


Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	Officine Maccaferri S.p.A.
Publisher:	Kiwa-Ecobility Experts
Programme operator:	Kiwa-Ecobility Experts
Registration number:	EPD-Kiwa-EE-000378-EN
Issue date:	09.04.2024
Valid to:	09.04.2029



MACMAT & ITALMAT range
Geomat of synthetic material filaments

1. General information

Officine Maccaferri S.p.A.

Programme operator

Kiwa-Ecobility Experts
 Kiwa GmbH, Ecobility Experts
 Wattstraße 11-13
 13355 Berlin
 Germany

Registration number

EPD-Kiwa-EE-000378-EN

This declaration is based on the Product Category Rules

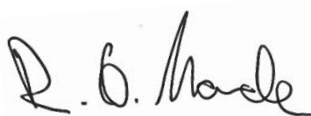
PCR B: Product Category Rules for geosynthetic products Edition 2022-02-08

Issue date

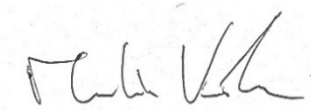
09.04.2024

Valid to

09.04.2029



Raoul Mancke
 (Head of programme operations, Kiwa-Ecobility Experts)



Martin Koehrer
 (Verification body, Kiwa-Ecobility Experts)

MACMAT & ITALMAT range

Owner of the declaration

Officine Maccaferri S.p.A.
 Via del Faggiolo, 1/12
 40132 Bologna (BO)
 Italy

Declared product / declared unit

1 m² of MacMat geomat including distribution packaging

Scope

The EPD (A1-A3,C1-C4; D) is based on the composition of MACMAT 19.1 (unit weight 550 g/m²). The LCA results are also representative of the others MACMAT, ITALMAT and MACFUSION products applying the scaling function reported in section 7.

Kiwa-Ecobility Experts assumes no liability for manufacturer's information, LCA data and evidence.

Verification

The European standard EN 15804+A2:2019 serves as the core PCR.

Independent verification of the declaration and data according to ISO 14025:2010.

internal

external



Dr.-Ing. Morteza Nikravan
 (External verifier of Kiwa GmbH)

2. Product

2.1 Product description

MACMAT, ITALMAT and MACFUSION are geomat consisting of a three-dimensional structure having a biconical cusped shape made from polypropylene filaments, tangled together to form a highly deformable layer, featured by a very high porosity (greater than 90% on average).



2.2 Application

MACMAT® is used to prevent erosion and surface planar failure phenomena on slopes. It is also used in hydraulic/water channels to protect them from the abrasive and tractive forces applied by the stream flow. ITALMAT and MACFUSION are used in roofing as semi-finished products.

2.3 Technical data

Characteristic	Unit	Value
Unit weight (EN ISO 9864)	≥ 250	g/m ²
Tensile Strength (EN ISO 10319) MD	≥ 1.1	kN/m
Tensile Strength (EN ISO 10319) CMD	≥ 0.5	kN/m
Durability (EN 13249ff, Appendix B)	can be exposed up to 1 month durable in natural soil with 4≤pH≤9 and soil temperature ≤25°C for a minimum of 100 years service life (*)	

(*) Performance are detailed in DOP.

2.4 Placing on the market/ Application rules

MACMAT geomats are CE certified for separation, reinforcement and drainage applications according to EN 13249:2016, EN 13250:2016, EN 13251:2016, EN 13252:2016, EN 13253:2016, EN 13254:2016, EN 13255:2016, EN 13257:2016, EN 13265:2016.

2.5 Base materials / Ancillary materials

The composition of the reference product is reported in its weight in table below.

