ENVIRONMENTAL PRODUCT DECLARATION

MCT

MARMOLEUM COMPOSITE TILE 2.0 MM

FORBO FLOORING SYSTEMS
RESILIENT LINOLEUM FLOOR COVERING

MCT: Color MCT-3251 lemon zest, MCT-621 dove grey

FLOORING SYSTEMS

Marmoleum is the world market leader in biobased linoleum flooring that has been manufactured by Forbo for more than 150 years. Marmoleum is produced having low environmental impacts as a result of the combination of natural renewable materials and high recycled content.
Forbo was the first flooring manufacturer to publish a complete Life Cycle Assessment (LCA) report verified by CML in 2000 to create full transparency that is independently evaluated. To offer further transparency this EPD is also including additional information to show the impacts on human health and eco-toxicity.
For more information visit;
www.forbo-flooring.com

Eco friendly linoleum flooring | Forbo Flooring Systems

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

FLOORING SYSTEMS

MCT, Marmoleum Composite Tile 2.0 mm
Resilient Linoleum Floor Covering

According to ISO 14025 & EN 15804

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment 333 Pfingsten Road Northbrook, IL 60611
DECLARATION HOLDER	Forbo Flooring B.V. Industrieweg 12 NL-1560 AA Krommenie
DECLARATION NUMBER	4791394460.101.1
DECLARED PRODUCT	MCT, Marmoleum Composite Tile 2.0mm Resilient Linoleum Floor Covering
REFERENCE PCR	EN 15804+A2: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products EN 16810:2017 Resilient, textile and laminate floor coverings – Environmental product declarations – Product category rules
DATE OF ISSUE	May 7th, 2025
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications
The PCR review was conducted by:	European Standards CEN/TC 134 https://www.en-standard.eu/
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Solutions
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

This EPD conforms with EN 15804

1 Product Definition

1.1 Description of Company/Organization

Forbo Flooring Systems has mastered the craft of manufacturing linoleum over the last 150 years and has been driving this development experience through in its Marmoleum brand. Marmoleum is made in two plants. In Assendelft in The Netherlands and Kirkcaldy in Scotland. The manufacturing locations are state-of the art production sites that are making sheet, tiles and planks in hundreds of different designs and colours.
Making Marmoleum has always been done in a way to achieve the lowest carbon footprint; the starting point for innovation and development. The Forbo organization has key environmental focus areas to displaying a carbon-negative product portfolio, using renewable electricity, becoming a zero-waste company and actively contributing to the circular economy.

For its complete manufacturing of Marmoleum, Forbo holds all the main certifications. For environmental performance **ISO 14001**, for quality **ISO 9001**, **SA8000** for social accountability and **ISO 45001** for Occupational Health and Safety Management Systems. In addition, Marmoleum has been awarded with various independent environmental products labels such as **Nordic SWAN**, **Umwelt Zeichen**, **Der Blaue Engel** and **Declare**.

1.2 Product Classification and description

Marmoleum is a resilient floor covering complying with all the requirements of ASTM F 2195 Standard Specification for Linoleum Floor Tile and EN-ISO 24011: Specification for plain and decorative linoleum. Marmoleum is made from natural raw materials making it preferable ecological and durable floor covering with a beautiful stylish and colorful design. The key raw materials include linseed oil, which comes from the flax plant seeds, gum rosin from pine trees, recycled wood waste of wood from controlled forests and limestone.

Linoleum is produced by Forbo Flooring for more than 150 years and our well-known brand Marmoleum is sold worldwide. This declaration refers to MCT Marmoleum composite tiles of 2.0 mm nominal thickness covering a broad range of designs and colors: Marbled and Piano design structures.

Figure 1: Illustration of MCT cross-section

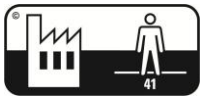
Marmoleum is build up in 3 layers as illustrated in the figure 1.These three layers form one homogeneous product by the cross linking bondings formed during the oxidative curing process:

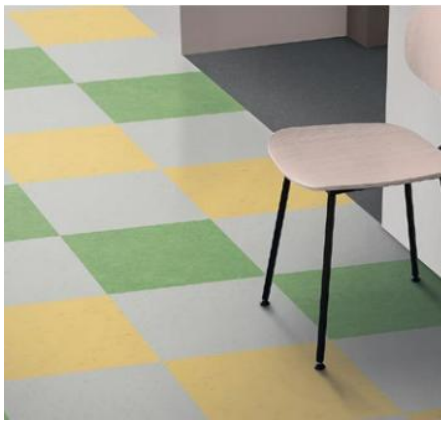
1. **Surface layer:** This layer gives Marmoleum its design and color. After finishing the product at the trimming department a factory finish Topshield pro is applied to protect the surface layer.
2. **Intermediate layer:** This layer is calendared on the polyester backing and contains reused and recycled Linoleum.
3. **Backing:** The backing is a woven polyester.

The declaration refers to the declared/functional unit of 1m² installed flooring product.

