ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH ISO 14025:2006 AND EN 15804+A2:2019/AC:2021

Polymer-modified cementitious adhesives by NORDIA S.A.

EPD of multiple products, based on the average results of the product group.
An EPD should provide current information and may be updated if conditions change.
The stated validity is therefore subject to the continued registration and publication at www.environdec.com

EPD registration number
IES-0009040

Publication date
2024-09-05

Date of validity
2029-09-04

Date of revision
2025-03-03

Program
The International EPD® system
www.Environdec.com

Program operator
EPD international AB

UN CPC
375 Articles of concrete, cement and plaster

PROGRAM INFORMATION

DETAILS OF PROGRAM OPERATOR

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ACCOUNTABILITIES FOR PCR, LCA & INDEPENDENT, THIRD-PARTY VERIFICATION

PRODUCT CATEGORY RULES (PCR)	▪ CEN Standard EN 15804 serves as the Core Product Category Rules (PCR) ▪ PCR 2019:14 Construction products version 1.3.3 (EN 15804:A2)
PCR REVIEW WAS CONDUCTED BY	The technical Committee of the International EPD System. See www.environdec.com for a list of members.
REVIEW CHAIR	No chair appointed. The review panel may be contacted via the Secretariat www.environdec.com/contact.
LIFE CYCLE ASSESSMENT (LCA)	LCA Accountability **SustChem Technical Consulting S.A.** www.sustchem.gr
THIRD-PARTY VERIFICATION	▪ Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: **EPD verification by accredited certification body** ▪ Third-party verification: **Business Quality Verification P.C.** is an approved certification body accountable for third-party verification www.bqv.gr – info@bqv.gr ▪ Approved by: **Hellenic Accreditation System ESYD with accreditation number 1218**
PROCEDURE FOR FOLLOW-UP OF DATA DURING EPD VALIDITY INVOLVED THIRD PARTY VERIFIER	YES ✓ NO

Nordia S.A. has the sole ownership, liability and responsibility for the EPD.
EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

VERSION HISTORY

Original version of the EPD: The original version of this EPD was published on 2024-09-05.
Updated version of the EPD: The updated version of the EPD was uploaded on 2025-03-03.

The differences between the original and the updated version include the replacement of the FK 202 product photo.

COMPANY INFORMATION

EPD OWNER

MARMOLINE

NORDIA

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DESCRIPTION OF THE ORGANIZATION

VISION

NORDIA S.A. is a prominent company with extensive expertise in the building materials industry, actively engaged in the following sectors:

- Production and construction of construction chemicals and mortars under the MARMOLINE brand.
- Production of concrete admixtures as an authorized licensee of the French multinational CHRYSO.
- Quarrying, processing, and sales of marble under the NORDIA MARBLE brand.

The company's objective is to cater to the construction sector's diverse needs, ranging from home renovations to large-scale new developments. Its foundation lays back in 1998 by establishing a manufacturing plant for construction mortars in Dionyssos, Attica. Dionyssos marble dust, a unique raw material featured in most of their products even today, played a significant role in the development of a product line focused on ready-to-use mortars, with particular emphasis on ready-to-use renders and tile adhesives.

ENVIRONMENTAL COMMITMENT

Each product is designed and produced according to the following principles:

- Raw material saving and recycling.
- Energy saving.
- Zero environmental pollution.
- Clean and tidy building site.

VALUES

The company's dedication is to create top-notch, user-friendly materials while maintaining a strong commitment to environmental responsibility. It adheres to the ISO 14001 standard for Environmental Management Systems, implement innovative and secure production processes, and employ state-of-the-art production facilities with ISO 9001-certified Quality Management. These measures ensure the production of high-quality products that conform to European Commission standards and meet the specific requirements of the countries where the products are distributed.

Its primary focus is on delivering safe, user-friendly, and environmentally responsible products for both residential and commercial developments. The company's team stands out for their exceptional scientific knowledge and professional expertise. Its main objective is to continually seek new knowledge to stay at the forefront of technological advancements. Concurrently, it prioritizes the development of its workforce's skills and foster a culture of teamwork and respect.

FACILITY-PRODUCTION SITE & HEADQUARTERS

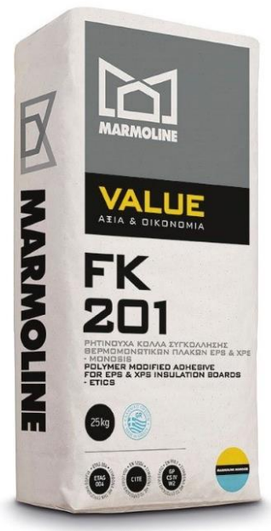
The Manufacturing site for the products examined in this EPD is located in 1km of provincial road Markopoulos - Oropos, Polydendri, 19011, Greece.

NORDIA

PRODUCT INFORMATION

FK 201 is a high-performance, polymer modified cement-based insulation boards adhesive. Ideal for the adhesion of expanded polystyrene (EPS) extruded polystyrene (XPS) as well as mineral wool (MW) boards on surfaces of concrete, render or brick masonry.

It is used as adhesive of thermal insulation boards, on surfaces such as concrete, bricks, render, cement blocks, aerated concrete, stone, etc., on exterior and interior surfaces of buildings. It can be used in combination with the decorative finish coat renders MARMOLINE SVR as a system for the external thermal insulation of buildings. FK 201 is part of a certified External Thermal Insulation Composite System (ETICS)

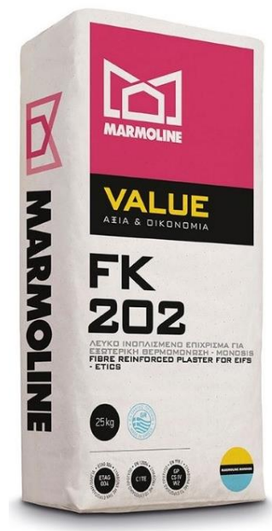


FK 201 VALUE is a high-quality, polymer modified cement-based insulation boards adhesive. Ideal for the adhesion of expanded polystyrene (EPS) extruded polystyrene (XPS) as well as mineral wool (MW) boards on surfaces of concrete, render or brick masonry.

