FRASSINORO

GRUPPO GRESMALT

2024

EPD
8,2 mm

ENVIRONMENTAL PRODUCT DECLARATION

Product Name:
Porcelain Stoneware Ceramic Tiles
8.2 mm thickness

Site Plant:
Via Mazzalasino 39, 42019 Scandiano (RE) Italy

In compliance with ISO 14025 and EN 15804+A2:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration number	EPD-GRESMALT-S002
Registration number	EPDITALY0982

Date of publication (first issue)	10/09/2025
Date of validity	10/09/2030

1. General Informations

EPD OWNER	
Company name	Gruppo Ceramiche Gresmalt S.p.A
Legal head office	Via Statale 467 45, 42013 Casalgrande (RE) – Italy
Contacts for information on the EPD	INNOVABILITY UNIT innovability@gresmalt.it
PROGRAM OPERATOR	
EPDITALY (www.epditaly.it)	Via Gaetano De Castillia 10, 20124 Milano (MI), Italy
INFORMATION ON THE EPD	
Product name	Porcelain Stoneware Ceramic Tiles 8.2 mm thickness
Plant involved in the declaration	Via Mazzalasino 39, 42019 Scandiano (RE) Italy
Short product description	This document refers to porcelain stoneware tiles produced with a thickness of 8.2 mm
Application area	Interior and exterior floor and wall coverings
CPC Code	37370
VERIFICATION INFORMATION	
Product Category Rules (PCR)	EN 15804:2012+A2:2019 is the framework reference for PCRs. PCR ICMQ-001/15 rev3.1
EPDItaly regulation	General Programme Instruction document of EPDItaly v.6
LCA tool	EPD based on a verified LCA tool: LCA tool creator for Ceramic Tile V6 [(27/11/2023) - DB version 2023.2]
Project LCA Tool Report	Background report for LCA tool for Confindustria Ceramica – 27/11/2023
Project Short Report	Gruppo Ceramiche Gresmalt S.p.A. Rapporto tecnico LCA" – Data emissione: 20/06/2025 – Revisione: 2
INDIPENDENT CHECK	Independent verification of the declaration and data, according to EN ISO 14025:2010. Internal □ External ☑ Third party verifier: ICMQ SpA, via De Castillia 10, 20124 Milano (MI), Italy (www.icmq.it). Accredited by Accredia.
COMPARABILITY	Environmental statements published within the same product category, but from different programs, may not be comparable. In particular, EPDs of construction products may not be comparable if they do not comply with EN 15804:2012+A2:2019.
ACCOUNTABILITY	Gruppo Ceramiche Gresmalt releases EPDItaly from any non-compliance with environmental legislation self-declared by the manufacturer itself. The holder of the declaration will be responsible for the information and supporting evidence; EPDItaly declines all responsibility for the manufacturer's information, data, and results of the life cycle assessment.
Additional information	
TECHNICAL SUPPORT	Sphera https://www.sphera.com

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2. The Company

Founded in 1968, Gresmalt Group is today one of the key players in the Italian ceramics industry, a go-to name for the production and sale of porcelain stoneware for floors and walls.
Operating within a 100% Italian production cycle, the Group's unique selling proposition is its ability to guarantee high quality product and advanced processes through the use of cutting-edge technologies.
Over time, the Group has consolidated an approach to environmental, social, economic and technological sustainability which enables it to chart its performance in detail and identify improvement actions.

Gresmalt's core values are honesty, passion, efficiency, continuous improvement, customer focus, and respect for people. These values are the tenets upon which the company's day-to-day management is built and they underpin everything we do.
Within the scope of these values, Gresmalt is committed to contributing to sustainable development and to increasingly integrating economic, environmental, and social issues within its decision-making processes, in order to grow the business and provide an excellent service to its customers, in line with some of the frameworks shared internationally, such as the principles of the UN Global Compact and the UN Agenda 2030.
Gresmalt's core values are reflected in its vision and mission statements, which describe exactly what the company offers its stakeholders and highlight the unique features that make it stand out:

Future-oriented vision
Gresmalt's ambition is to create smarter and more environment respectful ceramic materials, and to make customers' homes a place they love and in which they can live well.

Present-oriented mission
Gresmalt is committed to being recognised as an innovation- and sustainability- oriented ceramics manufacturer with the ability to make Italian style accessible to all, which provides high quality products that meet reasonable customer expectations.