1.3 Range of application

MCT, Marmoleum Composite Tile is classified in accordance with EN-ISO 24011 to be installed in the following use areas defined in EN–ISO 10874:

Area of application	2.0 mm thickness
Domestic	Class 23 
Commercial	Use class 32 
Industrial	Use class 41 



Examples of use areas

1.4 Product Standard

The products considered in this EPD have the following technical specifications:

- Meets or exceeds all technical requirements in ASTM F 2195 Standard Specification for Linoleum Floor Tile.
- Meets or exceeds all technical requirements in EN-ISO 24011 Specification for plain and decorative Linoleum.

Fire Testing:

- Class 1 when tested in accordance with ASTM E 648/NFPA 253, Standard Test Method for Critical Radiant Flux.
- Meets 450 or less when tested in accordance with ASTM E 662/NFPA 258, Standard Test Method for Smoke Density.
- Class C when tested in accordance to ASTM E 84/NFPA 255, Standard Test Method for Surface Burning

Characteristics.
- FSC1-150; SD-160 when tested in accordance to CAN/ULC S102.2, Standard Test Method for Flame Spread Rating and Smoke Development.

Emission testing:
- AgBB requirements following EN ISO 16000-9 Indoor Air Emissions: TVOC at 28 days
- French act Grenelle: A+
- Compliant with CDPH 01350 requirements for VOC emissions and indoor air quality.

1.5 Accreditation

All Forbo Flooring Systems' manufacturing operations have certified Management System in accordance with:
- ISO 9001 Quality Management System
- ISO 14001 Environmental Management System
- ISO 45001 Occupational Health and Safety Management Systems
- SA 8000 Social Accountability standard

Forbo's Marmoleum has been awarded a large array of international environmental certificates such as:
- Declare LBC Red List Free
- USDA certified biobased product
- UK Allergy seal
- GECA, Good Environmental Choice Australia
- HPD
- Clearchem

A Berkeley Analytical ClearChem Declaration is available for this product.
In addition Marmoleum floor covering improves the environmental and well-being score in building rating schemes such as LEED, Breeam and the Well building standard.

1.6 Delivery Status

Table 1: Specification of delivered product

Characteristics	Nominal Value	Unit	Nominal Value	Unit
Product thickness	2.0	mm	0.080”	inch
Product Weight	2450	g/m^2	0.5018	lbs/ft
Tiles Length x Width	333 x 333	mm	13.1” x 13.1”	inch

2 Material Content

2.1 Material Content of the Product

Table 2: Composition of MCT

Component	Material	Availability			Amount [%]	Origin
		Renewable	Recycled	Non-Renewable		
Binder	Linseed oil	Bio based crop			25	Canada/Europe
	Gum rosin	Bio based crop			5.5	Indonesia
Filler	Wood flour		Bio based waste product from wood processing		25	Germany
	Calcium carbonate			Abundant mineral	15.5	Germany
	Reused & Recycled Marmoleum		Pre- and post-consumer waste		20	Internal/External
Pigment	Titanium dioxide			Limited mineral	2	Global
	Other pigments			Limited mineral	1	Global
Backing	Polyester			Limited fossil	5	Europe
Finish	Lacquer				1	Netherlands


Flax plant


Gum Rosin


Wood flour


Calcium Carbonate


Production/Installation waste

2.2 Production of Main Materials

Linseed oil : Linseed oil is obtained by pressing the seeds of the flax plant. After filtering a clear golden yellow liquid remains.
Gum rosin : Rosin is obtained by wounding pine trees. The crude gum is collected and is separated into turpentine and rosin by distillation.
Wood flour : Postindustrial bio based soft wood waste from the wood industry, which is milled into flour.
Calcium carbonate : An abundant mineral found in all parts of the world as the chief substance in rocks (i.e., marble and limestone). It can be ground to varying particle sizes and is widely used as filler.
Reused and recycled Marmoleum : Scrap material coming from the Marmoleum production which is reused and post-consumer recycled Marmoleum scrap, grinded and processed as raw material into new flooring.
Titanium dioxide : A white pigment produced from the mineral rutile, a naturally occurring form of titanium dioxide. The production of the pigment is a large-scale chemical process
Various other pigments : The vast majority of the used color pigments are iron oxide based.
Polyester : Polyester fibers woven into a fabric which is used as a substrate.
Lacquer : The factory applied lacquer – Topshield pro – is a double layer factory finish based on a mixture of high quality polymers, acrylate functional mono- and copolymers, partly waterborne.