It is used as adhesive of thermal insulation boards, on surfaces such as concrete, bricks, render, cement blocks, aerated concrete, stone, etc., on exterior and interior surfaces of buildings. It may be used in combination with the decorative finish coat renders MARMOLINE SVR as a system for the external thermal insulation of buildings. FK 201 VALUE is part of a certified External Thermal Insulation Composite System (ETICS)

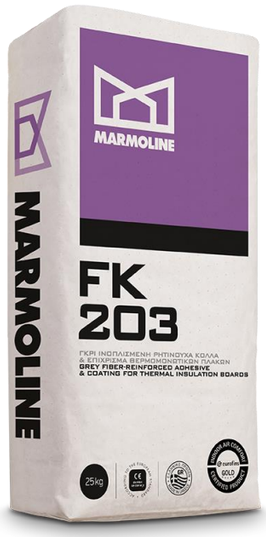
FK 202 is a high-performance, fiber-reinforced, polymer modified, cement- based insulation boards adhesive & coating. Ideal for the adhesion of expanded polystyrene (EPS) extruded polystyrene (XPS) as well as mineral wool (MW) boards on surfaces of concrete, render or brick masonry. Reinforced with suitable fiberglass mesh, can be used for the coating of thermal insulation boards, on external and internal surfaces of buildings.

It is used as adhesive of thermal insulation boards, on surfaces such as concrete, bricks, render, cement blocks, aerated concrete, stone, etc., on exterior and interior surfaces of buildings. It may be used in combination with the decorative finish coat renders MARMOLINE SVR as a system for the external thermal insulation of buildings. Additionally, it can be combined with suitable anchors, which secure the installation, it can be used for coating of thermal insulation boards. FK 202 is part of a certified External Thermal Insulation Composite System (ETICS).



FK 202 VALUE is a high performance, fiber-reinforced, polymer modified, cement- based insulation boards adhesive & coating. Ideal for the adhesion of expanded polystyrene (EPS) extruded polystyrene (XPS) as well as mineral wool (MW) boards on surfaces of concrete, render or brick masonry. Reinforced with suitable fiberglass mesh, can be used for the coating of thermal insulation boards, on external and internal surfaces of buildings.

It is used as adhesive of thermal insulation boards, on surfaces such as concrete, bricks, render, cement blocks, aerated concrete, stone, etc., on exterior and interior surfaces of buildings. It may be used in combination with the decorative finish coat renders MARMOLINE SVR as a system for the external thermal insulation of buildings. Additionally, it can be combined with suitable anchors, which secure the installation, it can be used for coating of thermal insulation boards. FK 202 VALUE is part of a certified External Thermal Insulation Composite System (ETICS).



FK 203 is a grey, fiber-reinforced, polymer modified, cement-based insulation boards adhesive & coating. Ideal for the adhesion of expanded polystyrene (EPS), extruded polystyrene (XPS) as well as mineral wool (MW) boards on surfaces of concrete, render or brick masonry. Reinforced with suitable fiberglass mesh, is used for the coating of thermal insulation boards, on external and internal surfaces of buildings.

It is used as adhesive of thermal insulation boards, on surfaces such as concrete, bricks, render, cement blocks, aerated concrete, stone, etc., on exterior and interior surfaces of buildings. It may be used in combination with the decorative finish coat renders MARMOLINE SVR as a system for the external thermal insulation of buildings. Additionally, it can be combined with suitable anchors, which secure the installation, it can be used for coating of thermal insulation boards. FK 203 is part of a certified External Thermal Insulation Composite System (ETICS).

FK 204 is a fiber-reinforced, polymer modified, cement-based insulation boards adhesive & coating. Ideal for the adhesion of expanded polystyrene (EPS), extruded polystyrene (XPS) as well as mineral wool (MW) boards on surfaces of concrete, render or brick masonry. Reinforced with suitable fiberglass mesh, is used for the coating of thermal insulation boards, on external and internal surfaces of buildings.

It is used as adhesive of thermal insulation boards, on surfaces such as concrete, bricks, render, cement blocks, aerated concrete, stone, etc., on exterior and interior surfaces of buildings. It may be used in combination with the decorative finish coat renders MARMOLINE SVR as a system for the external thermal insulation of buildings. Additionally, it can be combined with suitable anchors, which secure the installation, it can be used for coating of thermal insulation boards. FK 204 is part of a certified External Thermal Insulation Composite System (ETICS).

PRODUCT INFORMATION

THERMOWHITE is a fiber-reinforced, polymer modified, cement- based insulation boards adhesive & coating. Ideal for the adhesion of expanded polystyrene (EPS), extruded polystyrene (XPS) as well as mineral wool (MW) boards on surfaces of concrete, render or brick masonry. Reinforced with suitable fiberglass mesh, is used for the coating of thermal insulation boards, on external and internal surfaces of buildings. It is used as adhesive of thermal insulation boards, on surfaces such as concrete, bricks, render, cement blocks, aerated concrete, stone, etc., on exterior and interior surfaces of buildings. It may be used in combination with the decorative finish coat renders MARMOLINE SVR as a system for the external thermal insulation of buildings. Additionally, it can be combined with suitable anchors, which secure the installation, it can be used for coating of thermal insulation boards. THERMOWHITE is part of a certified External Thermal Insulation Composite System (ETICS).

THERMOWHITE 1.2 a fiber-reinforced, polymer-modified, cement-based adhesive and coating for insulation boards. It is ideal for bonding expanded polystyrene (EPS), extruded polystyrene (XPS), and mineral wool (MW) boards to surfaces such as concrete, render, or brick masonry. When reinforced with fiberglass mesh, it can be used for coating thermal insulation boards on both the exterior and interior of buildings. This adhesive is suitable for securing thermal insulation boards to surfaces like concrete, bricks, render, cement blocks, aerated concrete, stone, and more. It can be used alongside decorative finish coat renders like MARMOLINE SVR as part of an external thermal insulation system for buildings. Additionally, it can be combined with appropriate anchors to ensure secure installation and used for coating thermal insulation boards. THERMOWHITE1.2 is a component of a certified External Thermal Insulation Composite System (ETICS).

For the placement of products on the market within the European Union/European Free Trade Association (EU/EFTA), Regulation No 305/2011 (CPR) is applicable. All products are accompanied by a Declaration of Performance (DoP) in compliance with EN 998-1:2016.

