EPD®
THE INTERNATIONAL EPD® SYSTEM

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 for

Keraflex Maxi S1 Zero
Keraflex Maxi S1 Ultra White

Programme:	Programme operator:	EPD registration number:	Publication date:	Valid until:	Geographical scope:	Revision:
The International EPD® System; www.environdec.com	**EPD International AB**	**S-P-00907**	**2016-09-12**	**2023-10-31**	**International**	**2019-10-28**

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MAPEI®
ADHESIVES · SEALANTS · CHEMICAL PRODUCTS FOR BUILDING

1. COMPANY DESCRIPTION / GOAL & SCOPE

Founded in 1937 in Milan, Italy, Mapei produces adhesives and complementary products for laying all types of floor, wall and coating materials, and also specializes in other chemical products used in the building industry, such as waterproofing products, specialty mortars, admixtures for concrete, products for underground constructions and for the restoration of concrete and historical buildings.

There are currently 85 subsidiaries in the Mapei Group, with a total of 80 production facilities located around the world in 34 different countries and in 5 different continents. Mapei also has 18 central laboratories. Most locations are ISO 9001 and ISO 14001 or EMAS-certified.

Mapei's strategy of internationalization is based on two main objectives: being closer to local needs and lowering transportation costs. With the declared objective of being close to buyers and clients, Mapei's presence in the five continents enables the company to comply with the requirements of each location, and to use only locally-based managers and qualified personnel, without changing the approach of Mapei.

Mapei invests 12% in its company's total work-force and 5% of its turnover in Research & Development; in particular, 70% of its R&D efforts are directed to develop eco-sustainable and environmentally friendly products, which give important contribution to all major green rating systems for eco-sustainable buildings such as LEED and BREEAM.

Furthermore, Mapei has developed a sales and technical service network with offices all over the world and offers an efficient Technical Assistance Service that is valued by architects, engineers, contractors and owners.

The goal of the study is to provide necessary data and documentation to produce an EPD according to the requirements of PCR Environdec (version 2.3, 2018-11-15) under EN 15804:2014 and to have more comprehension about the environmental impacts related to **Keraflex Maxi S1 Zerø** and **Keraflex Maxi S1 Ultra White** manufactured in Mapei S.p.A. located in Robbiano di Mediglia (Italy), Latina (Italy) and Sassuolo (Italy), including packaging of the finished products.

Target audiences of the study are customers and other parties with an interest in the environmental impacts of **Keraflex Maxi S1 Zerø** and **Keraflex Maxi S1 Ultra White**.

This analysis shall not support comparative assertions intended to be disclosed to the public.

2. PRODUCT DESCRIPTION

Keraflex Maxi S1 Zerø is a high performance, deformable cementitious grey adhesive with extended open time and no vertical slip, for ceramic tiles and large stone slabs. The product has Low Dust technology and very low emission of volatile organic compounds.

Keraflex Maxi S1 Zerø has certified offsetting of residual greenhouse gas emissions.

Keraflex Maxi S1 Ultra White is a high performance, deformable cementitious white adhesive with extended open time and no vertical slip, for ceramic tiles and stone material, with Low Dust technology and very low emission level of volatile organic compounds. It is especially suitable for the installation of large-size porcelain tiles and natural stone.

The two products are compliant with EN 12004 (Adhesives for tiles. Requirements, evaluation of conformity, classification and designation) and ISO 13007-1 (Ceramic tiles - Grouts and adhesives - Part 1: Terms, definitions and specifications for adhesives: definitions and characteristics) as C2TES1 and are supplied in 25 kg (**Keraflex Maxi S1 Zerø**) and 23 kg (**Keraflex Maxi S1 Ultra white**) multiply bags.

3. CONTENT DECLARATION

The main components and ancillary materials of **Keraflex Maxi S1 Zerø** and **Keraflex Maxi S1 Ultra White** are the following:

Table 1: Composition

Materials	Percentage (%)
Binders	30 – 40
Fillers	35 – 60
Recycled content	≤ 3
Additives	≤ 3
Other	≤ 3

The products contain neither carcinogenic substances nor substances of very high concern (SVHC) on the REACH Candidate List published by the European Chemicals Agency in a concentration more than 0,1 % (by unit weight).