3 Production of the Floor Covering

3.1 Manufacturing

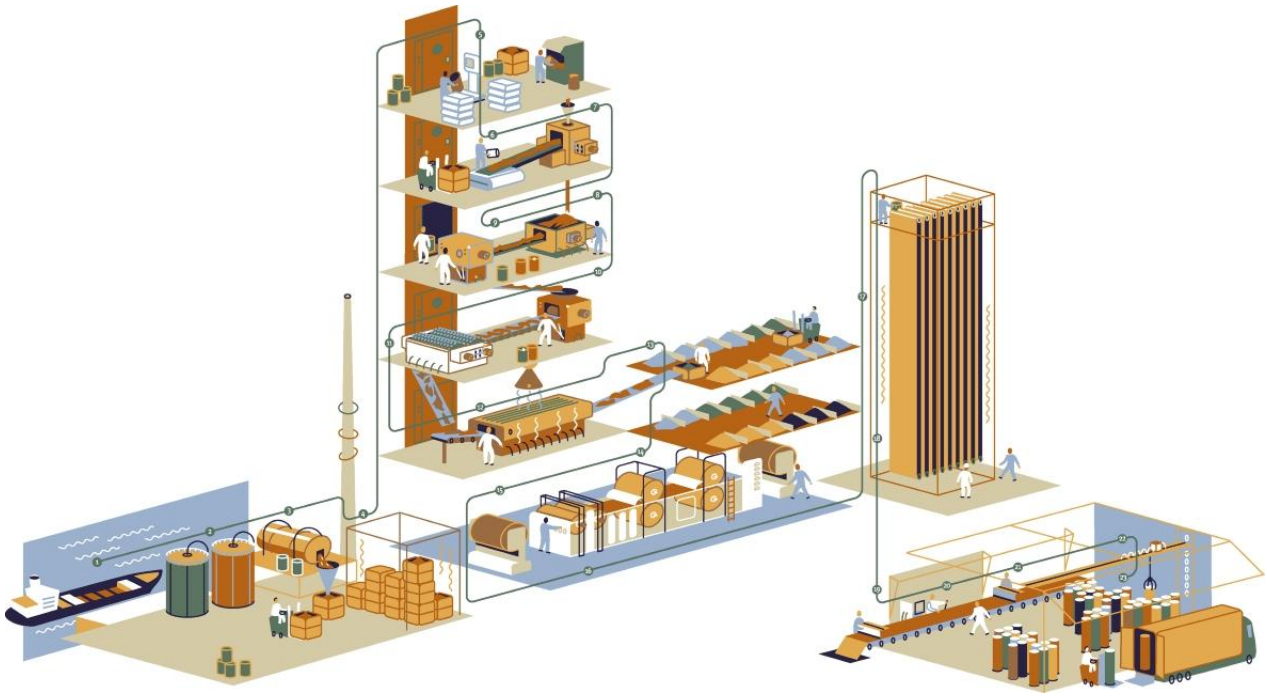


Figure 2: Illustration of the Production process

Marmoleum is a bio-based flooring product, with natural ingredients crafted into a climate positive, long lasting floorcovering.

MCT, Marmoleum Composite Tile is produced in several stages starting with the oxidation of linseed oil mixed with rosin. With the influence of oxygen from the atmosphere a tough sticky and chewy material is obtained.
The linoleum base material is stored in containers for a few days for further aging and after this it is mixed with wood flour, calcium carbonate, reused & recycled waste, titanium dioxide and pigments.
This mixture is calendared on a polyester substrate and stored in drying rooms, to cure till the required hardness is reached. After approximately 14 days the material is taken out from the drying room to the trimming department where the factory finish is applied on the surface of the product and the end inspection is done. Finally the edges are trimmed and the sheet is cut to length into tiles. The trimmings and the rejected product are reused into new Marmoleum floors.

The recycling plant on our factory site, processes both pre- and post-consumer waste into a new raw material, that is added to the linoleum base material, replacing a significant part of virgin material.

For the manufacturing of Marmoleum sustainable green electricity is being used, solar panels on the warehouses generate the electricity needed for our for the internal transport by truck and forklifts.
The drying rooms operate with an eco-control system and frequency controlled fans to reduce the energy usage and to improve operating efficiency.
During the manufacturing of Marmoleum no process water is being used or disposed.

3.2 Production Waste

Rejected material and the cuttings of the trimming stage are being reused in the manufacturing process.
Packaging materials are being collected separately and externally recycled.

4 Delivery and Installation of the Floor Covering

4.1 Delivery

A worldwide distribution by truck and container ship is considered. On average every square meter of Marmoleum is transported as follows:

- Transport distance 40 t truck 2536 km
- Transport distance 14t truck (Fine distribution) 347 km
- Capacity utilization trucks (including empty runs) 100%
- Transport distance Ocean ship 6024 km
- Capacity utilization Ocean ship 100%

Installation

Because of the specific techniques used during the installation of MCT 2% of the material is cut off as installation waste. For installation of MCT on the floor an average scenario has been modeled (assuming 0.280 kg/m^2 of adhesive is required). Forbo Flooring recommends to use a low emission EC1 adhesive for installing Marmoleum.
Cardboard tubes and packaging paper can be collected separately and should be used in a local recycling process. In the calculation model 100% incineration is taken into account for which there is a credit received.

5 Use stage

The service lifetime of a floor covering for a certain application on a floor is too widespread to give one common number. For this EPD model the reference service lifetime (RSL) is set to one year. This means that all impacts for the use phase are based on the cleaning and maintenance model for one year. Depending on the area of use, the technical lifetime advised by the manufacturer and the estimated time on the floor by the customer, the service lifetime can be determined. The use phase impacts should be multiplied with the foreseen service life to arrive at the total environmental impact.

5.1 Cleaning and Maintenance

Level of use	Cleaning Process	Cleaning Frequency	Consumption of energy and resources
Commercial/Residential/Industrial	Dust mopping	Daily	-
	Damp mopping	Once a week	Hot water Neutral detergent

For the calculations the following cleaning regime is considered:

- Dry cleaning with a dust mop
- Once a week wet cleaning with 0.062 l/m^2 water and 0.0008 kg/m^2 detergent. This result in the use of 3.224 l/m^2*year water and 0.04 kg/m^2*year detergent. The wet cleaning takes place without power machine usage. Waste water treatment of the arising waste water from cleaning is considered.

