to EN 1848-2	1.5m standard	m
Grammage acc. to /EN 1849-2/	0.081	kg/m²
Resistance to water penetration acc. to /EN 1928/ (class)	W1	-
Water vapor diffusion equivalent air layer thickness acc. to /EN ISO 12572/	0.025	m
Maximum tensile force acc. to /EN 12311-1/	250/210	N/50mm
Elongation acc. to /EN 12311-1/	10/15	%
Resistance to water penetration after ageing acc. to /EN 1297/, /EN 1928/ (class)	W1	-
Tear resistance (nail) acc. to /EN 12310-1/	90/85	N

2.4 Placing on the market / Application rules

For the placing on the market in the EU/EFTA (with exception of Switzerland) the regulation (EU) No 305/2011 applies. The products need a declaration of performance taking into consideration /EN 13859-1:2010/: Flexible sheets for waterproofing and /EN 13859-2:2010/: Flexible sheets for waterproofing and the CE-marking.
For the application and use the respective national provisions apply. (NO: SINTEF - Stiftelsen for industriell og teknisk forskning; GB: BBA - Bristish Board of Agrément; FR: CSTB - Centre scientifique et technique du bâtiment, etc.).

2.5 Delivery status

The single selling unit is a roll of up to 3m width and a length of up to 100m. Usually several rolls are strapped and piled on a wooden pallet.
The order unit is square meter [m²].

2.6 Base materials / Ancillary materials

Tyvek® single layer membranes are made of
- high density polyethylene (HDPE) >99%
- hindered amine light stabilizers (HALS, added for UV stabilization) <1%.

2.7 Manufacture

Tyvek® underlays are produced on semi-continuously operating production facilities in different countries. Process steps include:

1. Spinning of thin HDPE filaments.
2. Bonding of filament sheet.
3. Printing, slitting and packaging of the finished roll goods.

2.8 Environment and health during manufacturing

Some of the manufacturing facilities employed in the production of Tyvek® are /ISO 14001:2014/ certified. All facilities comply with local regulations and /DuPont internal standards:2015/.
Particular care is taken to ensure the safety of anyone involved in the Tyvek® supply chain in line with the DuPont safety culture: all injuries can be prevented (goal is ZERO).

2.9 Product processing/Installation

Tyvek® membranes for walls and roofs can be either installed on the construction site or in manufacturing facilities in case of pre-fabricated buildings. In both instances the material is usually installed by manually unwinding the sheet from the roll and placing it onto the designated surface. Tools required are usually a knife or scissors to cut the sheet as well as a stapler to fix it to the construction. Refer to Tyvek® installation guidelines for more information.

2.10 Packaging

Tyvek® is wound onto carton cores. Each roll comes with a paper insert sheet. Rolls are individually wrapped in foil (LDPE: low density PE) and stacked on wooden pallets which are also wrapped in LDPE stretch film. Vertical sides of the pallets are protected with a carton profile.
All packaging materials can be reused (e.g. pallets), recycled or valorised through energy recovery.

2.11 Condition of use

Materials are not expected to change or react during the period of use. Tyvek® is intended to be installed on the cold side of the insulation and is designed to withstand substantial temperature changes during service life.

2.12 Environment and health during use

Tyvek® membranes are usually concealed below roof decking or facade cladding. They do not require maintenance and will not produce emissions. There are no environmental or health concerns to be expected from the use of the material.

2.13 Reference service life

The documentation of the RSL is not required for this EPD since not the entire life cycle is declared (without modules B1-B7). Nevertheless, the product is assumed to have a reference service life of 30 years, corresponding to the average roof lifetime BNB *Nutzungsdauerliste*). But this assumption could not be verified because the Tyvek® envelopes have only been sold for 20 years.

2.14 Extraordinary effects

Fire

Fire protection

Name	Value
Building material class acc. to /EN13501-1/	E

Water

Tyvek® membranes are inherently waterproof. No part of the product will dissolve in water nor will the product release any toxic substances to water.

Mechanical destruction

No possible impacts on the environment following unforeseeable mechanical destruction are known.

2.15 Re-use phase

The material is not intended to be re-used or recycled. Energy recovery is possible.

2.16 Disposal

Incineration is the preferred way of disposal.
The /European Waste Code:2000/ for HDPE is 02 01 04, for random construction materials it is 17 09 04. Both may apply.