ESSENTIAL PROPERTIES BASED ON EN 998-1:2016

ESSENTIAL PROPERTIES	FK201	FK201 VALUE	FK202	FK202 VALUE	FK203	FK204	THERMOWHITE	THERMOWHITE 1.2
WATER ABSORPTION	Wc2	Wc2	Wc2	Wc2	Wc2	Wc2	Wc2	Wc2
PERMEABILITY COEFFICIENT FACTOR (M)	μ=5.5	μ=5.5	μ=5.5	μ=5.5	μ=5/20	μ=5/20	μ=5/20	μ=5/20
ADHESION	≥1.8 N/mm2 (FPc)	≥1.8 N/mm2 (FPc)	≥2.2 N/mm2 (FPc)	≥2.2 N/mm2 (FPc)	≥1.0 N/mm2 (FPc)	≥1.0 N/mm2 (FPc)	≥1.0 N/mm2 (FPc)	≥1.0 N/mm2 (FPc)
THERMAL CONDUCTIVITY	λ10,dry=0.16 W/m*K (tab. mean value P=50%)	λ10,dry=0.16W/ m*K (tab. mean value P=50%)	λ10,dry=0.16W/ m*K (tab. mean value P=50%)	λ10,dry=0.16W/ m*K (tab. mean value P=50%)	λ10,dry=0.17 W/m*K (tab. mean value P=50%)	λ10,dry=0. 17W/m*K (tab. mean value P=50%)	λ10,dry=0.17W/m *K (tab. mean value P=50%)	λ10,dry=0.17W/m *K (tab. mean value P=50%)
RERISTANCE (CHILLING, THAAWING, IN-SITU)	NPD	NPD	NPD	NPD	NPD	NPD	NPD	NPD
REACTION TO FIRE	Class A2-s1,d0	Class A2-s1,d0	Class A2-s1,d0	Class A2-s1,d0	Class A2-s1,d0	Class A2-s1,d0	Class A2-s1,d0	Class A2-s1,d0
RELEASE OF HARZARDOUS SUBSTANCES	Please refer to Product's Safety Data Sheet (SDS)	Please refer to Product's Safety Data Sheet (SDS)	Please refer to Product's Safety Data Sheet (SDS)	Please refer to Product's Safety Data Sheet (SDS)	Please refer to Product's Safety Data Sheet (SDS)	Please refer to Product's Safety Data Sheet (SDS)	Please refer to Product's Safety Data Sheet (SDS)	Please refer to Product's Safety Data Sheet (SDS)

More Information regarding the technical characteristics of the products can be acquired from the respective Technical Data Sheets (TDSs) of the products which are available on demand from Nordia's personnel.

According to the UN CPC classification system, these products can be classified under the UN CPC code: 375 Articles of concrete, cement and plaster

CONTENT DECLARATION

MARMOLINE

This is an EPD of multiple products, based on an average product weighted over production volumes. The composition of the product is expressed in mass per declared unit (kg/kg). The table below displays the content declaration for this average product along with the range in content for all products within the product group.

No substances included in the Candidate List of Substances of Very High Concern for authorization under the REACH Regulations that exceed 0.1% of the total weight are present in the examined systems.

CONTENT DECLARATION OF AN AVERAGE POLYMER-MODIFIED CEMENTITIOUS ADHESIVE EXPRESSED IN KG PER D.U. (KG/KG)

PRODUCT COMPONENTS	WEIGHT KG/KG	POST-CONSUMER RECYCLED MATERIAL (%)	BIOGENIC MATERIAL, WEIGHT- % & KG C/KG
Portland Cement	0.28	0%	-
Copolymers	0.02	0%	-
Binders	0.02	0%	-
Aggregates	0.68	0%	-
Additives	0.002	0%	-
TOTAL	**1.00**	**0%**	**-**

PACKAGING MATERIALS	WEIGHT KG/KG	WEIGHT (%) VERSUS THE PRODUCT	WEIGHT, BIOGENIC CARBON, KG C/KG
Paper Bags	0.0003	0.03%	0.0001
Wood (Pallets)	0.0001	0.01%	2.68E-06
Polythylene Film - LDPE	4.62E-06	0.0005%	0
TOTAL	**0.0004**	**0.04%**	**0.0001**

LCA INFORMATION

MARMOLINE

SYSTEM BOUNDARIES

This LCA study follows a "cradle-to-gate" approach with modules C1-C4 & module D.

DECLARED UNIT

The declared unit used in this EPD is **one (1) kilogram (kg) of an average Polymer-modified Cementitious Adhesive**

TIME REPRESENTATIVENESS

The data used for the analysis are based on one-year average production data, from 1st of January 2023 to 31st of December 2023.

GEOGRAPHICAL SCOPE

For Modules A1-A2, the geographic scope is global. Module A3 focuses on Greece, while Module C encompasses the European Union's region (EU-27)

DATABASES USED

Ecoinvent 3.9.1 & Managed LCA Content

SOFTWARE USED

LCA for experts provided by Sphera

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				RESOURCE RECOVERY STAGE
	RAW MATERIAL SUPPLY	TRANSPORT	MANUFACTURING	TRANSPORT	CONSTRUCTION INSTALLATION	USE	MAINTENANCE	REPAIR	REPLACEMENT	REFURBISHMENT	OPERATIONAL ENERGY USE	OPERATIONAL WATER USE	DE-CONSTRUCTION DEMOLITION	TRANSPORT	WASTE PROCESSING	DISPOSAL	REUSE - RECOVERY- RECYCLING POTENTIAL
MODULE	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
MODULES DECLARED	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
GEOGRAPHY	GLO	GLO	GR	-	-	-	-	-	-	-	-	-	EU-27	EU-27	EU-27	EU-27	EU-27
SHARE OF SPECIFIC DATA	<72%																
VARIATION – PRODUCTS	Variation – products up to 26.56%																
VARIATION - SITES	0%																

The variation above corresponds to the differences in GWP-GHG indicator results in A1-A3 between an average acrylic paste render & coating and FK202 ORGANIC.

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SYSTEM DIAGRAM

MARMOLINE

MODULES A1-A3

MODULE D

PRODUCT STAGE

- Aggregates
- Binders
- Portland Cement
- Co-polymers
- Additives
- Polyethylene Film
- Paper Sacks
- Wooden pallets

Transportation of Raw Materials to manufacturing plant

Diesel

Transportation of Packaging Materials to manufacturing plant

Diesel

Production of an Average Polymer-modified cementitious adhesive

RECOVERY STAGE

Potential benefits from recycling and /or energy recovery of waste flows from Module C3

MODULE C1 | MODULE C2 | MODULE C3 | MODULE C4

END-OF-LIFE STAGE

Demolition / deconstruction of the building

Diesel

Transportation of Raw Materials to manufacturing plant

Diesel

Treatment of deconstructed waste

Disposal of Inert waste

NORDIA

DESCRIPTION OF EXAMINED MODULES

MARMOLINE

As shown in the preceding diagram, the study includes specific life cycle stages: **Product, End-of-life**, and **Resource Recovery**. Information modules A4-A5 (Construction stage) and B1-B7 (Use phase stage) are excluded. These excluded modules are scenario-based, while the purpose of this EPD is to communicate the environmental aspects across life cycle stages where the company has influence.