The cleaning regime that is recommended in practice will be highly dependent on the use of the premises where the floor covering is installed. In high traffic areas more frequent cleaning will be needed compared to areas where there is low traffic. The use of an entrance mat of at least four steps will reduce the cleaning frequency.

5.2 Prevention of Structural Damage

All newly laid floor covering should be covered and protected with a suitable non-staining protective covering if other building activities are still in progress. Use protective feet on chairs and tables to reduce scratching. Castor wheels should be suitable for resilient floor coverings

6 End of Life

For recycling purposes both the subfloor and the floor covering need to remain as intact as possible at the End of Life stage and contamination of the material needs to be avoided. Therefore the deconstruction of installed Marmoleum from the floor is done mechanically with a special floor stripper.
The electrical energy needed for this is estimated to be 0.03 kWh/sqm, this amount of energy is taken into account for the calculations, although currently circularity has not yet been achieved on a large scale for floor coverings.

For the end of life stage two scenarios have been calculated assuming that the flooring is either 100% incinerated or 100% landfilled.

7 Life Cycle Assessment

A full Life Cycle Assessment has bee carried out according to ISO 14040 and ISO 14044.

The following Life Cycle Stages are assessed :
A1-3 : Product Stage (Raw material acquisition, transportation to Manufacturing and Manufacturing)
A4-5 : Construction process stage (Transport Gate to User, installation flooring)
B2 : Use Stage (Maintenance of the floor). For floor coverings the modules B1, B3 to B7 are not relevant to the environmental performance of a product.
C1-4 : End of Life Stage (Deconstruction, transport, waste processing, Disposal). Two different End of Life scenarios are declared and the results are indicated separately in module C. Each scenario is calculated as a 100% scenario:
Scenario 1: 100% Municipal Waste Incineration (MWI) with $R_1 > 60\%$
Scenario 2: 100% landfill disposal
D : Benefits and loads beyond the system boundary (Reuse, recovery, recycling potential)

End of life scenario 1: 100% Municipal Waste Incineration (MWI) with $R_1 > 60\%$

- C3-1 (Waste processing): Impact from waste incineration, generated electricity and steam are listed in the result table as exported energy
- C4-1 (Disposal): The product waste leaves the system in module C3-1 and causes no additional impact
- D-1 (Recycling potential): Benefits for generated energy due to incineration of product waste at the end-of-life

End of life scenario 2: 100% landfill disposal

- C3-2 (Waste processing): Landfill disposal needs no waste processing and causes no additional impact
- C4-2(Disposal): Impact from landfill disposal
- D-2 (Recycling potential): Benefits for generated energy due to landfill disposal of product waste at the end of life

Modules C3-2 and C4-1 cause no additional impact and are therefore not displayed in the result tables.

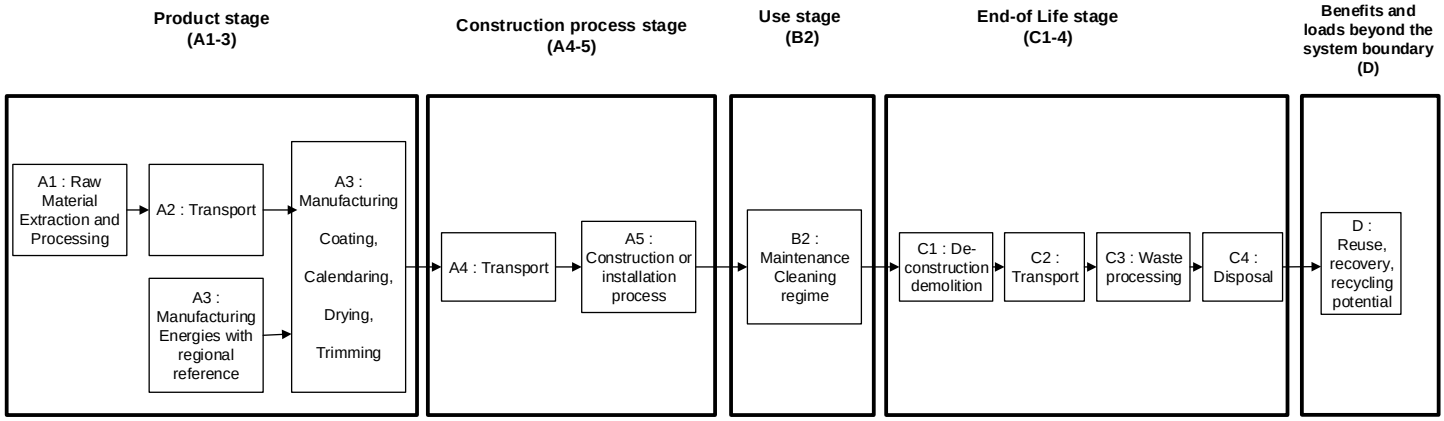


Figure 3: Flow chart of the Life Cycle Assessment

Comparisons of different floor coverings are only allowed, where EN 15804 consistent and/or preverified background data and EN 15804 consistent calculation methods and database versions are used and when the building context is

taken into account, i.e. on the basis of the same use-classification (EN ISO 10874), same service life and comparable assumptions for the end of life.