THE GROUP'S PRODUCTION STRUCTURE:
The Group's manufacturing activities are spread over three plants located in Italy, which provide production capacity, for glazed porcelain stoneware tiles, of approximately 20 million m^2/year.

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The huge range of products offered by Gresmalt include a vast assortment of sizes and thicknesses to satisfy all our customers' needs, guaranteeing maximum flexibility of use and application.
The main production plant, located in Scandiano, in the province of Reggio Emilia, houses production of the tile body mix employed for all the Group's products, which is then used on site or distributed to the sites in Viano, in the province of Reggio Emilia area, or Frassinoro, in the province of Modena.

DISTRIBUTION TO CUSTOMERS AND END USERS:
Using the services of advanced logistics hubs, the group distributes 70% of the ceramic tiles it produces via direct sales through specialist retailers, under its B2B brands "Sintesi", "Abitare la Ceramica", and "Ermes Aurelia". The remaining 30% is marketed by large-scale retailers under another B2B brand, "Frassinoro". These products, which are made on the basis of precise contractual specifications, undergo regular screening by customers, through on-site inspections at the production plants and specific tests on the products conducted by the Group to ensure quality and environmental compliance.
Outgoing products from the Group's production plants are distributed to customers using "cross-docking" methods, which involve direct delivery to the store, or delivery to the logistics centre for storage, as an intermediate step prior to delivery to the retailer's store.

OUR APPROACH TO SUSTAINABILITY:
Sustainability is a core value at Gresmalt, deeply integrated into the company's culture and daily operations. The Group is committed to the responsible use of natural and human resources, adopting innovative technologies to minimize environmental and social impacts. This approach is guided by a robust framework of governance and a focus on continuous improvement in Environmental, Social, and Governance (ESG) performance.
Gresmalt has formalized its sustainability commitments through comprehensive documentation, including a Code of Ethics, a Supplier Code of Conduct, an ESG Corporate Policy, and a sustainable procurement policy. These tools support the implementation of measurable sustainability goals, established within a detailed ESG Strategic Plan that follows clear strategic guidelines.
A focus on stakeholder engagement and materiality analysis underpins Gresmalt's efforts, ensuring alignment between its sustainability objectives and the expectations of its stakeholders. Additionally, structured training and awareness programs empower the ESG Committee and management teams to drive meaningful change and foster sustainable development across all areas of the business.

Through this proactive and integrated approach, Gresmalt seeks to balance economic growth with social and environmental responsibility, ensuring a sustainable future for the company and the communities it serves.

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OUR PRODUCTS:
Across its three manufacturing facilities, the Gresmalt Group manufactures top-end porcelain stoneware for floor and wall applications which are available to customers at competitive prices.
Over recent years, the Group has gradually reduced the environmental impacts of its production processes through the integration of state-of-the-art technology and substantial investments guided by smart manufacturing principles.
Research, development, and innovation activities have been oriented towards sustainability principles, life-cycle thinking and eco-design, within a framework of increasing collaboration with the world of scientific research.

THE GROUP'S BRANDS:
The Group's history in the world of ceramics began in 1968 and has led us today to rank among the leading names in Italy and worldwide for the manufacture and marketing of porcelain stoneware for floor and wall applications. Quality, innovation, and a fully Italian production process converge within our four brands:

abitare la ceramica

Abitare la ceramica: for a new idea of home.
Ceramics become the scenario to accommodate real-life situations to be built around the home. The relationship with space is strengthened through direct contact with ceramic surfaces designed to convey new living meanings.

ermesaurelia

Two souls, one brand: ermesaurelia.
Past, present, future. Three dimensions of time merge to create ermesaurelia's unique and instantly recognisable identity. Expressing the heritage of tradition with a contemporary angle, the brand of today designs for tomorrow.

FRASSINORO
GRUPPO GRESMALT

Frassinoro, the brand strongly sustainability-oriented, dedicated to the B2B market.
Constant technological innovation in sustainable product development, combined with attention to trends in architecture and interior desing, lead to the creation of high-quality ceramic collections with reduced environmental impact, to give style to living spaces.

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Performance, design, versatility
The careful development of design, colors and finishes is transformed, thanks to cutting-edge technologies, into collections with elegant and versatile aesthetics, capable of interpreting projects and living styles to the fullest while preserving their value over time.