4. DECLARED UNIT AND REFERENCE SERVICE LIFE

The declared unit is 1 kg of packaged finished product.
Packaging materials include:

- Multiply bag (paper/PE/paper)
- Wooden pallet
- LDPE used as wrapping material

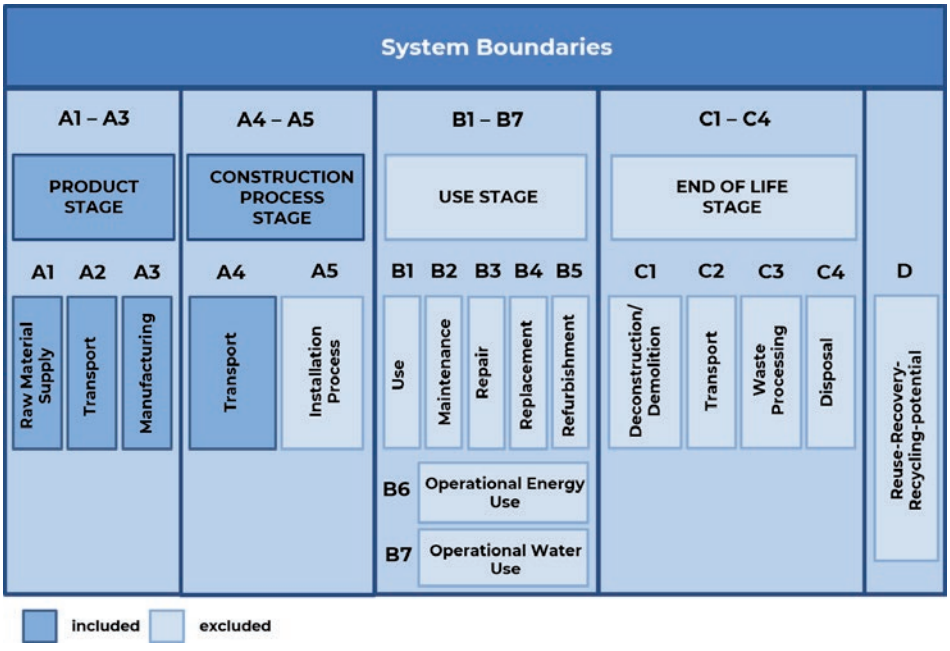
The reference service life of the adhesives, if professionally installed and properly used, is estimated to be the same as the building one.

5. SYSTEM BOUNDARIES AND ADDITIONAL TECHNICAL INFORMATION

The approach is “cradle to gate” with options. The following modules have been considered:

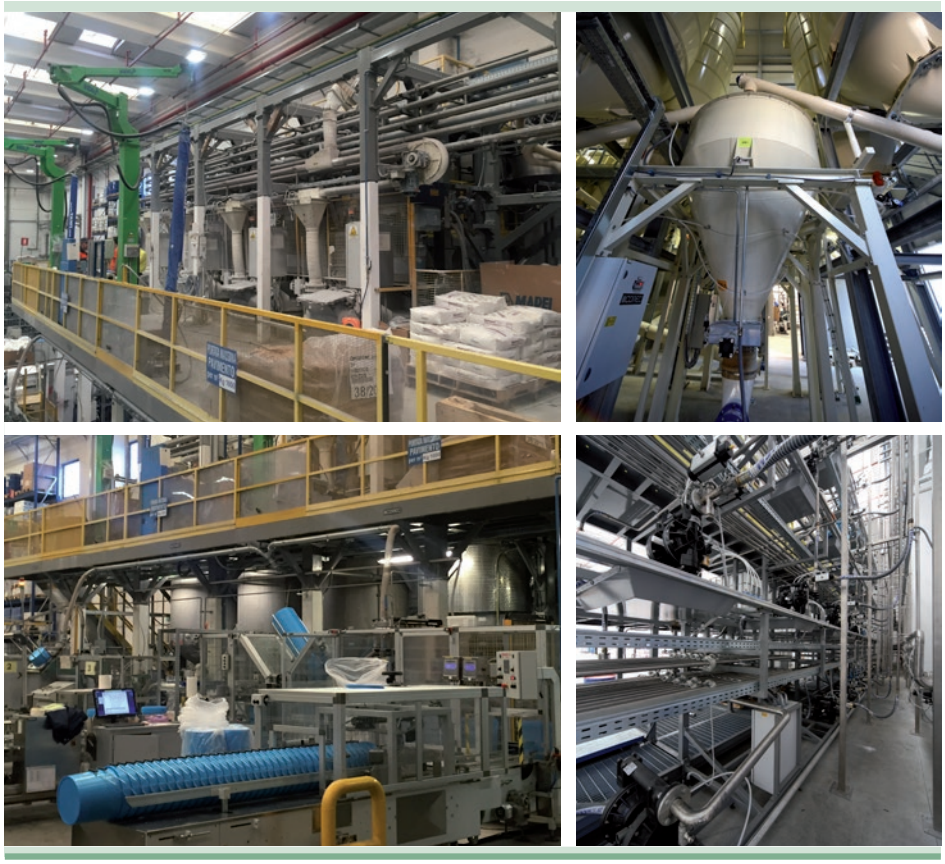
- A1, A2, A3 (Product stage): extraction and transport of raw materials and packaging, production process;
- A4 (Construction stage): transport of the finished product to final customers.

Table 2: System boundaries



A brief description of production process is the following:

Figure 1: Production process detail



The production process starts from raw materials, that are purchased from external and intercompany suppliers and stored in the plant. Bulk raw materials are stored in specific silos and added automatically in the production mixer, according to the formula of the product. Other raw materials, supplied in bags or big bags, are stored in their warehouse and added automatically or manually in the mixer. The production is a discontinuous process, in which all the components are mechanically mixed in batches. The semi-finished product is then packaged in bags, put on wooden pallets, covered by stretched hoods and stored in the Finished Products' warehouse. The quality of final products is controlled before the sale.

Figure 2: Mediglia Plant

Table 3: Transport to the building site (A4)

Name	Value	Unit
Means of transport: truck euro 3 with 27 tons of payload & Ocean ship with 27500 DWT		
Litres of fuel (truck)	~ 2E-03	l/DU*100km
Litres of fuel (ship)	~ 4E-04	l/DU*100km
Transport distance (weighted average)	~ 400	km
Capacity utilisation (including empty runs)	85	%
Gross density of products transported	~ 1400	km/m³
Capacity utilisation volume factor	100	%

DU: declared unit

6. CUT-OFF RULES AND ALLOCATION

Criteria for the exclusion of inputs and outputs (cut-off rules) in the LCA, information modules and any additional information are intended to support an efficient calculation procedure. They are not applied in order to hide data.
The following procedure is applied for the exclusion of inputs and outputs:

- All inputs and outputs to a unit process, for which data are available, are included in the calculation
- Cut-off criteria, where applied, are described in Table 4

Input flows are covered for the whole formula.

Table 4: Cut-off criteria

Process excluded from study	Cut-off criteria	Quantified contribution from process
A3: production (auxiliary materials)	less than 10^{-5} kg/kg of finished product	Sensitivity study demonstrates a relative contribution lower than 0,5%
A3: waste and particle emission	less than 10^{-5} kg/kg of finished product	Sensitivity study demonstrates a relative contribution lower than 0,5%

For the allocation procedure and principles consider the following table (Table 5):

Table 5: Allocation procedure and principles

Module	Allocation Principle
A1	All data are referred to 1 kg of product • A1: electricity is allocated to the whole plant production
A3	All data are referred to 1 kg of powder packaged product: • A3-wastes: all data are allocated to the whole plant production

7. ENVIRONMENTAL PERFORMANCE AND INTERPRETATION

GWP_{100}
Global Warming Potential refers to the emission/presence of GHGs (greenhouse gases) in the atmosphere (mainly CO_2, N_2O, CH_4) which contribute to the increase in the temperature of the planet.