7.1 Description of the Declared Functional Unit

The functional unit is one square meter of installed product and the use stage is considered for one year of service life.

7.2 Cut off Criteria

The cut-off criteria shall be 1% of renewable and non-renewable primary energy usage and 1% of the total mass of the unit process. The total neglected input flows per module shall be a maximum of 5% of energy usage and mass.

In practice, in this assessment, all data from the production data acquisition are considered, i.e. all raw materials used as per formulation, use of water, electricity and other fuels, the required packaging materials, and all direct production waste. Transport data on all considered inputs and output material are also considered.

7.3 Allocations

In the present study some allocations have been made. Detailed explanations can be found in the chapters below.

7.4 Co-product allocation

No co-product allocation occurs in the product system.

7.5 Allocation of multi-input processes

The Production and End of Life stage include incineration plants. In these processes different products are treated together within a process. The allocation procedures followed in these cases are based on a physical classification of the mass flows or calorific values.

Credits from energy substitution are allocated to the production stage, because the gained energy from energy substitution is lower than the energy input in this stage. The same quality of energy is considered.

7.6 Allocation procedure of reuse, recycling and recovery

The installation waste and end of life waste is fed into incineration processes. Incineration processes include cogeneration processes which give thermal and power energy as outputs. It is assumed that this recovered energy offsets that produced by the European average grid mix and thermal energy generation from natural gas. The gained energy is declared in module D as avoided environmental burden. Generated electricity and steam due to the incineration of installation and end of life waste are listed in the result table as exported energy.

7.7 Description of the allocation processes in the LCA report

The description of allocation rules in of this LCA report meets the requirements of the PCR.

7.8 LCA Data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes have been used as the first choice as a basis for calculating an EPD.

For life cycle modeling of the considered products, the GaBi 10 Software System for Life Cycle Engineering, developed by SPHERA AG has been used. All relevant LCA datasets are taken from the GaBi 10 software database. The datasets from the database GaBi are documented in the online documentation. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

7.9 Data Quality

The requirements for data quality and LCA data correspond to the specifications of the PCR.

Foreground data are based on 1 year averaged data (year 2024). The reference ages of LCA datasets vary but are given in the table in the Appendix. The time period over which inputs to and outputs from the system is accounted for is 100 years from the year for which the data set is deemed representative. The technological LCA of the collected data reflects the physical reality of the declared product. The datasets are complete, conform to the system boundaries and the criteria for the exclusion of inputs and outputs and are geographical representative for the supply chain of Forbo flooring.

For life cycle modeling of the considered products the GaBi 10 Software System for Life Cycle Engineering, developed by SPHERA, is used. All relevant LCA datasets are taken from the GaBi 10 software database. The last revision of the used data sets took place within the last 10 years.

7.10 System Boundaries

Production Stage includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues during the product stage.

Transport and Installation Stage includes provision of all materials, products and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction stage. These information modules also include all impacts and aspects related to any losses during this construction stage (i.e. production, transport, and waste processing and disposal of the lost products and materials). For the transportation a worldwide distribution is considered.

Use Stage includes provision and transport of all materials, products and related energy and water use, as well as waste processing up to the end-of-waste state or disposal of final residues during this part of the use stage. These information modules also include all impacts and aspects related to the losses during this part of the use stage (i.e. production, transport, and waste processing and disposal of the lost products and materials).

End of Life Stage includes provision and all transports, provision of all materials, products and related energy and water use. It also includes any declared benefits and loads from net flows leaving the product system that have not been allocated as co-products and that have passed the end-of-waste state in the form of reuse, recovery and/or recycling potentials.

7.11 Power mix

The selection of LCA data for the electricity generation is in line with the PCR.

The products are manufactured in Kirkcaldy, United Kingdom. The GaBi 10 Wind-power dataset for the United Kingdom have therefore been used (reference year 2024). The energy supplier is providing Forbo with a certificate every year.

7.12 CO_2-Certificates

No CO_2-certificates are considered in this study as the Marmoleum manufacturing is realized without offsetting.

7.13 Life Cycle Inventory Analysis

In table 3 the results are presented in accordance with the EN 15804+A2 standard, which mandates the compensation of biogenic carbon uptake in stages A1-A3 at the end-of-life stage. This is referred to as the “-1 in/+1 out” approach. According to EN 15804+A2, this approach requires reporting biogenic carbon flows by accounting for carbon uptake (negative emission) during the product stage and carbon release (positive emission) during the end-of-life stage.
In the installation phase (A5), the biogenic carbon absorbed by the packaging is released. Additionally, the biogenic carbon absorbed by the raw materials is released during phases C3/1 or C4/2.

The environmental impacts are presented for all the lifecycle stages with two End of Life scenarios:

- Scenario 1: 100% Municipal Waste Incineration (MWI) with R1 > 60%
- Scenario 2: 100% landfill disposal.