OUR PRODUCT QUALITY COMMITMENT:
Gresmalt ensures the highest standards of quality in its products through rigorous monitoring of both production processes and finished goods. The company conducts detailed checks to certify technical performance, ensure compliance with classification standards, and guarantee the quality and safety of its products.

Quality control procedures are grounded in formal policies and aligned with the requirements of international standards. Inspections are carried out at every stage of production by the technology laboratory and dedicated testing stations along the production chain. All incoming raw materials are tested to ensure their suitability for the tile body mix, and ongoing quality checks monitor key parameters such as moisture, density, and dimensional accuracy.

Finished products are subjected to detailed evaluations based on specific quality indicators. These include tests for mechanical properties, chemical resistance, surface hardness, and water absorption, conducted in accordance with UNI EN ISO international standards. External laboratories are also engaged to perform advanced characterization tests, ensuring the reliability and precision of the results.

The quality system at all Gresmalt facilities is certified to meet UPEC standards, enabling the development of products tailored to customer requirements. This certification, alongside regular audits and stringent internal protocols, demonstrates Gresmalt's commitment to product durability, performance, and customer satisfaction. Regular assessments by customers, including testing and external laboratory analysis, further validate the company's adherence to declared quality and performance standards.

By fostering a culture of excellence and continuous improvement, Gresmalt guarantees products that meet the highest expectations in terms of technical, aesthetic, and environmental performance.

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3. Goal and Scope of EPD

The entire life cycle of the product is considered (Type of EPD: cradle to grave) and the modules described below are declared in this EPD:

*Modules **A1-A3** include those processes that provide energy and material input for the system (A1), transport up to the factory gate of the plant (A2), manufacturing processes as well as waste processing (A3).*

*Module **A4** includes the transport from the production site to the customer or to the point of installation of the tiles.*

*Module **A5** considers all tile installation steps (like adhesives consumption) also packaging waste processing (recycling, incineration, disposal). Credits from energy substitution are declared in module D. During this phase a ceramic material loss of 6,5% has been considered.*

*Module **B2** includes the cleaning of the tiles. Provision of water, cleaning agent for the cleaning of the tiles, incl. waste water treatment are considered.*

*Module **C1** concerns the process of demolition and de-construction of the tiles from the building. It is not considered relevant for the environmental impacts.*

*Module **C2** considers transportation of the discarded tile to a recycling or disposal process.*

*Module **C3** considers every process (collection, crushing process etc.) properly for recycling the tiles.*

*Module **C4** includes all the landfill disposal processes, including pre-treatment and management of the disposal site.*

*Module **D** includes benefits from all net flows in the end-of-life stage that leave the product boundary system after having passed the end-of-waste stage. Loads from packaging incineration (A5) and resulted energy credits (electricity and thermal energy) are declared within module D.*

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END-OF-LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

MND: MODULE NOT DECLARED

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EPD TYPE:
The type of EPD is a specific EPD for the product “Porcelain Stoneware Ceramic Tiles 8.2 mm thickness” produced in the Gresmalt Group's plant in Scandiano (RE). All data refer to production and sales from July 2023 to June 2024.
According to the PCR ICMQ-001/15 rev. 3.1 the LCA study and the relative EPD, is “cradle to grave”. Modules included are A1, A2, A3, A4, A5, B1-B7, C1, C2, C3, C4 and D. All manufacturing activities and packaging/auxiliary’s production are in module A3, while energy production and input materials are in A1. Transport to clients (A4) and installation (A5) are included together with end-of-life scenarios (benefits and loads included according to D module).

GEOGRAPHICAL VALIDITY:
Performance was calculated with reference to the company sites. The reference market is worldwide.

DATABASE: Managed LCA Content (GaBi Database) (version 2023.2)

SOFTWARE: LCA for Expert (GaBi) (version 10.7)

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4. Detailed product description

Gresmalt Group focuses its production on porcelain stoneware tiles for floors and walls. Porcelain stoneware is a ceramic material with a compact structure, which is particularly resistant and long-lasting.
The porcelain stoneware manufactured by Gresmalt complies with the technical specifications established by standard EN 14411 (ISO 13006) and appendix G to ISO 10545 for dry pressed ceramic tiles with low water absorption (≤ 0.5%), group Bla.