AP
Acidification Potential refers to the emission of specific acidifying substances (i.e. NOx, SOx) in the air. These substances decrease the pH of the rainfall with predictable damages to the ecosystem.

EP
Eutrophication Potential refers to the nutrient enrichment of flowing water, which determines unbalance in aquatic ecosystems and causes the death of the aquatic fauna.

ODP
Ozone Depletion Potential refers to the degradation of the stratospheric layer of the ozone involved in blocking the UV component of sunrays. Depletion is due to particularly reactive components that originate from chlorofluorocarbon (CFC) or chlorofluoromethanes (CFM).

POCP
The Photochemical Ozone Creation Potential is the ozone formation in low atmosphere. This is quite common in the cities where a great amount of pollutants (like VOC and NOx) are emitted every day (industrial emissions and vehicles). It is mainly diffused during the summertime.

ADP_e (elements)
Abiotic Depletion Potential elements refers to the depletion of the mineral resources.

ADP_f (fossil fuel)
Abiotic Depletion Potential fossil fuel refers to the depletion of the fossil fuel resources.

Following tables show environmental impacts for the products considered according to CML methodology (2001 – Jan. 2016). All the results are referred to the declared unit (see chapter § 4).

Keraflex Maxi S1 Zerø

*Table 6: **Keraflex Maxi S1 Zerø**: Environmental categories referred to the declared unit*

Environmental Category	Unit	A1 – A3	A4
GWP_{100}	(kg CO_2 eq.)	4,75E-01	2,69E-02
ADPe (element)	(kg Sb eq.)	1,46E-07	2,22E-09
ADPf (fossil)	(MJ)	5,60E+00	3,65E-01
AP	(kg SO_2 eq.)	4,25E-04	1,60E-04
EP	(kg $(PO_4)^{3-}$eq.)	1,58E-04	4,09E-05
ODP	(kg R-11 eq.)	1,76E-08	7,32E-16
POCP	(kg ethylene eq.)	2,13E-04	-7,12E-05

GWP_{100}: Global Warming Potential; **ADPe**: Abiotic Depletion Potential (elements); **EP**: Eutrophication Potential; **AP**: Acidification Potential; **POCP**: Photochemical Ozone Creation Potential; **ODP**: Ozone Depletion Potential; **ADPf**: Abiotic Depletion Potential (fossil)

*Table 7: **Keraflex Maxi S1 Zero**: Other environmental indicators referred to the declared unit*

Environmental Indicator	Unit	A1-A3	A4
RPEE	MJ	5,42E-01	2,02E-02
RPEM	MJ	-	-
TPE	MJ	5,42E-01	2,02E-02
NRPE	MJ	5,71E+00	3,66E-01
NRPM	MJ	-	-
TRPE	MJ	5,71E+00	3,66 E-01
SM	kg	2,74E-02	-
RSF	MJ	-	-
NRSF	MJ	-	-
W	m^3	5,24E-03	4,58E-04

RPEE Renewable primary energy as energy carrier; **RPEM** Renewable primary energy as material utilisation; **TPE** Total use of renewable primary energy sources; **NRPE** Non-renewable primary energy as energy carrier; N**RPM** Non-renewable primary energy as material utilization; **TRPE** Total use of non-renewable primary energy sources; **SM** Use of secondary materials; **RSF** Renewable secondary fuels; **NRSF** Non-renewable secondary fuels; **W** Net use of fresh water

*Table 8: **Keraflex Maxi S1 Zero**: Waste production & other output flows referred to the declared unit*

Output flow	Unit	A1-A3	A4
NHW	kg	1,15E-03	-
HW	kg	6,22E-04	-
RW	kg	0,00E+00	-
Components for re-use	kg	-	-
Materials for recycling	kg	6,55E-03	-
Materials for energy recovery	kg	-	-
Exported energy	MJ	-	-