Table 3: Results of the LCA – Environmental impact for MCT 2.0 mm (one year)

Parameter	A1-A3	A4	A5	B2	C1	C2	C3/1	C4/2	D/1	D/2
GWP - total [kg CO2 eq.]	8,04E-02	2,81E-01	1,57E+00	6,35E-02	1,66E-01	1,51E-02	2,74E+00	2,80E+00	-1,99E-01	-1,92E-02
GWP - fossil [kg CO2 eq.]	2,71E+00	2,76E-01	1,16E-01	6,09E-02	1,64E-01	1,50E-02	1,22E-01	1,75E-01	-1,98E-01	-1,91E-02
GWP - biogenic [kg CO2 eq.]	-2,63E+00	4,19E-03	1,45E+00	2,57E-03	1,48E-03	-2,06E-05	2,62E+00	2,62E+00	-9,00E-04	-9,56E-05
GWP - luluc [kg CO2 eq.]	3,35E-03	5,29E-04	4,76E-04	5,58E-07	3,47E-05	8,31E-05	0,00E+00	8,28E-05	-1,88E-05	-2,05E-06
ODP [kg CFC-11 eq.]	1,22E-09	1,14E-14	9,57E-11	1,58E-09	2,40E-12	8,93E-16	5,96E-09	2,28E-13	-1,11E-12	-1,25E-13
AP [Mole of H+ eq.]	1,36E-02	4,24E-03	3,11E-04	1,16E-04	3,60E-04	4,70E-05	1,49E-03	7,16E-04	-2,35E-04	-2,47E-05
EP - freshwater [kg P eq.]	6,69E-04	3,05E-07	1,74E-06	2,09E-06	4,78E-07	4,45E-08	2,31E-08	9,94E-05	-2,27E-07	-2,55E-08
EP - marine [kg N eq.]	1,00E-02	1,18E-03	1,07E-04	4,01E-05	8,07E-05	2,17E-05	5,98E-04	8,79E-04	-6,68E-05	-6,74E-06
EP - terrestrial [Mole of N eq.]	5,20E-02	1,30E-02	1,20E-03	2,30E-04	8,47E-04	2,42E-04	6,85E-03	2,33E-03	-7,19E-04	-7,22E-05
POCP [kg NMVOC eq.]	1,02E-02	3,12E-03	2,80E-04	9,12E-05	2,18E-04	4,25E-05	1,56E-03	1,24E-03	-1,88E-04	-1,89E-05
ADPF [MJ]	4,12E+01	2,46E+00	2,73E+00	1,22E+00	2,97E+00	1,99E-01	1,56E+00	2,41E+00	-3,34E+00	-3,24E-01
ADPE [kg Sb eq.]	2,09E-06	1,15E-08	2,62E-08	3,65E-10	4,47E-08	1,25E-09	1,25E-12	1,18E-08	-2,63E-08	-2,82E-09
WDP [m³ world equiv.]	2,87E-01	1,03E-03	2,67E-02	1,37E-01	3,74E-02	1,34E-04	3,38E-01	6,78E-03	-1,75E-02	-1,97E-03

Caption: GWP - total = global warming potential; GWP - fossil = global warming potential (fossil fuel only); GWP - biogenic = global warming potential (biogenic); GWP - luluc = global warming potential (land use only); ODP = ozone depletion; AP = acidification terrestrial and freshwater; EP - freshwater = eutrophication potential (freshwater); EP - marine = eutrophication potential (marine); EP- terrestrial = eutrophication potential (terrestrial); POCP = photochemical ozone formation; ADPE = abiotic depletion potential (element), ADPF = abiotic depletion potential (fossil) WDP = water scarcity

When organic materials derived from biomass sources are disposed of in landfills, a portion of the carbon in these materials does not decompose. Under natural conditions, nearly all of the material would decompose aerobically, releasing carbon as biogenic carbon dioxide (CO2). However, in landfills, aerobic biodegradation is prevented. Carbon in materials that do not fully decompose anaerobically in landfills is excluded from the global carbon cycle, classified as “stored,” and recognized as an anthropogenic carbon sink.
In the landfill scenario, it is essential to account for the partial decomposition of biogenic carbon. Some of the carbon will be released as CO2 or methane, while a portion will remain sequestered in the landfill.

In Table 4 the results of the landfill scenario for Marmoleum Modular, including its partial decomposition, is presented.

Table 4: Results of the LCA – Environmental impact for MCT 2.0 mm (one year)