MANUFACTURING PROCESS DESCRIPTION:
The Gresmalt Group production process is a complete cycle that begins with the processing of raw materials extracted from in quarries and culminates in the logistics for the distribution of the finished products:

- **Storage:** After quarrying, the raw materials which will used to make the ceramic tiles are transported to the factory and stored in designated indoor areas, separated into batches based on their type.
- **Grinding:** The raw materials are mixed and ground with water in continuous rotary mills until a solid/ liquid suspension called slurry is obtained.
- **Spray drying:** Next, special pumps are used to send the slurry to a vertical dryer for dry-spraying, which facilitates rapid evaporation of most of the water.
- **Shaping:** The tiles are shaped into the desired dimensions by the pressing process, which is designed to compact the powders.
- **Drying:** During the drying step, the remaining water in the ceramic mix (about 6-7%) is removed from the shaped product, as required to ensure the tiles' integrity.
- **Glazing:** Glazing and decoration consist in the application of glazes and inks to the surface of the previously pressed and dried tiles.
- **Firing:** The pressed, glazed, and decorated tiles are taken to the kilns for firing at temperatures reaching 1.210-1.230°C employing cycles of different durations depending on their format.
- **Final processing:** After firing, the tiles may undergo additional processing: cutting, rectification, brushing, lapping/honing.
- **Packaging:** Afterwards, the products are grouped into quality classes and placed in homogeneous batches, before being sent for packaging and final distribution.

Through the implementation of Internet of Things (IoT) technologies, the Group can collect detailed data about flows of materials, energy usage (heat and electricity), and emissions into the atmosphere for each step described.

The digitisation of manufacturing plants, in line with the Industry 5.0 approach, has involved the installation of smart meters for each machine to monitor real time energy

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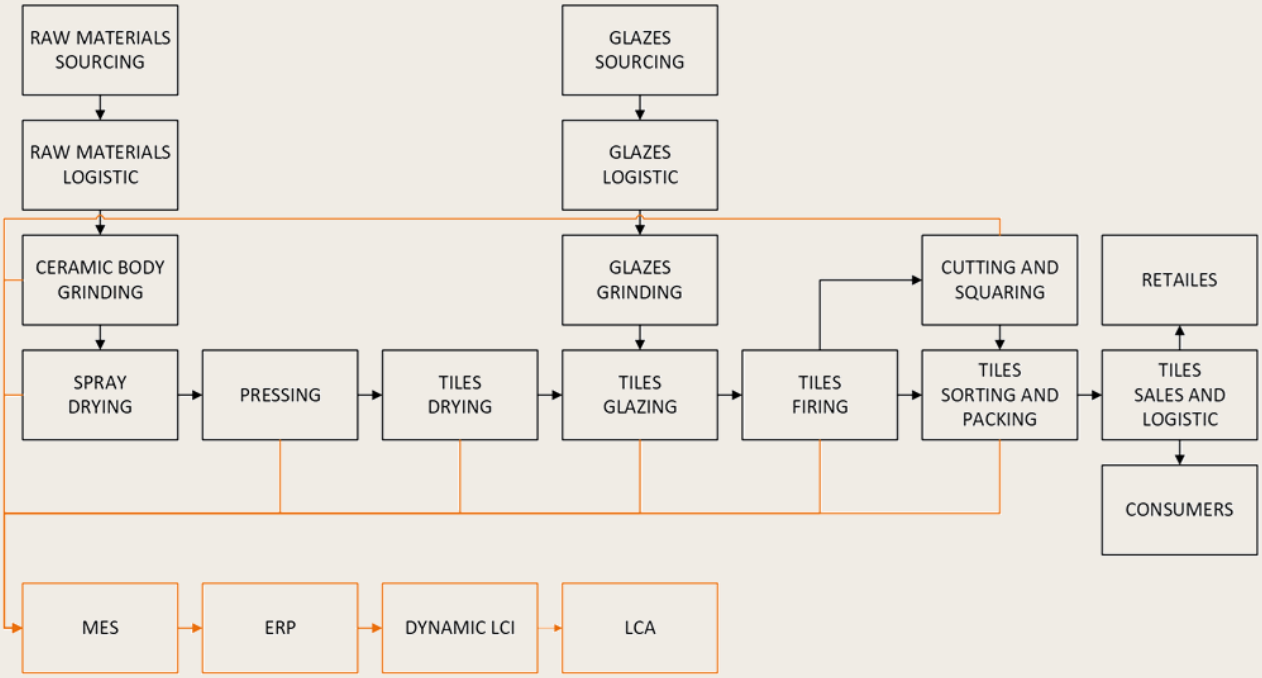
consumption in and collect production data. This network of sensors is wirelessly connected to the MES (Manufacturing Execution System), a computer system that governs and controls the entire production process, from order placement to the finished product, aligning business management needs with those of the factory and, therefore, bridging the gap between those who make the decision and those who implement them. The MES is in turn integrated with the ERP (Enterprise Resource Planning) and provides real-time data on the implementation of the processes to allow, in addition to management of current operations, the analysis of the stock to assess environmental impacts (LCA, Life Cycle Assessment).