HW Hazardous waste disposed; **NHW** Non Hazardous waste disposed; **RW** Radioactive waste disposed

Keraflex Maxi S1 Ultra White

Table 9: ***Keraflex Maxi S1 Ultra White****: Environmental categories referred to the declared unit*

Environmental Category	Unit	A1 – A3	A4
GWP_{100}	(kg CO_2 eq.)	5,08E-01	2,14E-02
ADPe (element)	(kg Sb eq.)	1,46E-07	1,76E-09
ADPf (fossil)	(MJ)	4,20E+00	2,90E-01
AP	(kg SO_2 eq.)	5,26E-04	1,28E-04
EP	(kg $(PO_4)^{3-}$eq.)	2,61E-04	3,25E-05
ODP	(kg R-11 eq.)	8,35E-09	5,83E-16
POCP	(kg ethylene eq.)	6,17E-05	-5,61E-05

GWP_{100}: Global Warming Potential; **ADPe**: Abiotic Depletion Potential (elements); **EP**: Eutrophication Potential; **AP**: Acidification Potential; **POCP**: Photochemical Ozone Creation Potential; **ODP**: Ozone Depletion Potential; **ADPf**: Abiotic Depletion Potential (fossil)

*Table 10: **Keraflex Maxi S1 Ultra White**: Other environmental indicators referred to the declared unit*

Environmental Indicator	Unit	A1-A3	A4
RPEE	MJ	6,48E-01	1,60E-02
RPEM	MJ	-	-
TPE	MJ	6,48E-01	1,60E-02
NRPE	MJ	4,31E+00	2,91E-01
NRPM	MJ	-	-
TRPE	MJ	4,31E+00	2,91E-01
SM	kg	-	-
RSF	MJ	-	-
NRSF	MJ	-	-
W	m^3	4,98E-03	3,64E-04

RPEE Renewable primary energy as energy carrier; **RPEM** Renewable primary energy as material utilisation; **TPE** Total use of renewable primary energy sources; **NRPE** Non-renewable primary energy as energy carrier; N**RPM** Non-renewable primary energy as material utilization; **TRPE** Total use of non-renewable primary energy sources; **SM** Use of secondary materials; **RSF** Renewable secondary fuels; **NRSF** Non-renewable secondary fuels; **W** Net use of fresh water

*Table 11: **Keraflex Maxi S1 Ultra White**: Waste production & other output flows referred to the declared unit*

Output flow	Unit	A1-A3	A4
NHW	kg	7,28E-04	-
HW	kg	3,72E-04	-
RW	kg	0,00E+00	-
Components for re-use	kg	-	-
Materials for recycling	kg	4,61E-03	-
Materials for energy recovery	kg	-	-
Exported energy	MJ	-	-

HW Hazardous waste disposed; **NHW** Non Hazardous waste disposed; **RW** Radioactive waste disposed

Tables above show absolute results for every considered environmental impact category. They clearly indicate that module **A1** gives the highest contribution for each of them, up to 95% of the total impact in the whole system boundary.
In particular hydraulic binders and organic polymers, which are some of the main components in the adhesives formulations, carry a significant impact for all environmental categories.
Electricity consumption in the production process does not affect the considered environmental categories.
Modules **A2** and **A4** (transport of raw materials and transport of finished product), give a negative contribution to POCP, due to nitrogen dioxide and monoxide emission factors (for more details, see the methodology used: *HBEFA -Handbook Emission Factors for Road Transport*).
A specific amount of **recycled material** is contained in the formulation of **Keraflex Maxi S1 Zerø**. The value is shown in Table 7 as **SM** (Secondary Material) indicator.
Details about the relative contribution of the different modules considered in the system boundaries are shown in Table 12 and Table 13.
A focus on GWP_{100} for the two products is shown in Table 14.