Parameter	A1-A3	A4	A5	B2	C1	C2	C4/2	D/2
GWP - total [kg CO2 eq.]	8,04E-02	2,81E-01	1,57E+00	6,35E-02	1,66E-01	1,51E-02	2,23E+00	-1,92E-02
GWP - fossil [kg CO2 eq.]	2,71E+00	2,76E-01	1,16E-01	6,09E-02	1,64E-01	1,50E-02	1,75E-01	-1,91E-02
GWP - biogenic [kg CO2 eq.]	-2,63E+00	4,19E-03	1,45E+00	2,57E-03	1,48E-03	-2,06E-05	2,06E+00	-9,56E-05
GWP - luluc [kg CO2 eq.]	3,35E-03	5,29E-04	4,76E-04	5,58E-07	3,47E-05	8,31E-05	8,28E-05	-2,05E-06
ODP [kg CFC-11 eq.]	1,22E-09	1,14E-14	9,57E-11	1,58E-09	2,40E-12	8,93E-16	2,28E-13	-1,25E-13
AP [Mole of H+ eq.]	1,36E-02	4,24E-03	3,11E-04	1,16E-04	3,60E-04	4,70E-05	7,16E-04	-2,47E-05
EP - freshwater [kg P eq.]	6,69E-04	3,05E-07	1,74E-06	2,09E-06	4,78E-07	4,45E-08	9,94E-05	-2,55E-08
EP - marine [kg N eq.]	1,00E-02	1,18E-03	1,07E-04	4,01E-05	8,07E-05	2,17E-05	8,79E-04	-6,74E-06
EP - terrestrial [Mole of N eq.]	5,20E-02	1,30E-02	1,20E-03	2,30E-04	8,47E-04	2,42E-04	2,33E-03	-7,22E-05
POCP [kg NMVOC eq.]	1,02E-02	3,12E-03	2,80E-04	9,12E-05	2,18E-04	4,25E-05	1,24E-03	-1,89E-05
ADPF [MJ]	4,12E+01	2,46E+00	2,73E+00	1,22E+00	2,97E+00	1,99E-01	2,41E+00	-3,24E-01
ADPE [kg Sb eq.]	2,09E-06	1,15E-08	2,62E-08	3,65E-10	4,47E-08	1,25E-09	1,18E-08	-2,82E-09
WDP [m³ world equiv.]	2,87E-01	1,03E-03	2,67E-02	1,37E-01	3,74E-02	1,34E-04	6,78E-03	-1,97E-03

Caption: GWP - total = global warming potential; GWP - fossil = global warming potential (fossil fuel only); GWP - biogenic = global warming potential (biogenic); GWP - luluc = global warming potential (land use only); ODP = ozone depletion; AP = acidification terrestrial and freshwater; EP - freshwater = eutrophication potential (freshwater); EP - marine = eutrophication potential (marine); EP- terrestrial = eutrophication potential (terrestrial); POCP = photochemical ozone formation; ADPE = abiotic depletion potential (element), ADPF = abiotic depletion potential (fossil) WDP = water scarcity

7.14 Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one year usage.

The LCA for GWP reflects the use of renewable raw materials for the production of Marmoleum (linseed oil and gum rosin). Carbon dioxide, a greenhouse gas, is locked in from the atmosphere in the course of the plant growth via photosynthesis and stored during the use stage.
For the production stage (A1-A3) the uptake of CO_2 is almost equal to the emission of greenhouse gasses resulting in a slightly positive life cycle stage.

In general the production stage has the main contribution to the overall impact for all of the other environmental impact categories. For these categories the main contributor in the production stage is the raw material extraction and processing.

Forbo declares in the EPD a distribution by truck and container ship to the North American market. For this scenario the transport has a relevance of 0%-21% in the environmental impact categories.

In general the impact of the installation of the flooring is not very significant, except for GWP-luluc as a consequence of the biobased materials used in the low emission adhesive.

In the use stage which is calculated for one year of service life time only ODP has a significant contribution of 18%. This contribution is caused by the detergent used to wet clean the floor once a week.

7.15 Resource use

In table 5 the parameters describing resource use are presented for all the lifecycle stages for a one year usage with two End of Life scenarios:

- Scenario 1: 100% Municipal Waste Incineration (MWI) with R1 > 60%
- Scenario 2: 100% landfill disposal.

Table 5: Results of the LCA – Resource use for MCT 2.0 mm (one year)

	A1-A3	A4	A5	B2	C1	C2	C3/1	C4/2	D/1	D/2
PERE [MJ]	1,27E+01	7,66E-02	1,24E+00	1,74E-02	1,65E+00	1,13E-02	3,12E-02	1,98E-01	-7,67E-01	-8,65E-02
PERM [MJ]	4,26E+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
PERT [MJ]	5,53E+01	7,66E-02	1,24E+00	1,74E-02	1,65E+00	1,13E-02	3,12E-02	1,98E-01	-7,67E-01	-8,65E-02
PENRE [MJ]	-1,27E+00	2,47E+00	2,73E+00	1,22E+00	2,97E+00	2,00E-01	1,56E+00	2,41E+00	-3,34E+00	-3,24E-01
PENRM [MJ]	4,28E+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
PENRT [MJ]	4,15E+01	2,47E+00	2,73E+00	1,22E+00	2,97E+00	2,00E-01	1,56E+00	2,41E+00	-3,34E+00	-3,24E-01
SM [kg]	5,22E-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
RSF [MJ]	1,44E-08	0,00E+00	2,64E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF [MJ]	1,69E-07	0,00E+00	3,10E-08	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW [m3]	1,61E-02	8,85E-05	8,55E-04	4,84E-05	1,58E-03	1,28E-05	7,86E-03	2,28E-04	-7,40E-04	-8,31E-05

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

7.16 Waste categories and output flows

In table 6 other environmental information describing different waste categories and output flows are presented for all the lifecycle stages with two End of Life scenarios:

- Scenario 1: 100% Municipal Waste Incineration (MWI) with R1 > 60%
- Scenario 2: 100% landfill disposal.