PRODUCT STAGE

MODULE A1

This module includes all activities related to the production of input commodities, covering the generation of raw materials used in the manufacturing of the evaluated products and the supply of utilities, which in this context, is confined to electricity and propane used for drying aggregates. The electricity utilized in production is obtained from the Greek medium voltage electricity grid, with the company having a contractual agreement with the electricity provider 'Protergia'. For electricity modeling, the provider's residual electricity mix is considered, based on the latest report from the Greek Administrator of Renewable Energy and Guarantees of Origin (DAPEEP), reflecting the year 2022. The emission intensity of electricity production, calculated using the LCA Software 'LCA for Experts' for the provider's residual electricity mix for 2022, results in a GWP-GHG value of 0.546 kg CO2 eq./kWh.

MODULE A2

In Module A2, the transport of input commodities to the manufacturing plant is covered, including both raw and packaging materials. The transportation routes and distances in kilometers are based on assumptions considering the actual locations of the producers. Transportation modes were modeled using selected LCI datasets from the Managed LCA Database (MLC database), taking into account technological and temporal specifics. Due to the varying densities of the goods transported, two different datasets were used for heavy and light goods for road transportation..

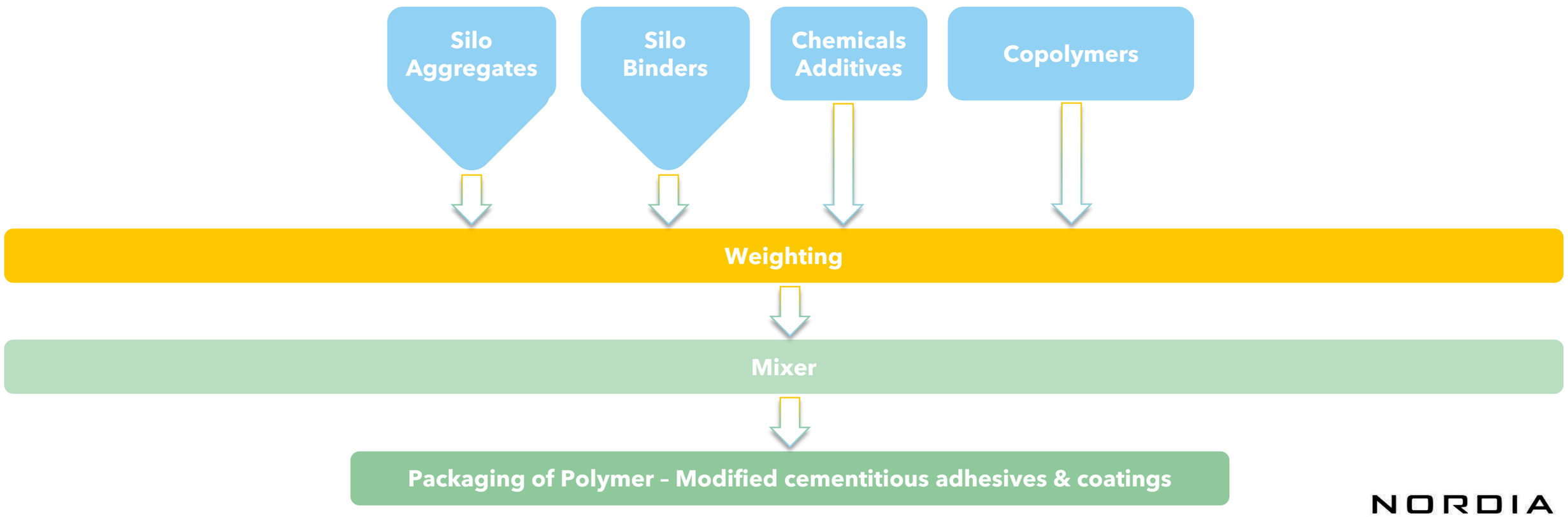
MODULE A3

This module includes the manufacturing of packaging materials, the operation of dryer, as well as the production of the examined products. The production process for polymer-modified cementitious adhesives encompasses several critical steps to ensure the final product's quality and performance. It begins with the meticulous selection of high-quality raw materials, including copolymers, Portland cement types CEM II and CEM I, various additives, and aggregates. These components are pre-weighed and batched precisely according to the formulation requirements. The mixing stage involves combining dry and wet components in a large mixer, ensuring optimal dispersion and homogenization, with specific attention to incorporating additives to adjust properties like workability and setting time.

SCENARIOS FOR PROVISION OF INPUT COMMODITIES

TRANSPORTATION ROUTE	TYPE OF TRANSFERRED GOOD	TRANSPORTATION MODE
Road	Heavyweight cargo transferred in bulk	Lorry, Euro 6, 28 - 32t gross weight / 22t payload capacity/ Fuel type: Diesel
Road	Lightweight cargo	Truck, Euro 6, 12 - 14t gross weight / 9.3t payload capacity/ Fuel type: Diesel

PRODUCTION PROCESS OVERVIEW



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DESCRIPTION OF EXAMINED MODULES

MARMOLINE

END-OF-LIFE STAGE

The end-of-life stage for the construction product begins when it is replaced, dismantled, or removed from the building or construction project, ceasing to serve any function. This stage can also commence at the building's end-of-life, based on the chosen end-of-life scenario for the product. In this study, the end-of-life stage for acrylic paste renders and coatings is considered to start when they are deconstructed along with the building, as they become an integrated part of the structure once installed.

POLYMER-MODIFIED CEMENTITIOUS ADHESIVES	
PROCESSES	**UNIT (EXPRESSED PER DECLARED UNIT)**
Collection process specified by type	0kg collected separately 1kg collected with mixed construction waste
Recovery system specified by type	0kg for re-use 0kg for recycling 0kg for energy recovery
Disposal specified by type	1kg product or material for final deposition
Assumptions for scenario development (transportation)	Distance of waste disposal facilities: 100km

MODULE C1

The deconstruction of polymer-modified cementitious adhesives and coatings is expected to take place concurrently with the demolition of the building structure. In particular, the removal of the polymer-modified cementitious adhesives, along with the rest of the building, is assumed to be carried out by a 100kW diesel-powered excavator.

MODULE C2

This module considers the transportation of dismantled polymer-modified cementitious adhesives to final waste handling facilities. It assumes an average distance of 100 km between construction sites and landfill facilities. Road route is chosen as the primary mode of transportation.