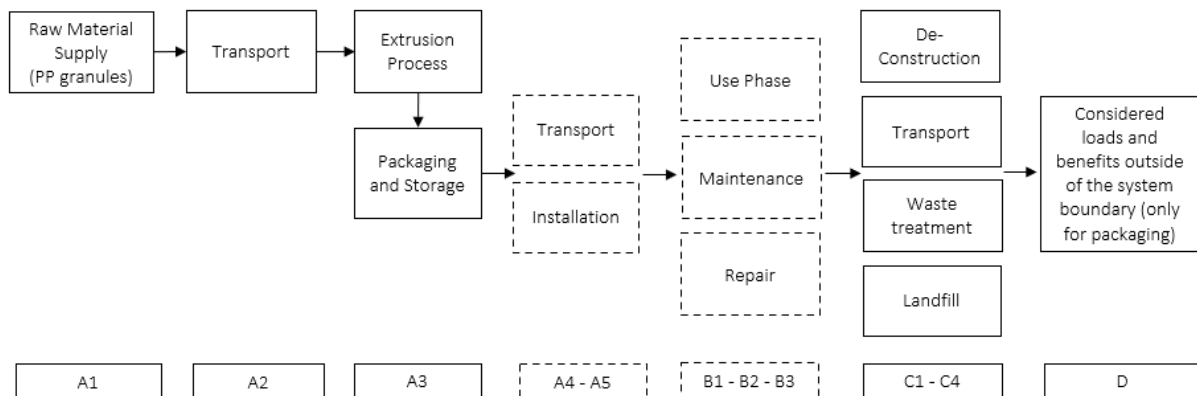
Raw material	Unit	Value
Polypropylene	kg	0.594
Mastebatch polypropylene	kg	0.013

The content of SVHC in the MACMAT does not exceed 0.1 % of its weight.

2.6 Manufacturing

The manufacturing is managed in Senica Plant (Slovakia).

The production process is the implementation of the core (geomat), through an extrusion process of the polymer. Below is a diagram of the product system and the modules considered.



2.7 Packaging

The finished product is winded and rolled up, then protected by a LLDPE stretch film. The finished product should be rolled into a cylindrical cardboard shape according to the dimensions and loaded onto wooden pallets. The table below shows the quantities per kg of product.

Packed product	Packaging type	Packaging amount per kg of finished product
MacMat	Wooden pallet	0.003 kg
	Cardboard	0.001 kg
	Plastic film (LLDPE)	0.007 kg

2.8 Reference Service Life (RSL)

The typical service life is up to 100 years, according to related DOP.

2.9 Other Information

For further information on this product please visit the webpage under the following link:

www.maccaferri.com

3. LCA: Calculation rules

3.1 Declared unit

In accordance with the PCR B, 1 m² of MACMAT & ITALMAT range geomat is chosen as the declared unit.

Product	Unit weight (g/m ²)	Conversion factor di 1 kg
MACMAT 19.1	550	1.818

3.2 System boundary

This is a cradle to gate EPD with modules C1-C4 and module D. More precisely, the following processes were accounted for each module:

A1 - Production of raw materials used in the products, as well as the production of energy carriers used in the production process.

A2 - Transport of raw materials to the manufacturing site and internal handling.

A3 - Manufacturing of the Officine Maccaferri MACDRAIN M which includes the manufacturing steps re-ported in section 2.6 as well as the production of the distribution packaging and of the ancillary material. In addition, the treatment of waste generated from the manufacturing process are accounted for.

C1 – Dismantling of the strip from the construction work.

C2 - Transport from collection point to waste processing and disposal site.

C3 - Shredding and sorting of fractions for recycling.

C4 - Landfill of material fractions not recycled.

D - Benefit and load beyond the product system.

Description of the system boundary																
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manu- facturing	Transport from manu- facturer to place of use	Construction -installation -process	Use	Main- tenance	Repair	Replacement	Refur- bishmen	Operational energy use	Operational water use	De- construction	Transport	Waste processing	Disposal	Reuse- Recovery- Recycling- potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X
X=Module declared MND=Module not declared																

3.3 Estimates and assumptions

The main assumptions are related to packaging for raw materials transportation and distances of inbound transportations. A generic packaging is assumed for the transport of raw materials and auxiliaries, composed as below.

Packaging type	Packaging amount per kg of input	Notes
Wooden pallet	0.02 kg	Average reuse rate of 25 times
Cardboard	0.01 kg	
Plastic bag (HDPE	0.005 kg	

3.4 Cut-off Criteria

The cut-off applied are related to the packaging of the lubricating oil used in the production process in the Senica plant.