Table 6: Results of the LCA – Output flows and Waste categories for MCT 2.0 mm (one year)

	A1-A3	A4	A5	B2	C1	C2	C3/1	C4/2	D/1	D/2
HWD [kg]	1,73E-07	1,10E-11	1,16E-08	1,89E-12	2,57E-10	9,56E-13	0,00E+00	3,72E-10	-4,79E-10	-4,42E-11
NHWD [kg]	2,82E-01	2,95E-04	2,70E-03	3,52E-03	2,24E-03	2,86E-05	0,00E+00	2,01E+00	-1,56E-03	-1,61E-04
RWD [kg]	5,03E-04	2,93E-06	4,05E-05	2,57E-05	4,75E-04	2,46E-07	9,33E-05	2,97E-05	-2,20E-04	-2,48E-05
CRU [kg]	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
MFR [kg]	2,02E-02	0,00E+00	4,90E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER [kg]	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
EEE [MJ]	0,00E+00	0,00E+00	9,49E-02	0,00E+00	0,00E+00	0,00E+00	1,19E+00	0,00E+00	0,00E+00	0,00E+00
EET [MJ]	0,00E+00	0,00E+00	1,86E-01	0,00E+00	0,00E+00	0,00E+00	3,06E+00	0,00E+00	0,00E+00	0,00E+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; EET = Exported thermal energy

7.17 Biogenic Carbon content

Table 7 Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Unit (kg CO_2/m^2)
Biogenic carbon content in product MCT 2.0 mm	1.45
Biogenic carbon content in accompanying packaging MCT 2.0 mm	0.06
Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO_2	

8 Additional Environmental Impact Indicators

To be fully transparant Forbo Flooring does not only want to declare the environmental impacts required in the PCR, but also the additional environmental impact indicators according to the European Standard EN15804 + A2.

Table 8: Results of the LCA – Environmental impact for MCT 2.0 mm (one year)

	A1-A3	A4	A5	B2	C1	C2	C3/1	C4/2	D/1	D/2
PM [Disease incidences]	1,92E-07	6,57E-08	2,79E-09	7,74E-10	2,98E-09	2,62E-10	6,26E-09	6,85E-09	-1,95E-09	-2,04E-10
IR [kBq U235 eq.]	1,69E-01	4,29E-04	7,04E-03	2,53E-03	8,05E-02	3,60E-05	1,48E-03	4,38E-03	-3,72E-02	-4,20E-03
ETF-fw [CTUe]	2,14E+01	1,71E+00	1,22E+00	2,93E-01	1,30E+00	1,38E-01	2,53E+00	3,60E+00	-6,16E-01	-6,92E-02
HTP-c [CTUh]	1,51E-09	3,31E-11	8,47E-11	7,09E-12	3,74E-11	2,79E-12	1,84E-11	9,51E-11	-3,24E-11	-3,24E-12
HTP-nc [CTUh]	7,61E-08	1,88E-09	7,05E-09	2,22E-10	1,37E-09	1,66E-10	1,00E-09	1,12E-08	-1,26E-09	-1,25E-10
SQP [Pt]	2,79E+02	4,39E-01	8,06E+00	5,85E-03	1,07E+00	6,85E-02	0,00E+00	1,74E-01	-4,98E-01	-5,61E-02
Caption: PM = Particulate matter emissions; IR = Ionizing radiation, human health; ETF-fw = Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects, SQP = Soil quality potential/ Land use related impacts										

8.1 Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one year usage.

As with the mandatory environmental impact categories, the production phase is dominant in the contribution of the total lifespan of the additional environmental impact indicators. This is largely due to the production of the raw materials. A much smaller impact is coming from the thermal energy used to manufacture.

8.2 Disclaimers to the declaration of core and additional environmental impact indicators

According to the "ILCD Handbook: Recommendations for Life Cycle Impact Assessment in the European context" the recommended characterization models and associated characterization factors are classified according to their quality into three levels:

- Type 1 (recommended and satisfactory),
- Type 2 (recommended but in need of some improvements)
- Type 3 (recommended, but to be applied with caution).

Table 9: Classification of disclaimers to the declaration of core and additional environmental impact indicators

ILCD classification	Indicator	Disclaimer
ILCD Type 1	Global Warming Potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 2	Abiotic depletion potential for non-fossil resources (ADP-minerals & metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user)deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans HTP-c)	2
	Potential Comparative Toxic Unit for humans HTP-nc)	2
	Potential Soil quality index (SQP)	2
Disclaimer 1 – 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 – 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 experience with the indicator.		

9 References

GABI 10 2012	Sphera; GaBi 10: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2017.
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UL ENVIRONMENT	UL Environment's Program Operator Rules
PE 2012 ILCD Handbook: General guide for Life Cycle Assessment - Detailed guidance	Description of Selected Impact Categories, Sphera, 2012 European Commission-Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook- Recommendations for Life Cycle Impact Assessment in the European context. First edition November 2011. EUR 24571 EN. Luxemburg. Publications Office of the European Union; 2011
STANDARDS AND LAWS	
DIN EN ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines (ISO 14044:2006); English version EN ISO 14044
ISO 14025 2006	EN ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures
ISO 14040 2006	Environmental management - Life cycle assessment - Principles and framework (ISO 14040); English version EN ISO 14040
CEN/TR 15941	Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data; German version CEN/TR 15941
EN 15804 + A2	EN 15804+A2: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products
ISO 24011 ASTM 2195	Resilient floor coverings - Specification for plain and decorative linoleum Standard specification for Linoleum Floor Tile
CPR	REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
EN-ISO 10874	Resilient, textile and laminate floor coverings – Classification