*Table 12: Environmental Impact of **Keraflex Maxi S1 Zerø** as percentage*

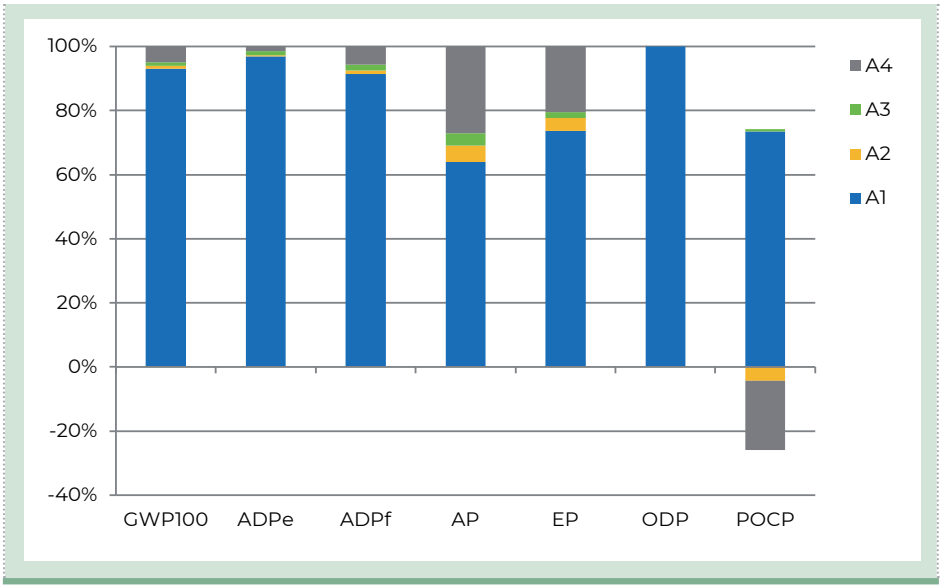


*Table 13: Environmental Impact of **Keraflex Maxi S1 Ultra White** as percentage*

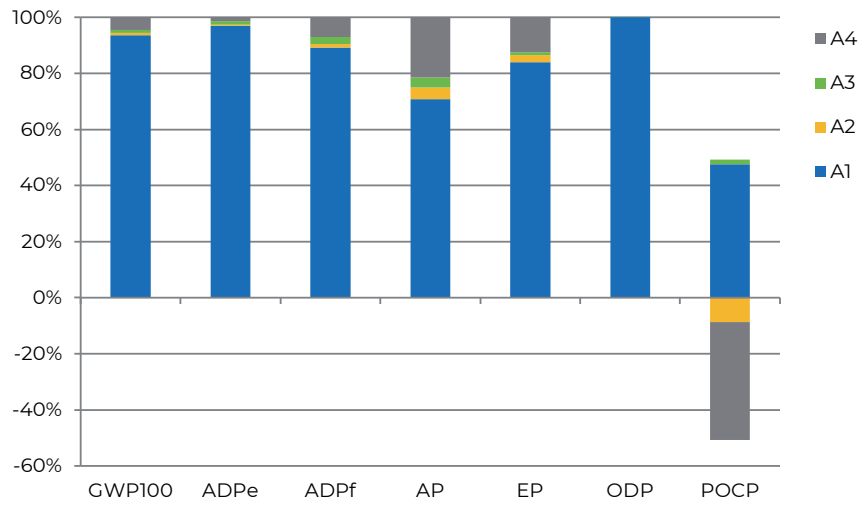
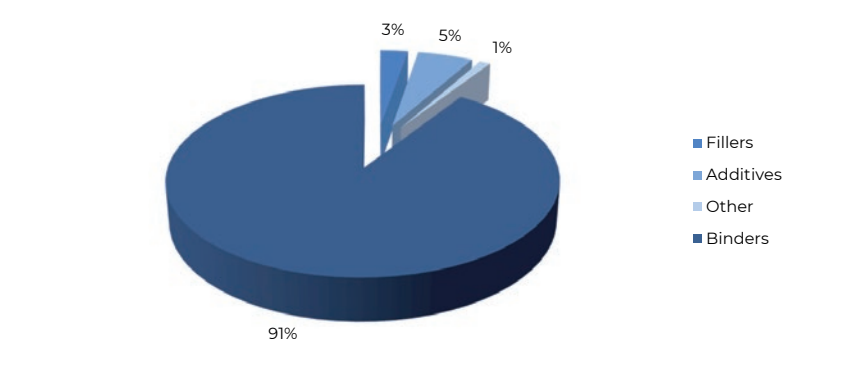