MODULE C3

This module does not include any emissions since the end-of-life scenario assumes that all dismantled polymer-modified cementitious adhesives are sent to landfill.

MODULE C4

This module reports the emissions associated with the landfilling of polymer-modified cementitious adhesives designated for disposal. Selection of disposal was conducted based on the most plausible scenario for inert waste management in Greece.

RESOURCE/ RECOVERY STAGE

MODULE D

Generally, this module accounts for the net benefits from recovery processes. However, in this study, the product is assumed to be fully landfilled after use, yielding no recovery benefits. Additionally, Module A5 is outside the system boundary, so potential benefits from recycling or reusing packaging materials cannot be considered.

ADDITIONAL LCA INFORMATION

ALLOCATIONS:

- Identifying 39% of the total consumed electricity specifically allocated to aggregates, where drying and breaking of aggregates takes place, while 37% of total electricity consumption is attributed to cementitious products, including polymer-modified cementitious adhesives, was achieved by measuring the kWh consumption across each machinery within each production line throughout the reference period.
- Propane, employed exclusively in the drying process, is dedicated solely to the aggregates production line. As a result, the entire propane consumption, amounting to 100%, is allocated to aggregates, i.e. limestone from the quarry.

CUT-OFFS:

The study incorporates data for processes, accounting for at least 99% of the stated environmental impacts. Excluded processes are:

- Production of infrastructure and capital goods
- End-of-life of waste packaging from raw materials and problematic batches of paper sacks may occur, resulting in their disposal as out-of-spec packaging materials.
- Wooden pallets and IBCs management introduced as packaging of the raw materials is not included since these packaging materials are designed for reuse

ASSUMPTIONS:

- A distance of 100 kilometers (km) between construction sites and waste treatment facilities was considered in within the study's calculations. This assumption takes into account the hypothetical distance that materials would need to be transported to access the treatment facilities necessary for their processing or disposal. It serves as a baseline assumption for logistical planning and environmental impact assessments
- It is assumed that all of the waste generated from the deconstruction process will be disposed of in landfills as part of its waste handling procedure.

NORDIA

ENVIRONMENTAL PERFORMANCE

ENVIRONMENTAL RESULTS NORMALIZED TO 1KG OF AVERAGE POLYMER-MODIFIED CEMENTITIOUS ADHESIVE

In this EPD, the selected impact categories and respective indicators describing them, as defined by International EPD System, default indicator list version 2.0. and PCR 2019:14 "Construction products" v.1.3.3 are declared. In addition, the results of a supplementary indicator for climate impact is declared. The characterization factors (CFs) used, are aligned with the EF-JRC package for EN 15804 based on EF reference package 3.1.

Please note that the estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks. The LCIA results are normalized to the selected declared unit, **1kg of average polymer - modified cementitious adhesive**.

Please be advised that the inclusion of module C in the Environmental Product Declaration (EPD) mandates a comprehensive consideration of its results alongside modules A1-A3. It is strongly discouraged to utilize the outcomes of modules A1-A3 without duly integrating the results of module C.

POTENTIAL ENVIRONMENTAL IMPACTS / 1 KG OF AVERAGE POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

CORE ENVIRONMENTAL IMPACT INDICATORS		UNIT	A1-A3	C1	C2	C3	C4	D
Global Warming Potential – total	GWP-total	kg CO_2 eq.	2.87E-01	6.60E-04	1.45E-02	0.00E+00	1.03E-02	0.00E+00
Global Warming Potential – fossil	GWP-fossil	kg CO_2 eq.	2.87E-01	6.50E-04	1.43E-02	0.00E+00	1.03E-02	0.00E+00
Global Warming Potential – biogenic[1]	GWP-biogenic	kg CO_2 eq.	-1.14E-04	0.00E+00	0.00E+00	0.00E+00	1.14E-04	0.00E+00
Global Warming Potential – land use and land use change	GWP-luluc	kg CO_2 eq.	3.84E-04	1.05E-05	2.33E-04	0.00E+00	1.05E-05	0.00E+00
Ozone Depletion Potential	ODP	kg CFC 11 eq.	6.47E-09	9.19E-17	2.04E-15	0.00E+00	3.20E-09	0.00E+00
Acidification Potential	AP	Mole of H+ eq.	6.92E-04	3.22E-06	1.94E-05	0.00E+00	8.88E-05	0.00E+00
Eutrophication Potential – freshwater	EP-freshwater	kg P eq.	1.50E-05	2.67E-09	5.92E-08	0.00E+00	3.06E-06	0.00E+00
Eutrophication Potential – marine	EP-marine	kg N eq.	8.84E-05	1.52E-06	7.08E-06	0.00E+00	3.06E-05	0.00E+00
Eutrophication Potential – terrestrial	EP-terrestrial	mol N eq.	2.35E-03	1.68E-05	8.43E-05	0.00E+00	3.33E-04	0.00E+00
Photochemical Oxidant Formation Potential	POCP	kg NMVOC eq.	6.05E-04	4.30E-06	1.93E-05	0.00E+00	9.65E-05	0.00E+00
Abiotic Depletion Potential – elements[2]	ADPe	kg Sb eq.	5.79E-07	5.44E-11	1.21E-09	0.00E+00	3.44E-08	0.00E+00
Abiotic Depletion Potential. fossil resources[2]	ADPf	MJ net calorific value	2.78E+00	8.22E-03	1.83E-01	0.00E+00	2.53E-01	0.00E+00
Water Deprivation Potential[2]	WDP	m^3 world eq. deprived	7.68E-02	9.67E-06	2.15E-04	0.00E+00	1.12E-02	0.00E+00

[1] Negative results of GWP-biogenic corresponding biogenic carbon dioxide which is stored in the wood packaging are already balanced out in modules A1-A3 since Module A5 is out of the system boundaries.