3.5 Period under review and Geographical reference area

All process-specific data was collected for the operating year 2022. Geographical reference area is global.

3.6 Data quality

Specific data were collected at Senica site in Slovakia considering an annual average referred to 2022, whereas the most updated selected generic datasets available in the LCI databases were used for the other modules. Thus, in line with PCR A requirements, manufacturer-specific data is not older than 5 years and generic data is not older than 10 years. The assessment of the potential environmental impacts of the products and components under study has been performed with the support of LCA for Expert v. 10.7.1.28 software and the 2023.2 professional Sphera DB.

3.7 Allocation

A mass allocation based on the weight of the production volumes has been applied.

3.8 Comparability

In principle, a comparison or assessment of the environmental impacts of different products is only possible if they have been prepared in accordance with EN 15804. For the evaluation of the comparability, the following aspects have to be considered in particular: PCR used, functional or declared unit, geographical reference, definition of the system boundary, declared modules, data selection (primary or secondary data, background database, data quality), scenarios used for use and disposal phases, and the life cycle inventory (data collection, calculation methods, allocations, validity period). PCRs and general program instructions of different EPDs programs may differ. A comparability needs to be evaluated. For further guidance see EN 15804+A2 (5.3 Comparability of EPD for construction products) and ISO 14025 (6.7.2 Requirements for comparability).

4. LCA: Scenarios and additional technical information

It is assumed that 25% of the product remains in the soil while 75% is removed and sent to landfill. For the digging up from the soil it was considered the impacts related to the removal of the geogrid from the soil.

Regarding the end of life of packaging components, the following scenarios were applied:

- The end-of-life plastic component was, conservatively, incinerated.
- The end-of-life treatment of the wooden pallet was taken from the PEF Guidance.
- The end-of-life treatment of cardboard component was based on Eurostat data.

Processes	Unit (expressed per FU or DU of components, products or materials and by type of material)	MACMAT 19.1
Collection process specified by type	Kg collected separately	Polymer: 0.417 kg
		Paper: 7.03E-04 kg
		Wood: 1.71E-03 kg
Recovery system specified by type	Kg for reuse	0
	Kg for recycling	Wood: 5.13E-04 kg
	Kg for energy recovery	Polymer: 4.23E-03 kg
		Paper: 5.22E-04 kg
Disposal specified by type	Kg product or material for final disposition	Wood: 5.38E-04 kg
		Landfill (Polymer): 0.413 kg
		Landfill (Paper): 1.81E-04 kg
		Landfill (Wood): 6.41E-04 kg

5. LCA: Results

The following tables show the results of the impact assessment indicators, resource use, waste and other output streams. The results presented here refer to the declared average product.