Table 14: Focus on GWP_{100} of the module A1, representative for all products



More details about electrical mix used in this EPD, are shown below:

	Data source	Amount	Unit
Electricity grid mix (IT) – 2014	GaBi database	0,4020	kg CO_2-eqv/kWh
Electricity from photovoltaic (IT) – 2014	GaBi database	0,0641	kg CO_2-eqv/kWh

8. DATA QUALITY

Table 15 Data quality

Dataset & Geographical reference	Database (source)	Temporary reference
A1-A3		
Grey PTL cement	EPD S-P-00880	2016 – 2018
White PTL cement	EPD-CIS-20150243-CAA1	2015
Fillers (EU)	GaBi Database;	2017
Additives (EU)	GaBi Database	2012 – 2017
Electricity grid mix (IT)	GaBi Database	2014
Electricity from photovoltaic (IT)	GaBi Database	2014
Packaging components (EU)	GaBi Database, PlasticEurope	2005 – 2017
A2; A4		
Truck transport (euro 3, 27t payload – GLO)	GaBi Database	2017
Light Train (Gross Ton Weight 500t - GLO)	GaBi Database	2017
Oceanic ship (27500 DWT - GLO)	GaBi Database	2017
Electricity grid mix (EU)	GaBi Database	2014
Diesel for transport (EU)	GaBi Database	2014
Heavy Fuel Oil (EU)	GaBi Database	2014

All data included in table above refer to a period between 2005 and 2018; the most relevant ones are specific from suppliers, while the others (i.e. transport and minor contribution dataset), come from European and global databases.
All dataset are not more than 10 years old according to EN 15804 § 6.3.7 "Data quality requirements". The only exception is represented by one raw material used for one packaging component production.
Primary data concern the year 2018 and represent the whole annual production.

9. REQUISITE EVIDENCE

9.1 VOC emissions

Volatile Organic Compounds (VOC) special tests and evidence have been carried out on the two products, according to ISO 16000 parts 3, 6, 9 and 11 and EN 16516.

The two tile-adhesives have been evaluated in emission chambers, in order to detect their VOC emissions after 3 and 28 days storage in the ventilated chambers, according to GEV (Gemeinschaft Emissionskontrollierte Verlegewerkstoffe, Klebstoffe und Bauprodukte e.V.) test method.

Keraflex Maxi S1 Zerø and **Keraflex Maxi S1 Ultra White** meet the requirements for the emission class Emicode EC1R^{PLUS}, as "very low VOC emission", released by GEV.

Next table describes the limits for the Emicode EC1^{PLUS} class:

Table 16: EC1^{PLUS} VOC limits

	3 days µg/m³	28 days µg/m³
TVOC (C6-C16)	≤ 750 µg/m³	≤ 60 µg/m³
TSVOC (C16-C22)		≤ 40 µg/m³
C1A-C1B substances	Total ≤ 10 µg/m³	Single substance ≤ 1 µg/m³
Formaldehyde/ acetaldehyde	≤ 50 µg/m³	
Sum of formaldehyde/ acetaldehyde	≤ 50 ppb	
sum of non-assessable VOCs		≤ 40
R value		≤ 1