HEALTH AND SAFETY OF WORKERS:

Ensuring the health and safety of workers is a core priority for Gresmalt and is achieved through rigorous compliance with applicable regulations, particularly Italian Legislative Decree 81/08 and subsequent amendments, as well as adherence to state-region agreements. The company is committed to creating a safety-oriented culture aimed at preventing injuries and accidents, integrated into its organizational framework and operational practices.

Risk assessments are conducted for each plant and documented in the Risk Assessment Documents (RAD), addressing chemical, physical, and biological hazards typical of the ceramics sector. Regular quarterly inspections are carried out by supervisors to identify potential risks, with corrective actions included in annual improvement plans.

A robust system is in place for managing workplace accidents. When an incident occurs, a detailed report is prepared, followed by a verification inspection involving safety

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managers and department representatives. Improvement measures are implemented based on these evaluations, ensuring a continuous enhancement of workplace safety.
Training on health and safety is a key focus at Gresmalt. Workers undergo tailored training programs aimed at addressing specific risks in their roles, contributing significantly to the reduction of accidents. Employee health is also closely monitored by an occupational doctor, with mandatory pre-hire and annual medical exams.

ENVIRONMENTAL PROTECTION:
Gresmalt is deeply committed to responsibly managing the environmental impact of its operations through an Environmental Management System compliant with ISO 14001:2015 and all applicable national and international regulations.
By continuously investing in energy efficiency, renewable energy generation, and enhancing the circularity of its production processes, the company is progressively reducing its environmental footprint.
The three production sites operate under the Integrated Environmental Authorization (IEA) scheme, implementing Best Available Techniques (BAT) to monitor performance, document results, and share them with relevant authorities. Advanced digital tools for data collection ensure precise monitoring of energy and water consumption, enabling the creation of detailed monthly reports to optimize operations.

Emissions management:
Gresmalt takes proactive measures to minimize the environmental impact of emissions, employing state-of-the-art technologies such as dust abatement systems, fabric bag filters, and wet abatement systems. Additionally, hydrated lime is used to reduce fluoride emissions from the firing process. Continuous and periodic monitoring ensures compliance with applicable regulations, controlling emissions of particulate matter, nitrogen oxides, sulfur oxides, carbon monoxide, and other substances.
Through significant investments, the company has substantially reduced CO_2 emissions by leveraging IoT technologies and Industry 5.0 models to enhance energy efficiency. Furthermore, alarm systems at the Scandiano and Frassinoro plants have been implemented to detect and signal emissions exceeding thresholds voluntarily set 80% lower than legal limits.

Energy consumption:
Gresmalt is committed to maximizing energy efficiency by reducing electricity and natural gas consumption per unit of product. The company employs innovative technologies and advanced organizational models to achieve these goals.

A combined heat and power (CHP) system produces both electricity and heat efficiently, recovering combustion fumes to power the spray dryers in the ceramic tile preparation process. Additionally, a 3 MWp photovoltaic system was installed at the Scandiano plant to further integrate renewable energy into production processes.

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Water usage:
Optimizing water consumption is a priority for Gresmalt, which fully recycles wastewater generated during its operations and incorporates wastewater from other ceramics manufacturers. Currently, 87% of the water required for grinding raw materials is sourced from recycled wastewater, with the remaining 13% coming from wells or the mains supply.
At the Scandiano plant, external wastewater is received and treated to ensure its suitability for production through rigorous conductivity and density testing.

Raw materials usage:
To reduce the environmental impact of its products, Gresmalt fosters sustainability across its supply chain by increasing the use of recycled raw materials. Certified secondary raw materials exceed 30% of the total mix since October 2023, and this proportion continues to grow as part of the company's commitment to circular economy principles. By incorporating raw and fired waste back into the ceramic body mix, Gresmalt reduces its reliance on new raw materials while maintaining high product quality.
Over 70% of raw materials are nationally sourced, and European clays are primarily transported by rail, reducing environmental impact throughout the product lifecycle.