[2] The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

ENVIRONMENTAL PERFORMANCE

MARMOLINE

ENVIRONMENTAL RESULTS NORMALIZED TO 1KG OF POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

POTENTIAL ENVIRONMENTAL IMPACTS / 1 KG OF AVERAGE POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

CLIMATE CHANGE		UNIT	A1-A3	C1	C2	C3	C4	D
Global Warming Potential – GHG[3]	GWP-GHG	kg CO2 eq.	2.87E-01	6.60E-04	1.45E-02	0.00E+00	1.03E-02	0.00E+00

[3] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such. the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

POTENTIAL ENVIRONMENTAL IMPACTS / 1 KG OF AVERAGE POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

RESOURCE USE INDICATORS		UNIT	A1-A3	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ. net calorific value	3.44E-01	7.08E-04	1.57E-02	0.00E+00	4.27E-03	0.00E+00
Use of renewable primary energy resources used as raw materials	PERM	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy resources	PERT	MJ. net calorific value	3.46E-01	7.08E-04	1.57E-02	0.00E+00	4.27E-03	0.00E+00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ. net calorific value	2.78E+00	8.22E-03	1.83E-01	0.00E+00	2.53E-01	0.00E+00
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources	PENRT	MJ. net calorific value	2.78E+00	8.22E-03	1.83E-01	0.00E+00	2.53E-01	0.00E+00
Use of secondary material	SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	RSF	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	NRSF	MJ. net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	FW	m^3	1.82E-03	7.89E-07	1.75E-05	0.00E+00	2.62E-04	0.00E+00

ENVIRONMENTAL PERFORMANCE

MARMOLINE

ENVIRONMENTAL RESULTS NORMALIZED TO 1KG OF AVERAGE POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

POTENTIAL ENVIRONMENTAL IMPACTS / 1 KG OF AVERAGE POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

WASTE INDICATORS		UNIT	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed	HWD	kg	2.92E-06	3.15E-13	6.99E-12	0.00E+00	0.00E+00	0.00E+00
Non-hazardous waste disposed	NHWD	kg	1.74E-04	1.34E-06	2.98E-05	0.00E+00	0.00E+00	0.00E+00
Radioactive waste disposed	RWD	kg	8.45E-06	1.50E-08	3.33E-07	0.00E+00	0.00E+00	0.00E+00

POTENTIAL ENVIRONMENTAL IMPACTS / 1 KG OF AVERAGE POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

OUTPUT FLOWS		UNIT	A1-A3	C1	C2	C3	C4	D
Components for re-use	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy. Electricity	EEe	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy. Thermal	EEt	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

POTENTIAL ENVIRONMENTAL IMPACTS / 1 KG OF AVERAGE POLYMER - MODIFIED CEMENTITIOUS ADHESIVE

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS		UNIT	A1-A3	C1	C2	C3	C4	D
Particulate matter emissions	PM	Disease incidence	6.62E-09	3.84E-11	1.97E-10	0.00E+00	1.72E-09	0.00E+00
Ionizing radiation human[4]	IRP	kBq U235 eq.	1.89E+00	2.17E-06	4.83E-05	0.00E+00	1.17E-03	0.00E+00
Eco-toxicity. Freshwater[2]	ETP-fw	CTUe	5.90E-01	6.10E-03	1.36E-01	0.00E+00	6.38E-02	0.00E+00
Human toxicity. cancer effects[2]	HTP-c	CTUh	4.41E-10	1.23E-13	2.74E-12	0.00E+00	7.60E-12	0.00E+00
Human toxicity. non-cancer effects[2]	HTP-nc	CTUh	1.43E-08	5.54E-12	1.23E-10	0.00E+00	6.40E-11	0.00E+00
Land use related impacts/Soil quality[2]	SQP	dimensionless	6.48E-01	4.04E-03	8.98E-02	0.00E+00	5.92E-01	0.00E+00

[2] The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

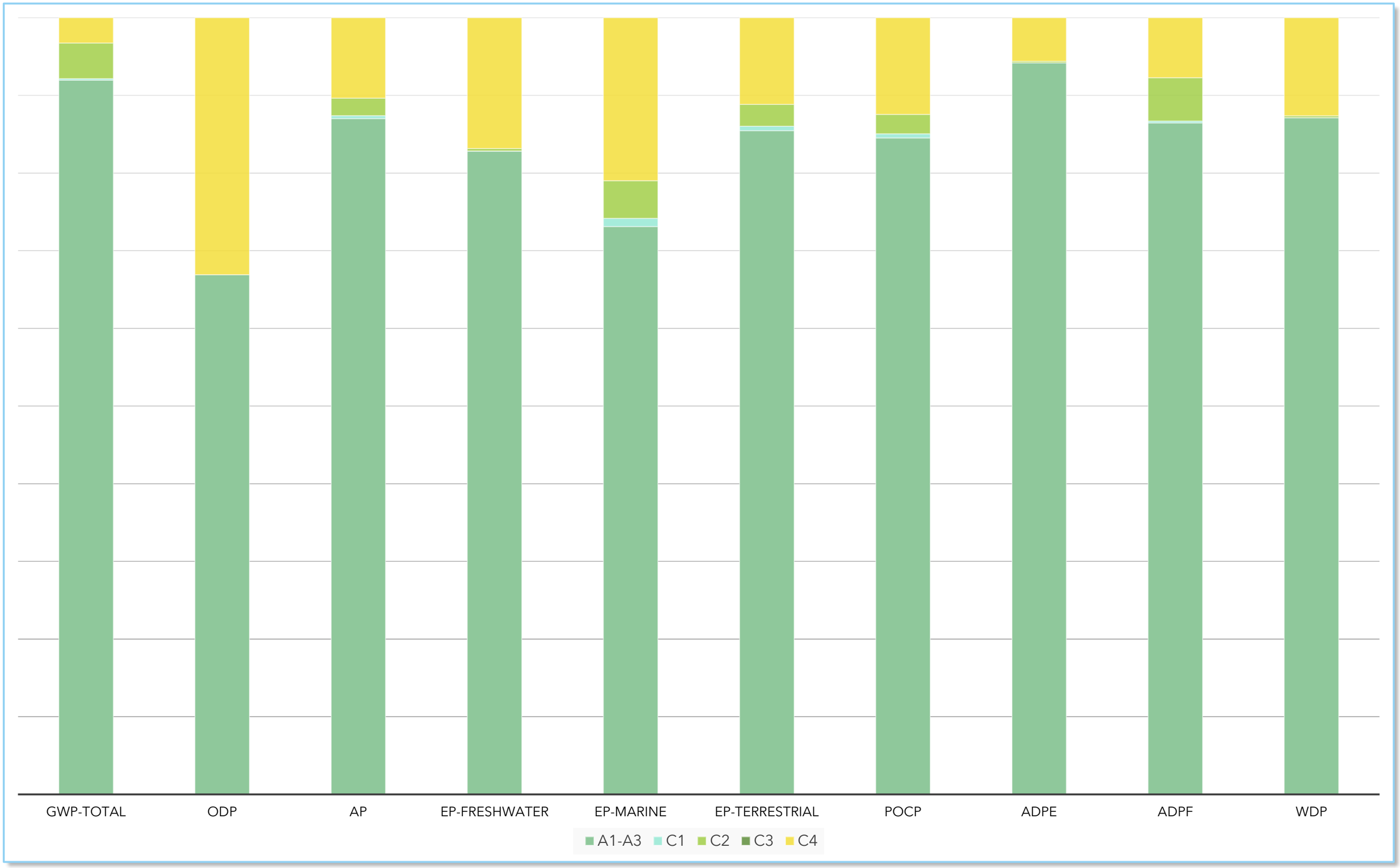
[4] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents. occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil. from radon and from some construction materials is also not measured