LCA results - Indicators describing environmental impacts based on the impact assessment (LCIA): 1 m ² of MACMAT 19.1 (EN 15804+A2)							
Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Core environmental impact indicators (EN 15804+A2)							
GWP-total	kg CO2 eqv.	1.23E+00	2.49E-04	3.52E-03	1.41E-02	3.02E-02	-6.32E-03
GWP-f	kg CO2 eqv.	1.23E+00	2.50E-04	3.54E-03	1.33E-02	2.83E-02	-6.29E-03
GWP-b	kg CO2 eqv.	3.84E-03	-3.42E-06	-5.23E-05	8.60E-04	1.78E-03	-2.85E-05
GWP-luc	kg CO2 eqv.	1.04E-03	2.28E-06	3.27E-05	1.65E-08	2.34E-05	-4.08E-07
ODP	kg CFC 11 eqv.	4.29E-12	2.16E-17	3.09E-16	7.14E-16	4.79E-14	-4.88E-14
AP	mol H+ eqv.	3.30E-03	1.26E-06	1.85E-05	1.45E-06	8.56E-05	-7.80E-06
EP-fr	kg P eqv.	2.45E-06	8.98E-10	1.29E-08	1.73E-10	5.46E-06	-1.01E-08
EP-mar	kg N eqv.	1.19E-03	5.94E-07	8.97E-06	3.15E-07	2.00E-05	-2.29E-06
EP-ter	mol N eqv.	1.29E-02	6.58E-06	9.98E-05	6.75E-06	2.16E-04	-2.46E-05
POCP	kg NMVOC eqv.	4.07E-03	1.67E-06	1.76E-05	9.27E-07	6.30E-05	-6.39E-06
ADP-e	kg Sb-eqv.	6.69E-08	1.60E-11	2.29E-10	6.64E-12	7.52E-10	-4.46E-10
ADP-f	MJ	4.43E+01	3.35E-03	4.80E-02	1.79E-03	4.25E-01	-1.16E-01
WU	m3 world eqv.	6.66E-02	2.84E-06	4.07E-05	1.32E-03	-3.03E-04	-5.84E-04
Additional environmental impact indicators (EN 15804+A2)							
PM	disease incidence	4.29E-08	1.43E-11	8.68E-11	8.62E-12	8.29E-10	-6.62E-11
IR	kBq U235 eqv.	5.88E-02	6.27E-07	8.98E-06	1.73E-05	7.45E-04	-1.46E-03
ETP-fw	CTUe	2.12E+01	2.36E-03	3.38E-02	7.09E-04	3.63E-01	-1.60E-02
HTP-c	CTUh	5.10E-10	4.75E-14	6.83E-13	9.54E-14	1.86E-11	-1.28E-12
HTP-nc	CTUh	1.85E-08	2.10E-12	3.01E-11	1.16E-12	1.49E-09	-3.16E-11
SQP	Pt	6.06E+00	1.40E-03	2.00E-02	5.63E-04	3.68E-02	-2.19E-02
<p>ADP-e= Abiotic depletion potential for non-fossil resources ADP-f=Abiotic depletion for fossil resources potential AP= Acidification potential, Accumulated Exceedance EP-fr = Eutrophication potential, fraction of nutrients reaching freshwater end compartment EP-mar= Eutrophication potential, fraction of nutrients reaching marine end compartment EP-ter= Eutrophication potential, Accumulated Exceedance GWP-b=Global Warming Potential biogenic GWP-f=Global Warming Potential fossil fuels GWP-luc=Global Warming Potential land use and land use change GWP-total=Global Warming Potential total ODP=Depletion potential of the stratospheric ozone layer POCP=Formation potential of tropospheric ozone WU=Water (user) deprivation potential, deprivation- weighted water consumption ETP-fw=Potential Comparative Toxic Unit for ecosystems HTP-c=Potential Toxic Unit for Humans toxicity, cancer HTP-nc= Potential Toxic Unit for humans, non-cancer IRP=Potential Human exposure efficiency relative to U235, human health PM=Potential incidence of disease due to Particulate Matter emissions SQP=Potential soil quality index</p>							

Disclaimer on ADP-e, ADP-f, WDP, ETP-fw, HTP-c, HTP-nc, SQP: The results of these environmental impact indicators must be used with caution, as the uncertainties in these results are high or as there is limited experience with the indicator.

Disclaimer on IR: This impact category mainly addresses the potential effect of low dose ionizing radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposures, nor does it consider radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, radon, and some building materials is also not measured by this indicator.

LCA results - Indicators describing resource use and environmental information derived from life cycle inventory (LCI): 1 m² of MACMAT 19.1 (EN 15804+A2)

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
PERE	MJ	2.88E+00	2.37E-04	3.40E-03	4.56E-04	3.83E-02	-3.33E-02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.88E+00	2.37E-04	3.40E-03	4.56E-04	3.83E-02	-3.33E-02
PENRE	MJ	1.97E+01	3.36E-03	4.81E-02	1.80E-03	4.25E-01	-1.16E-01
PENRM	MJ	2.47E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	4.44E+01	3.36E-03	4.81E-02	1.80E-03	4.25E-01	-1.16E-01
SM	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	M3	5.42E-03	2.61E-07	3.74E-06	3.09E-05	6.51E-06	-2.69E-05
HWD	Kg	5.20E-09	1.24E-14	1.78E-13	4.04E-14	3.58E-11	-6.39E-12
NHWD	Kg	1.05E-02	4.84E-07	6.94E-06	6.97E-05	4.11E-01	-5.69E-05
RWD	Kg	6.46E-04	4.34E-09	6.22E-08	1.07E-07	5.04E-06	-8.81E-06
CRU	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	Kg	2.95E-05	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
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.83E-02
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.03E-02