2.17 Further information

Additional information about product properties and use can be found at construction.tyvek.com.
Material Safety Data Sheets (MSDS) of the product can be found at www.dupont.com.

3. LCA: Calculation rules

3.1 Declared Unit

This declaration applies to 1 m^2 of DuPont™ Tyvek® 1580B and 2480B membranes, with a declared unit weight of 81 g/m^2.

Declared Unit

Name	Value	Unit
Declared unit	1	m^2
Grammage	0.081	kg/m^2
Conversion factor to 1 kg	12.341567	-

3.2 System boundary

Type of EPD: Cradle-to-gate (with options)
The system boundaries of the EPD follow the modular construction system as described by /EN 15804:2012/.
The LCA takes into account the following modules:

- A1-A3: Manufacturing of pre-products, packaging, ancillary materials, transport to the factory, production including energy supply and waste handling
- A4: Transport to the construction site
- A5: Installation into the building (disposal of packaging)
- C4: Waste disposal (incineration)
- D: Potential for reuse, recovery and/or recycling (benefits for incineration and recovery of packaging materials from module A5 and envelopes incineration from module C4).

3.3 Estimates and assumptions

The colour paste used in the finishing process was valued with a general composition of water-based colour paste (conservative approach).

3.4 Cut-off criteria

All data were taken into consideration (recipe constituents, process water, electricity used). In case of missing data, a cut-off criteria of 1% of the total input mass was applied for unit processes and 5% for the entire modules (as recommended by /EN 15804:2012/, section 6.3.5) and therefore some inputs were excluded: tape and spiking agent for monolayer production (sum < 0.04% of total input mass for monolayer production), paper ink, hotmelt, paper, tape and detergent for finishing process (sum < 0.2% of total input mass for finishing process). Transports were considered for all inputs and outputs. Manufacturing of the production machines and systems and associated infrastructure were not taken into account in the life cycle assessment (LCA). Regarding possible off-cuts during installation, the amount is lower than 5% and therefore also neglected.

3.5 Background data

All background data for the LCA model were taken from the database of the /GaBi software version 6.106:2015/.

3.6 Data quality

To simulate the product stage, data recorded by DuPont Luxembourg s.à r.l. and the converting plant in Germany from the production year 2013 were used. Eurostat data for the year 2012 were used to model the modules A4 (freight transport modal split) and A5 (packaging disposal routes).
Regarding background processes, the Luxembourg and German electricity grid mix were applied to the production plants in these countries (A1-A3). Other background data were specific to Germany or the European average, and were not older than 3 years. The representativeness can be classified as very good.

3.7 Period under review

The period of study encompasses the year 2013.

3.8 Allocation

Mass allocation was applied for production. At the DuPont site in Luxembourg, Tyvek® waste materials are recycled internally or sold and transformed externally. The avoided production of HDPE granulates is considered in the modules A1-A3 for the valuable pellets sold with specification. The low quality plastic pellets without specification and some packaging materials sent for recycling are transformed externally to obtain valuable material. In this case, the materials for recycling are considered as waste material and a system cut-off is applied to the Life Cycle Inventory (LCI). The packaging and Tyvek® production waste sent to incineration are modelled through the combustion process of the specific material and the avoided conventional energy production is credited 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 technical information serves as a basis for the declared modules or can be used for the development of specific scenarios in the context of a building assessment.

Transport from the gate to the construction site (A4)

Name	Value	Unit
Transport distance (weighted average)	2667	km
Transport (train)	1.86E-02	tkm
Transport (road)	7.69E-02	tkm
Transport (water)	8.34E-02	tkm

Installation of the product into the building (A5)

Name	Value	Unit
Wood waste to landfill	1.36E-03	kg
Wood waste to incineration	1.25E-03	kg
Cardboard waste to landfill	4.02E-04	kg
Cardboard waste to incineration	3.46E-04	kg
Plastic waste to landfill	9.32E-05	kg
Plastic waste to incineration	7.02E-05	kg

Reference Service Life (RSL)

Name	Value	Unit
Reference service life	30	a

End-of-life stage (C1-C4)

Name	Value	Unit
Collected separately Tyvek® waste	0.081	kg
Energy recovery	100	%
R+ value	< 0.6	

5. LCA: Results

The results displayed below apply to 1 m^2 of DuPont™ Tyvek® 1580B and 2480B membranes, with a declared unit weight of 81 g/m^2.