Packaging:
Gresmalt's packaging is the result of an attentive R&D process, aimed at combining protection, sustainability and functionality. The use of cutting-edge machines and environmentally sustainable materials allow us to package our products in such a way as to:

- Protect the ceramic product during the transport and handling phases
- Ensure safety for operatives along the entire supply chain
- Contain the information required by reference standards
- Contain information required by the product users
- Have a reduced impact on the environment

In particular, as regards the aspects of use of materials from recycling processes and recyclability, the packaging of all our collections uses:

- Cartons which are 100% derived from FSC-certified recycling and 100% recyclable
- Plastics which are 80% derived from recycling and 100% recyclable
- Inks which are 100% plant based
- PEFC-certified wooden EPAL pallets, 100% recyclable

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Circularity of the production process:
The ceramic production process at Gresmalt demonstrates a high level of circularity. The company continuously seeks innovative ways to further enhance this aspect. All internal wastewater is fully recycled, supplemented by wastewater from external sources, and reused in a continuous cycle until complete evaporation.
Raw and fired production waste is entirely recycled and reused in compliance with regional regulations, contributing to the circular economy. Additionally, Gresmalt collaborates with suppliers to increase the percentage of externally sourced recycled materials in its products, with significant portions of secondary raw materials.

TECHNICAL DATA:
The products covered by this document comply with the following specifications:

Name	Value	Unit
Shaping acc. to EN14411	Compliant	
Surface quality acc. to ISO 10545-2 § 7	> 95	%
Water absorption acc. to ISO 10545-3	< 0.5	%
Breaking Strength acc. to ISO 10545-4	> 1300	N
Flexural strength acc. to ISO 10545-4	> 35	N/mm^2
Resistance to surface wear – Glazed tiles acc. to ISO 10545-7	2 – 5 (depending on product)	class
Coefficient of linear thermal expansion acc. to ISO 10545-8	6.0×10^{-6}	$°C^{-1}$
Thermal shock resistance acc. to ISO 10545-9	Resistant	
Crazing resistance acc. to ISO 10545-11, glazed tiles	Resistant	
Frost resistance acc. to ISO 10545-12	Resistant	
Nonslip property (class A, B or C) acc. to. CEN/TS 16165	R9 – R10 – R11 – R12 – 0 – A – B – C (depending on product)	class
Bond strength/adhesion acc. to. EN 12004	> 0.5	N/mm^2
Impact resistance acc. to ISO 10545-5	> 0.85	m
Reaction to fire NO testing (CWT)	A1 – A1fl	class
Resistance to low concentrations of acids and alkalis acc. to ISO 10545-13	LA	class
Resistance to household chemicals and swimming pool salts acc. to ISO 10545-13	A	class
Resistance to low and high concentrations of acids and alkalis acc. to ISO 10545-13	HA	class
Resistance to staining acc. to ISO 10545-14	5	class
Release of lead and cadmium – Glazed tiles acc. to ISO 10545-15	Lead < 0.01 Cadmium < 0.05	mg/l
Moisture expansion acc. to ISO 10545-10	0.01	mm/m

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BASE MATERIALS / ANCILLARY MATERIALS:

Body raw materials:

- Clays: 40 – 46 %
- Feldspars: 15 – 17 %
- Sands and feldspars sands: 11 – 12 %
- Ceramic waste (unfired + fired): 8 – 10%
- Certified recycled raw materials: 20 – 23%

Glaze components:

- Powdered clays
- Powdered kaolins
- Powdered sodium-potassium feldspars
- Powdered quartz
- Powdered alumina
- Ceramic frits
- Ceramic stains

Auxiliary additives:

- Fluidifying agents
- Pigments for dry coloring
- Suspending agents
- Dispersants
- Binders
- Glaze fixers
- Primers for inkjet
- Mediums for digital inks

PRODUCT PROCESSING/INSTALLATION:

Tiles are fixed to the walls and floors surfaces using different materials and amounts, for example, dispersion and cementitious adhesives and mortars, sealants or liquid applied membranes. During the installation, no emissions occur and no health or environmental risks derive from ceramic tile installations.

RELEVANT CHARACTERISTICS DURING USE:

Fire resistance: In accordance with /EN 13501-1:2007+A1:2009/, ceramic tiles can be classified as fire resistance class A1 as they are non-flammable.
Coating ceramic tiles in the event of fire has been shown to reduce the heat input on them and thus the risk of collapse.
Water resistance: Ceramic tiles are insoluble materials and do not react with water.