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 fresh water | HWD=Hazardous waste disposed | NHWD=Non-hazardous waste disposed | RWD=Radioactive waste disposed | CRU=Components for re-use | MFR=Materials for recycling | MER=Materials for energy recovery | EET=Exported energy, thermal | EE=Exported energy, electrical

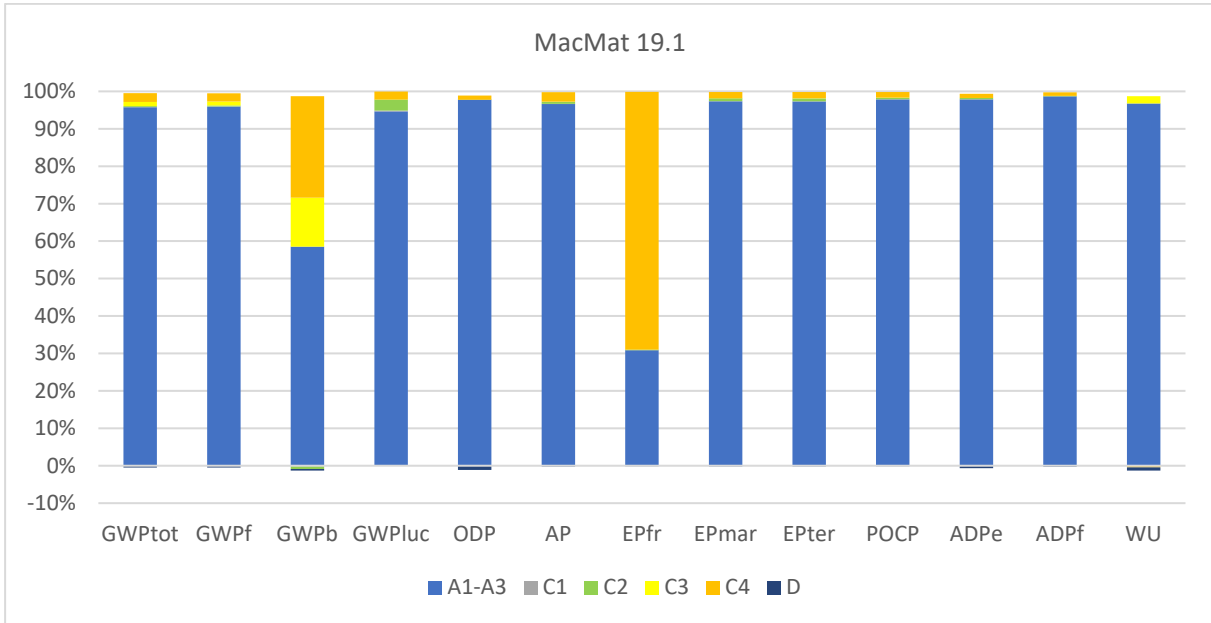
LCA results - information on biogenic carbon content at the factory gate: 1 m² of MACMAT 19.1 (EN 15804+A2)

Parameter	Unit	Value
biogenic carbon content in product	kg C	0
biogenic carbon content in accompanying packaging	kg C	9.09E-04

NOTE 1 kg biogenic carbon is equivalent to 44/12 kg CO₂

6. Interpretation

The analysis of the contribution of each module to the impacts of MACMAT is shown in the graph below. It can be observed that the impacts are driven by modules A1-A3, while the contribution of the other modules is about 4% for all impact categories analyzed, except for EPfr, whose impacts are driven by the disposal of the geogrid in landfill, and GWP biogenic, due to the end-of-life of packaging materials. The contribution of module D is negligible (<1%) compared to modules A1-A3.



7. Scaling

The environmental impacts for the production phase (Module A1-A3) of specific **MACMAT**, **ITALMAT** and **MACFUSION** products, defined by nominal unit weight, are shown in the following tables. For other grades the scaling function in the last column can be used, where 'x' represents the nominal unit weight in kg/m².