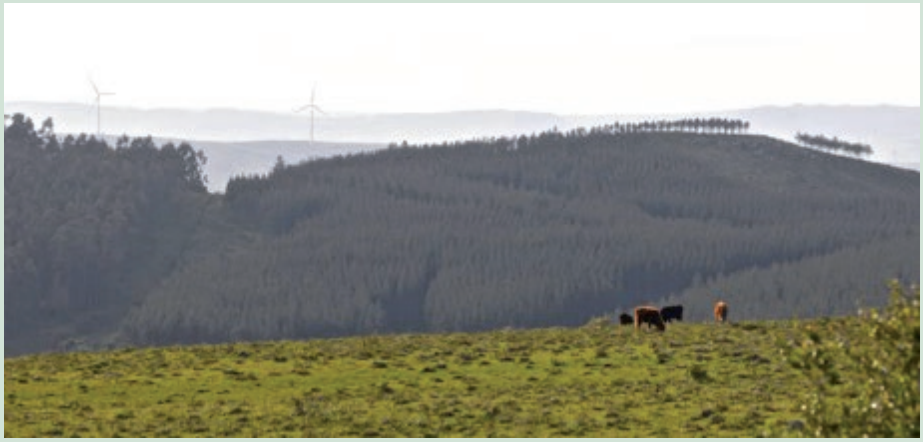
9.2 Recycled Content

Keraflex Maxi S1 Zerø contains about 2,8% of recycled material.

9.3 CO_2 offset

Residual greenhouse gas emissions of **Keraflex Maxi S1 Zerø** have been offset by purchasing environmental credits certified by Energyway, financing the reforestation of a depleted area in Uruguay of more than 21000 hectars.

More information are available on the website:
https://www.mapei.com/it/en/about-us/mapei-in-italy/the-environment-group



Keraflex Maxi S1 Zero
Keraflex Maxi S1 Ultra White

10 SIGNIFICANT CHANGES FROM THE PREVIOUS VERSION

In this revision new primary data (referred to the reference year 2018) have been adopted. The new version of PCR 2.3 has been considered. Secondary materials has been included in the content declaration and SM indicator has been updated. Due to these updates, environmental categories have changed more than ±10% (POCP).

11. VERIFICATION AND REGISTRATION

EPD of construction products may not be comparable if they do not comply with EN 15804.
Environmental product declarations within the same product category from different programs may not be comparable.

CEN standard EN15804 served as the core PCR	
PCR:	PCR 2012:01 Construction products and Construction services, Version 2.3, 2018-11-15
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair: Massimo Marino Contact via **info@environdec.com**
Independent verification of the declaration and data, according to ISO 14025	☒ EPD Process Certification (Internal) ☐ EPD Verification (external)
Third party verifier:	Certiquality S.r.l. Number of accreditations: 003H rev15
Accredited or approved by:	Accredia
Procedure for follow-up of data during EPD validity involves third-party verifier	☒ Yes ☐ No

12. REFERENCES

- EN 12004 “ADHESIVES FOR TILES. REQUIREMENTS, EVALUATION OF CONFORMITY, CLASSIFICATION AND DESIGNATION”
- EN 15804: SUSTAINABILITY OF CONSTRUCTION WORKS - ENVIRONMENTAL PRODUCT DECLARATIONS - CORE RULES FOR THE PRODUCT CATEGORY OF CONSTRUCTION PRODUCTS
- GENERAL PROGRAMME INSTRUCTIONS OF THE INTERNATIONAL EPD® SYSTEM. VERSION 3.0
- HBEFA - HANDBOOK EMISSION FACTORS FOR ROAD TRANSPORT
- ISO 13007-1 CERAMIC TILES - GROUTS AND ADHESIVES - PART 1: TERMS, DEFINITIONS AND SPECIFICATIONS FOR ADHESIVES: DEFINITIONS AND CHARACTERISTICS
- ISO 14025 ENVIRONMENTAL LABELS AND DECLARATIONS - TYPE III ENVIRONMENTAL DECLARATIONS - PRINCIPLES AND PROCEDURES
- ISO 14044 ENVIRONMENTAL MANAGEMENT – LIFE CYCLE ASSESSMENT – REQUIREMENTS AND GUIDELINES
- PCR 2012:01; “PRODUCT GROUP CLASSIFICATION: MULTIPLE UN CPC CODES CONSTRUCTION PRODUCTS AND CONSTRUCTION SERVICES”; VERSION 2.3

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