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	MND	MND	MND	MND	MND	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m2 DuPont™ Tyvek® Monolayer 80 (1580B and 2480B)

Parameter	Unit	A1-A3	A4	A5	C4	D
Global warming potential	[kg CO_2-Eq.]	3.93E-1	8.14E-3	5.47E-3	2.54E-1	-1.48E-1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	6.10E-11	3.14E-13	1.68E-14	5.60E-13	-4.61E-11
Acidification potential of land and water	[kg SO_2-Eq.]	1.67E-3	8.94E-5	1.02E-6	1.83E-5	-3.63E-4
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	1.02E-4	1.51E-5	4.83E-7	3.48E-6	-2.56E-5
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	1.73E-4	-1.31E-5	7.14E-7	2.17E-6	-3.13E-5
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	7.86E-8	3.51E-10	5.38E-11	1.23E-9	-1.42E-8
Abiotic depletion potential for fossil resources	[MJ]	9.22E+0	1.09E-1	2.49E-3	2.65E-2	-2.10E+0

RESULTS OF THE LCA - RESOURCE USE: 1 m2 DuPont™ Tyvek® Monolayer 80 (1580B and 2480B)

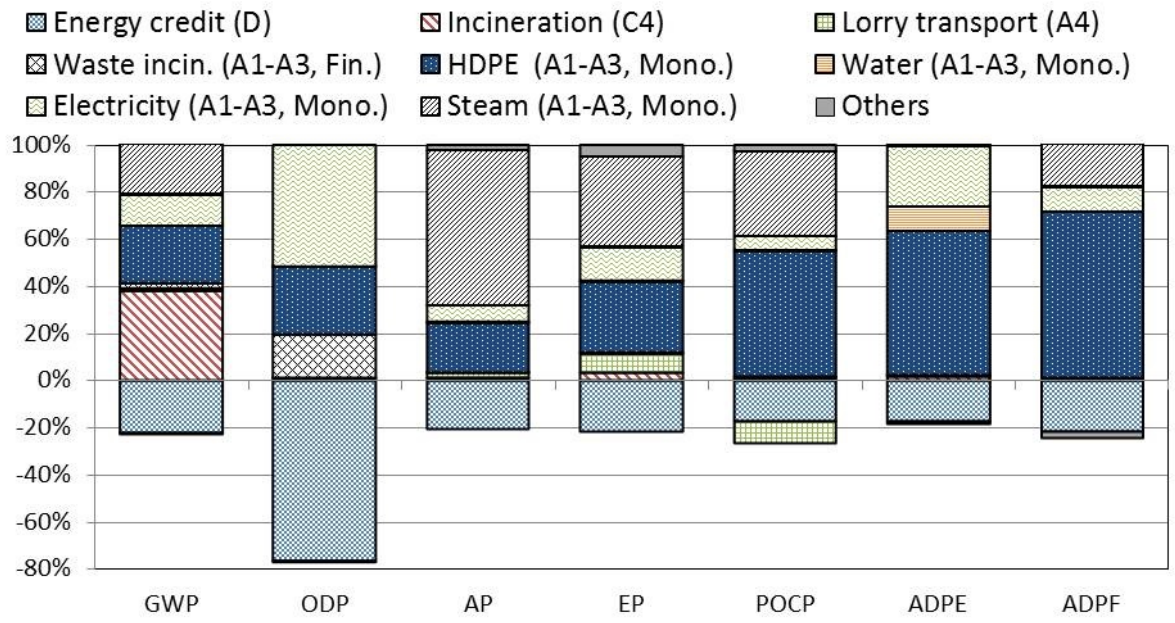
Parameter	Unit	A1-A3	A4	A5	C4	D
Renewable primary energy as energy carrier	[MJ]	5.38E-1	6.22E-3	1.78E-4	3.12E-3	-2.35E-1
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	5.38E-1	6.22E-3	1.78E-4	3.12E-3	-2.35E-1
Non-renewable primary energy as energy carrier	[MJ]	1.05E+1	1.20E-1	2.91E-3	3.42E-2	-2.74E+0
Non-renewable primary energy as material utilization	[MJ]	9.94E-7	1.78E-13	1.81E-14	3.63E-13	-2.58E-11
Total use of non-renewable primary energy resources	[MJ]	1.05E+1	1.20E-1	2.91E-3	3.42E-2	-2.74E+0
Use of secondary material	[kg]	6.22E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	7.38E-5	7.76E-7	1.42E-6	4.45E-7	-2.70E-5
Use of non-renewable secondary fuels	[MJ]	7.82E-4	8.13E-6	3.05E-6	4.00E-6	-2.83E-4
Use of net fresh water	[m^3]	2.34E-1	1.71E-3	1.26E-4	3.24E-3	-2.09E-1