INTERPRETATION

As illustrated in the diagram, it is evident that the production stage (Modules A1-A3) makes the most substantial contribution to the results of each of the examined impact indicators. More specifically the following observations are pointed out:

- The total Global Warming Potential is allocated across Modules A1-A3, accounting for almost 92% of the overall potential environmental impacts.
- The contribution of disposal in Module C4 is significant of Ozone Depletion Potential, Eutrophication freshwater and Eutrophication marine, accounting for 33.09%, 16.83% and 24.00% respectively.
- Contribution of remaining Modules (C1, C2 & C3) is rather negligible.

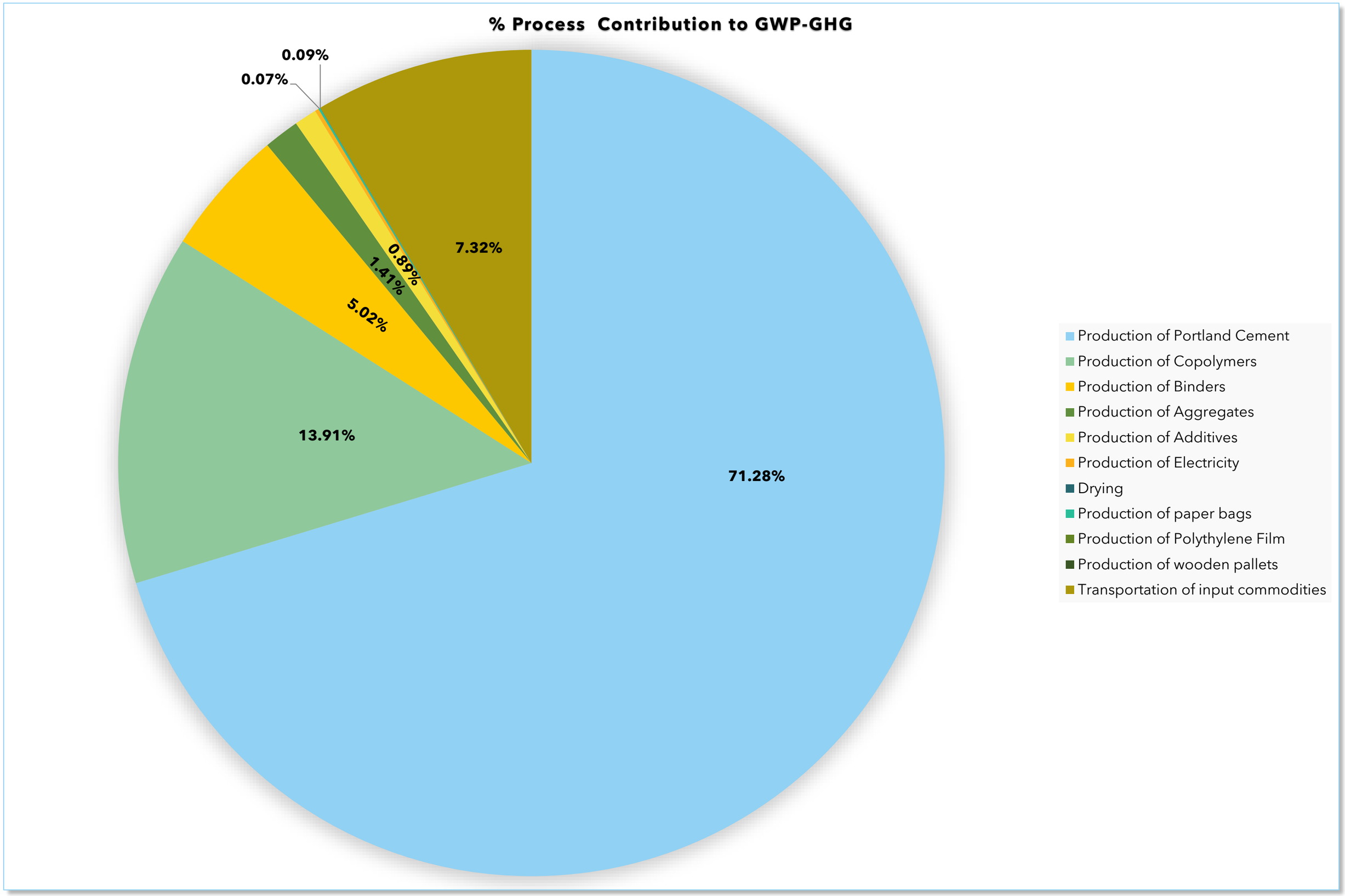
% MODULES CONTRIBUTION TO THE ENVIRONMENTAL PERFORMANCE INDICATORS OF THE DECLARED PRODUCT



INTERPRETATION

PROCESS CONTRIBUTION TO GWP-GHG FOR MODULES A1-A3 FOR AN AVERAGE POLYMER-MODIFIED CEMENTITIOUS ADHESIVE

Most of the examined impact indicators, including Global Warming Potential (GWP-GHG), are mainly influenced by Modules A1-A3. Specifically, 71.28% of the impact is due to the production of Portland Cement. The production of copolymers also have significant impact, contributing 13.91% in total. The production of binders accounts for 5.02% of the total GWP-GHG emissions, with the remaining processes contributing minimally to the overall impact.



ADDITIONAL ENVIRONMENTAL INFORMATION

MARMOLINE

The following tables offer a detailed overview of the differences observed across all examined products, covering all considered environmental impact aspects. These differences are compared to the expected environmental impacts of an average product. The tables provide in-depth insight into how each product's environmental footprint diverges from the benchmark of an average product.