		250	350	430	490	550	Scaling Function
Nominal Unit weight	(g/m ²)						(X*1000)
Nominal Unit weight	(kg/m ²)	0.25	0.35	0.43	0.49	0.55	X
Core environmental impact indicators (EN 15804+A2)							
GWP-total	kg CO ₂ eqv.	5.64E-01	7.87E-01	9.65E-01	1.09E+00	1.23E+00	2.22E+00x+9.96E-03
GWP-f	kg CO ₂ eqv.	5.61E-01	7.84E-01	9.61E-01	1.09E+00	1.23E+00	2.21E+00x+9.92E-03
GWP-b	kg CO ₂ eqv.	1.76E-03	2.46E-03	3.01E-03	3.41E-03	3.84E-03	6.93E-03x+3.12E-05
GWP-luc	kg CO ₂ eqv.	4.77E-04	6.66E-04	8.17E-04	9.26E-04	1.04E-03	1.88E-03x+8.41E-06
ODP	kg CFC 11 eqv.	1.96E-12	2.74E-12	3.36E-12	3.81E-12	4.29E-12	7.73E-12x+3.47E-14
AP	mol H+ eqv.	1.51E-03	2.11E-03	2.59E-03	2.93E-03	3.30E-03	5.94E-03x+2.66E-05
EP-fr	kg P eqv.	1.12E-06	1.56E-06	1.92E-06	2.17E-06	2.45E-06	4.41E-06x+1.98E-08
EP-mar	kg N eqv.	5.45E-04	7.60E-04	9.33E-04	1.06E-03	1.19E-03	2.14E-03x+9.59E-06
EP-ter	mol N eqv.	5.89E-03	8.22E-03	1.01E-02	1.14E-02	1.29E-02	2.32E-02x+1.04E-04
POCP	kg NMVOC eqv.	1.86E-03	2.60E-03	3.19E-03	3.61E-03	4.07E-03	7.33E-03x+3.28E-05
ADP-e	kg Sb-eqv.	3.07E-08	4.28E-08	5.25E-08	5.95E-08	6.70E-08	1.21E-07x+5.42E-10
ADP-f	MJ	2.03E+01	2.83E+01	3.48E+01	3.94E+01	4.43E+01	7.99E+01x+3.59E-01
WU	m3 world eqv.	3.05E-02	4.26E-02	5.22E-02	5.91E-02	6.66E-02	1.20E-01x+5.39E-04
Additional environmental impact indicators (EN 15804+A2)							
PM	disease incidence	1.96E-08	2.74E-08	3.36E-08	3.81E-08	4.29E-08	7.72E-08x+3.45E-10
IR	kBq U235 eqv.	2.69E-02	3.76E-02	4.61E-02	5.22E-02	5.88E-02	1.06E-01x+4.76E-04
ETP-fw	CTUe	9.72E+00	1.36E+01	1.66E+01	1.89E+01	2.12E+01	3.82E+01x+1.72E-01
HTP-c	CTUh	2.34E-10	3.26E-10	4.00E-10	4.53E-10	5.10E-10	9.19E-10x+4.13E-12
HTP-nc	CTUh	8.47E-09	1.18E-08	1.45E-08	1.64E-08	1.85E-08	3.33E-08x+1.50E-10
SQP	Pt	2.78E+00	3.87E+00	4.75E+00	5.38E+00	6.06E+00	1.09E+01x+4.91E-02