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m2 DuPont™ Tyvek® Monolayer 80 (1580B and 2480B)

Parameter	Unit	A1-A3	A4	A5	C4	D
Hazardous waste disposed	[kg]	-4.56E-7	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Non-hazardous waste disposed	[kg]	-2.56E-4	0.00E+0	1.86E-3	0.00E+0	0.00E+0
Radioactive waste disposed	[kg]	2.08E-4	1.16E-6	7.53E-8	2.10E-6	-1.66E-4
Components for re-use	[kg]	IND	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND	IND
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	2.33E-2	4.78E-1	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	7.51E-2	1.08E+0	0.00E+0

6. LCA: Interpretation

The following chart shows the relative contributions of the different modules to the various LCA categories and to primary energy use in a dominance analysis.



For most of the impact categories, more than 70% of the impacts are dominated by the Tyvek® production (A1-A3) and in particular by the supply of HDPE granulates, steam and electricity. This result makes sense since the production step is requiring the main efforts in terms of materials and energy input.
The avoided energy production due to waste incineration (D) leads to significant benefits, between 17% and 75% of the impact results. Emissions of carbon dioxide during monolayer incineration (C4) generate 38% of the **GWP** results but this process shows negligible impacts on other categories.
Tyvek® waste incineration during the finishing step (included in A1-A3) contributes to 21% of **ODP** score due to halogens emissions to air in the incineration module. The emissions of nitrogen monoxide from lorry transport (A4) generate significant impacts on **EP** and negative results on **POCP** (it decreases tropospheric ozone production). Impacts linked to packaging production as well as packaging disposal are negligible.

Glossary:

ADPE: Abiotic depletion potential for non-fossil resources
ADPF: Abiotic depletion potential for fossil resources
EP: Eutrophication potential
Fin.: Finishing process
GWP: Global Warming Potential
HDPE: High-Density Polyethylene
LCA: Life Cycle Assessment
Mono: Monolayer production
ODP: Depletion potential of the stratospheric ozone layer
POCP: Formation potential of tropospheric ozone photochemical oxidants

7. Requisite evidence

No requisite evidence is required for DuPont™ Tyvek® 1580B and 2480B monolayer membranes.

8. References

DuPont internal standards:2013
DuPont Luxembourg Environmental Policy, February 2015; DuPont Safety, Health and the Environment (SHE) Commitment, February 2013; The DuPont Luxembourg Environmental Handbook

European Waste Code:2000
European List of Waste (Commission Decision 2000/532/EC) and Annex III to Directive 2008/98/EC

GaBi 6.106:2015
Life Cycle Engineering software and database. LBP, University of Stuttgart and thinkstep, 2015.

PCR 2014, Part B
PCR Guidance-Texts for Building-Related Products and Services: Requirements on the EPD for False ceiling and underlay sheeting (version 1.6, 2014)

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.bau-umwelt.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

EN 12310-1:1999
Flexible sheets for waterproofing - Part 1: Bitumen sheets for roof waterproofing; determination of resistance to tearing (nail shank)

EN 12311-1:1999
Flexible sheets for waterproofing - Part 1: Bitumen sheets for roof waterproofing; Determination of tensile properties

EN 1297:2004
Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing - Method of artificial ageing by long term exposure to the combination of UV radiation, elevated temperature and water

EN 13501-1:2007+A1:2010
Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 13859-1:2010
Flexible sheets for waterproofing - Definitions and characteristics of underlays - Part 1: Underlays for discontinuous roofing

EN 13859-2:2010
Flexible sheets for waterproofing - Definitions and characteristics of underlays - Part 2: Underlays for walls

EN ISO 14001:2004
Environmental management systems - Requirements with guidance for use (ISO 14001:2004 + Cor. 1:2009)

EN ISO 12572:2001
Hygrothermal performance of building materials and products -- Determination of water vapour transmission properties

EN 1849-2:2009
Flexible sheets for waterproofing - Determination of thickness and mass per unit area - Part 2: Plastic and rubber sheets

EN 1928:2000
Flexible sheets for waterproofing - Bitumen, plastic and rubber sheets for roof waterproofing - Determination of watertightness

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