CORE ENVIRONMENTAL INDICATORS	VARIATIONS FROM THE DECLARED AVERAGE (A-C)							
	FK 201	FK 201 VALUE	FK 202	FK 202 VALUE	FK 203	FK 204	THERMOWHITE	THERMOWHITE 1.2
Climate Change - Total (kg CO2 eq)	3.42%	0.35%	26.56%	25.35%	-8.89%	-7.52%	-7.52%	7.96%
Climate Change - Fossil (kg CO2 eq)	3.39%	0.34%	26.57%	25.37%	-8.90%	-7.52%	-7.52%	7.98%
Climate Change - Biogenic (kg CO2 eq)	-	-	-	-	-	-	-	-
Climate Change - Land Use and Land Use Change (kg CO2 eq)	16.38%	4.90%	22.53%	14.48%	-7.42%	-7.90%	-7.90%	-1.09%
Ozone Depletion (kg CFC-11 eq.)	8.80%	2.94%	24.43%	20.93%	-4.54%	-7.64%	-7.64%	4.91%
Acidification (Mole of H+ eq.)	27.20%	19.95%	25.18%	20.75%	8.50%	-11.28%	-11.28%	2.64%
Eutrophication, fresh water (kg P eq.)	33.34%	19.32%	33.25%	23.79%	-2.06%	-13.83%	-13.83%	0.77%
Eutrophication, marine (kg N eq.)	19.57%	0.56%	27.17%	15.56%	-9.44%	-8.97%	-8.97%	-2.29%
Eutrophication, terrestrial (Mole of N eq.)	34.11%	28.68%	19.58%	16.57%	21.34%	-11.35%	-11.35%	1.20%
Photochemical Ozone Formation, human health (kg NMVOC eq.)	32.53%	28.40%	21.71%	18.85%	18.07%	-11.72%	-11.72%	1.89%
Resource use, mineral and metals (kg Sb eq.)	101.76%	81.20%	34.35%	19.59%	-22.27%	-26.67%	-26.67%	-10.63%
Resource use, fossils (MJ)	19.14%	7.05%	37.27%	28.28%	-12.70%	-12.31%	-12.31%	1.82%
Water Deprivation Potential (m3 world equiv.)	27.84%	4.51%	36.30%	22.16%	-10.28%	-12.56%	-12.56%	-3.58%

CLIMATE CHANGE	VARIATIONS FROM THE DECLARED AVERAGE (A-C)							
	FK 201	FK 201 VALUE	FK 202	FK 202 VALUE	FK 203	FK 204	THERMOWHITE	THERMOWHITE 1.2
Global Warming Potential- GWP-GHG (kg CO2 eq)	3.42%	0.35%	26.56%	25.35%	-8.89%	-7.52%	-7.52%	7.96%

NORDIA

ADDITIONAL ENVIRONMENTAL INFORMATION

MARMOLINE

RESOURCE USE	VARIATIONS FROM THE DECLARED AVERAGE (A-C)							
	FK 201	FK 201 VALUE	FK 202	FK 202 VALUE	FK 203	FK 204	THERMOWHITE	THERMOWHITE 1.2
(PERE) Use of renewable primary energy excluding renewable primary energy resources as raw materials (MJ)	10.99%	3.32%	15.03%	10.80%	-1.19%	-5.35%	-5.35%	0.59%
(PERT) Total use of renewable primary energy resources (primary energy resources used as raw material and primary energy) (MJ)	13.10%	5.53%	14.65%	10.43%	0.96%	-5.67%	-5.67%	0.25%
(PENRE) Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (MJ)	19.22%	7.13%	37.27%	28.26%	-12.64%	-12.33%	-12.33%	1.80%
(PENRT) Total use of non-renewable primary energy resources (MJ)	19.14%	7.05%	37.27%	28.28%	-12.70%	-12.31%	-12.31%	1.82%
Use of net fresh water (m3)	28.51%	5.60%	35.77%	21.83%	-9.13%	-12.59%	-12.59%	-3.63%

WASTE CATEGORIES	VARIATIONS FROM THE DECLARED AVERAGE (A-C)							
	FK 201	FK 201 VALUE	FK 202	FK 202 VALUE	FK 203	FK 204	THERMOWHITE	THERMOWHITE 1.2
Hazardous waste disposed (kg)	27.66%	27.66%	-4.26%	-4.26%	-4.26%	-4.26%	-4.26%	-4.26%
Non-hazardous waste disposed (kg)	7.33%	3.97%	4.41%	1.78%	1.83%	-2.20%	-2.20%	-1.67%
Radioactive waste disposed (kg)	-3.71%	-4.97%	-5.57%	-6.75%	-6.54%	2.40%	2.40%	-2.76%

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS	VARIATIONS FROM THE DECLARED AVERAGE (A-C)							
	FK 201	FK 201 VALUE	FK 202	FK 202 VALUE	FK 203	FK 204	THERMOWHITE	THERMOWHITE 1.2
Particulate Matter emissions (Disease incidence)	10.54%	5.26%	22.22%	19.30%	-2.21%	-7.47%	-7.47%	4.44%
Ionizing radiation human (kBq U235 eq.)	6.67%	9.66%	21.92%	25.57%	6.58%	-7.67%	-7.67%	10.78%
Eco-toxicity, freshwater (CTUe)	23.96%	7.41%	24.95%	14.34%	-9.66%	-9.48%	-9.48%	-3.45%
Human toxicity, cancer effects (CTUh)	13.87%	15.26%	20.91%	23.18%	9.74%	-8.60%	-8.60%	8.57%
Human toxicity, non-cancer effects (CTUh)	0.05%	1.26%	24.58%	27.16%	-3.45%	-6.89%	-6.89%	11.80%
Land use related impacts/Soil quality (dimensionless)	25.63%	16.89%	11.18%	5.98%	11.98%	-7.03%	-7.03%	-3.21%

REFERENCES

- International EPD® System, PCR 2019:14 Construction Products, version 1.3.3 (EN 15804: A2)
- EN 15804:2012+A2:2019/AC 2021 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- International EPD® System, General Program Instructions for the International EPD System, version 4.01
- ISO 14020:2000- Environmental Labels and Declarations – General Principles
- ISO 14025:2006 - Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 14040:2006 - Environmental management – Life Cycle assessment – Principles and framework
- ISO 14044:2006 - Environmental management – Life Cycle assessment – Requirements and guidelines
- The International EPD® System – The International EPD System is a programme for type III environmental declarations, maintaining a system to verify and register EPDs as well as keeping a library of EPDs and PCRs in accordance with ISO 14025. www.environdec.com
- Ecoinvent/ Ecoinvent Centre – www.Eco-invent.org
- Sphera – LCA for Experts Product Sustainability software – www.sphera.com
- Paralike, Maria & Karachaliou, Theodora (2019). Progress and Challenges in C&D Waste Management in Greece. 5. 32-41.
- Residual Energy Mix 2022 from Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)