		250	350	430	490	550	Scaling Function
Nominal Unit weight	(g/m ²)						(X*1000)
Nominal Unit weight	(kg/m ²)	0.25	0.35	0.43	0.49	0.55	X
Indicators describing resource use and environmental information derived from life cycle inventory (LCI)							
PERE	MJ	1.32E+00	1.84E+00	2.26E+00	2.56E+00	2.88E+00	5.18E+00x+2.33E-02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
PERT	MJ	1.32E+00	1.84E+00	2.26E+00	2.56E+00	2.88E+00	5.18E+00x+2.33E-02
PENRE	MJ	9.03E+00	1.26E+01	1.54E+01	1.75E+01	1.97E+01	3.55E+01x+1.61E-01
PENRM	MJ	1.13E+01	1.58E+01	1.94E+01	2.19E+01	2.47E+01	4.45E+01x+1.98E-01
PENRT	MJ	2.03E+01	2.84E+01	3.48E+01	3.94E+01	4.44E+01	8.00E+01x+3.59E-01
SM	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
FW	M3	2.48E-03	3.46E-03	4.25E-03	4.81E-03	5.42E-03	9.76E-03x+4.38E-05
HWD	Kg	2.38E-09	3.32E-09	4.08E-09	4.62E-09	5.20E-09	9.37E-09x+4.21E-11
NHWD	Kg	4.83E-03	6.74E-03	8.27E-03	9.36E-03	1.05E-02	1.90E-02x+8.53E-05
RWD	Kg	2.96E-04	4.13E-04	5.07E-04	5.74E-04	6.46E-04	1.16E-03x+5.23E-06
CRU	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
MFR	Kg	1.35E-02	1.89E-02	2.32E-02	2.62E-02	2.95E-02	5.32E-02x+2.39E-04
MER	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00

The environmental impacts for the end-of-life phase (Module C1-C4) of specific **MACMAT**, **ITALMAT** and **MACFUSION** products, defined by nominal unit weight, are shown in the following tables. For other grades the scaling function in the last column can be used, where 'x' represents the nominal unit weight in kg/m².

							Scaling Function
Nominal Unit weight	(g/m ²)	250	350	430	490	550	(X*1000)
Nominal Unit weight	(kg/m ²)	0.25	0.35	0.43	0.49	0.55	X
Core environmental impact indicators (EN 15804+A2)							
GWP-total	kg CO ₂ eqv.	2.19E-02	3.06E-02	3.76E-02	4.27E-02	4.80E-02	8.71E-02x+1.33E-04
GWP-f	kg CO ₂ eqv.	2.07E-02	2.89E-02	3.55E-02	4.04E-02	4.54E-02	8.23E-02x+1.08E-04
GWP-b	kg CO ₂ eqv.	1.18E-03	1.65E-03	2.03E-03	2.29E-03	2.58E-03	4.65E-03x+2.42E-05
GWP-luc	kg CO ₂ eqv.	2.65E-05	3.72E-05	4.57E-05	5.20E-05	5.84E-05	1.06E-04x+4.74E-09
ODP	kg CFC 11 eqv.	2.22E-14	3.11E-14	3.82E-14	4.36E-14	4.89E-14	8.89E-14x+7.32E-18
AP	mol H+ eqv.	4.86E-05	6.80E-05	8.36E-05	9.52E-05	1.07E-04	1.94E-04x+1.85E-08
EP-fr	kg P eqv.	2.49E-06	3.49E-06	4.28E-06	4.88E-06	5.48E-06	9.96E-06x+3.06E-11
EP-mar	kg N eqv.	1.36E-05	1.90E-05	2.34E-05	2.66E-05	2.99E-05	5.44E-05x+8.04E-09
EP-ter	mol N eqv.	1.50E-04	2.10E-04	2.58E-04	2.93E-04	3.29E-04	5.99E-04x+8.57E-08
POCP	kg NMVOC eqv.	3.78E-05	5.29E-05	6.50E-05	7.40E-05	8.31E-05	1.51E-04x+1.81E-08
ADP-e	kg Sb-eqv.	4.57E-10	6.39E-10	7.85E-10	8.95E-10	1.00E-09	1.83E-09x+1.02E-13
ADP-f	MJ	2.17E-01	3.04E-01	3.73E-01	4.26E-01	4.78E-01	8.68E-01x+2.94E-05
WU	m3 world eqv.	4.86E-04	6.78E-04	8.31E-04	9.39E-04	1.06E-03	1.90E-03x+1.15E-05
Additional environmental impact indicators (EN 15804+A2)							
PM	disease incidence	4.27E-10	5.98E-10	7.34E-10	8.36E-10	9.39E-10	1.71E-09x+1.16E-13
IR	kBq U235 eqv.	3.51E-04	4.91E-04	6.04E-04	6.88E-04	7.72E-04	1.40E-03x+1.69E-07
ETP-fw	CTUe	1.82E-01	2.54E-01	3.13E-01	3.56E-01	4.00E-01	7.27E-01x+2.26E-05
HTP-c	CTUh	8.83E-12	1.24E-11	1.52E-11	1.73E-11	1.94E-11	3.53E-11x+1.21E-15
HTP-nc	CTUh	6.91E-10	9.67E-10	1.19E-09	1.35E-09	1.52E-09	2.76E-09x+5.29E-14
SQP	Pt	2.67E-02	3.74E-02	4.60E-02	5.24E-02	5.88E-02	1.07E-01x+8.27E-06

							Scaling Function
Nominal Unit weight	(g/m ²)	250	350	430	490	550	(X*1000)
Nominal Unit weight	(kg/m ²)	0.25	0.35	0.43	0.49	0.55	X
Indicators describing resource use and environmental information derived from life cycle inventory (LCI)							
PERE	MJ	1.93E-02	2.70E-02	3.32E-02	3.78E-02	4.24E-02	7.71E-02x+5.20E-06
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
PERT	MJ	1.93E-02	2.70E-02	3.32E-02	3.78E-02	4.24E-02	7.71E-02x+5.20E-06
PENRE	MJ	2.17E-01	3.04E-01	3.74E-01	4.26E-01	4.78E-01	8.69E-01x+2.94E-05
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
PENRT	MJ	2.17E-01	3.04E-01	3.74E-01	4.26E-01	4.78E-01	8.69E-01x+2.94E-05
SM	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
FW	M3	1.89E-05	2.64E-05	3.24E-05	3.68E-05	4.14E-05	7.15E-05x+2.69E-07
HWD	Kg	1.64E-11	2.29E-11	2.81E-11	3.21E-11	3.60E-11	6.54E-11x+9.85E-16
NHWD	Kg	1.87E-01	2.62E-01	3.22E-01	3.67E-01	4.11E-01	7.48E-01x+4.91E-06
RWD	Kg	2.37E-06	3.32E-06	4.08E-06	4.64E-06	5.21E-06	9.46E-06x+1.06E-09
CRU	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
MFR	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
MER	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00x+0.00E+00

8. References

Ecoinnovazione; 2024. Technical report: LCA study of geosynthetic products (GSY) for civil engineering works.

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

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

ISO 14025:2010: Environmental labels and declarations — Type III environmental declarations — Principles and procedures EN 13249

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

PCR A: General Program Category Rules for Construction Products from the EPD program Kiwa-Ecobility Experts, R.0_2021-07-16

PCR B: Product Category Rules for geosynthetic products - Requirements on the Environmental Product Declarations for geosynthetic products, Edition 2022-02-08

 kiwa Ecobility Experts -VERIFICATION BODY-	Publisher Kiwa-Ecobility Experts Kiwa GmbH, Ecobility Experts Wattstraße 11-13 13355 Berlin Germany	Mail Web	DE.Ecobility.Experts@kiwa.com https://www.kiwa.com/de/de/themes/ecobility-experts/ecobility-experts/
 kiwa Ecobility Experts -VERIFICATION BODY-	Programme operator Kiwa-Ecobility Experts Kiwa GmbH, Ecobility Experts Wattstraße 11-13 13355 Berlin Germany	Mail Web	DE.Ecobility.Experts@kiwa.com https://www.kiwa.com/de/de/themes/ecobility-experts/ecobility-experts/
 ecoinnovazione <small>spin off ENA</small>	LCA Practitioner Ecoinnovazione Srl Via della Liberazione 6/C 40128 Bologna (BO)	Tel. Web	+ 39 328 987 0609 www.ecoinnovazione.it
 MACCAFERRI	Owner of the declaration Officine Maccaferri S.p.A. Via del Faggiolo, 1/12 40132 Bologna (BO) Italy	Tel. Fax. Mail Web	+39 051 6436000 +39 051 6436201 info@maccaferri.com www.maccaferri.com

Kiwa-Ecobility Experts -
 established member of