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Strength: Porcelain stoneware tiles offer high mechanical strength and abrasion resistance.
Non-deformability: Porcelain stoneware maintains its original shape and size over time even when exposed to certain environmental conditions such as humidity.
Cleanliness and care: Porcelain stoneware does not require any special maintenance and is easy to clean and sanitise.

ENVIRONMENT AND HEALTH DURING USE:
Porcelain stoneware is an inorganic, chemically stable material that does not release VOCs (volatile organic compounds) or contain CMR SVHCs (substances of very high concern that are carcinogenic, mutagenic, or toxic for reproduction). Classified as A+, it undergoes a high-temperature firing process exceeding 1200°C, which eliminates any remnants of organic chemical compounds. As a result, ceramic is intrinsically inert and does not emit substances that are harmful to the environment or human health during its use.

DECLARED UNIT and REFERENCE FLOW:
The declared unit is 1 m^2 ceramic tiles for covering walls and floors for 1 year. The mass of the surface considered is 16.05 kg, while the thickness is 8.2 mm.

REFERENCE SERVICE LIFE (RSL):
The service life of tiles is typically more than 50 years (BNB 2011). Furthermore, according to the US Green Building Council, the useful life of tiles could be the same as the useful life of the building itself. Therefore, 60 years represents an alternative for tiles. The reported results consider the use of tiles for 1 year, multiplying the B2-values by 50 or 60 gives B2-values for 50 or 60 years. No RSL was defined according to ISO 15686.

MECHANICAL DESTRUCTION:
Ceramic tiles can be smashed mechanically, but no harmful damage on the environment is expected.

RE-USE PHASE:
After the demolition and deconstruction stage, ceramic tiles can be crushed and then used in a range of different applications, like concrete aggregates or road construction.

DISPOSAL:
According to the /European Waste Catalogue/ (EWC) ceramic tiles waste belongs to the group 17 “Construction and demolition wastes”, tiles and ceramic (code:17 01 03).

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5. LCA Results

In Life Cycle Assessment (LCA), various impact categories are utilized to evaluate the potential environmental effects of a product or process throughout its entire life cycle.

Among these, certain categories are particularly significant for the ceramic industry, due to its energy demands, water usage, and waste generation.

Below is a detailed description of these primary impact categories:

- **Global Warming Potential (GWP):** This metric quantifies the potential contribution of greenhouse gas emissions to climate change by measuring the radiative forcing over a specified time horizon, typically 100 years.
  It is expressed in kilograms of CO_2 equivalents (kg CO_2-eq). GWP accounts for gases such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), each weighted by its respective global warming potential relative to CO_2.

- **Freshwater Use (FW):** This category assesses the total consumption of freshwater resources throughout the life cycle of a product or process. It encompasses both direct water usage and indirect water consumption embedded in upstream processes, expressed in cubic meters (m^3).
  Evaluating freshwater use is crucial for understanding the potential impacts on water scarcity and the health of aquatic ecosystems.

- **Primary Energy Demand:** This indicator measures the total amount of primary energy extracted from the environment, differentiated into renewable and non-renewable sources.

  - **Primary Energy Renewable Total (PERT):** Represents the total renewable primary energy consumed, including sources such as solar, wind, hydro, and biomass, expressed in megajoules (MJ).
    Utilizing renewable energy sources can reduce environmental impacts and enhance sustainability.

  - **Primary Energy Non-Renewable Total (PENRT):** Denotes the total non-renewable primary energy used, derived from fossil fuels like coal, oil, and natural gas, also expressed in megajoules (MJ).
    Reliance on non-renewable energy sources is associated with resource depletion and higher environmental burdens.

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- **Non-Hazardous Waste Disposed (NHWD):** This category quantifies the amount of non-hazardous waste generated and disposed of during the life cycle of a product or process, expressed in kilograms (kg). Proper management of non-hazardous waste is essential to minimize environmental impacts such as land use and potential pollution.
- **Hazardous Waste Disposed (HWD):** Measures the quantity of hazardous waste produced and disposed of, expressed in kilograms (kg). Hazardous waste includes materials that pose significant risks to human health and the environment due to their toxic, corrosive, flammable, or reactive properties. Safe handling and disposal are critical to prevent adverse effects.

The tables below show the results of the LCA (Life Cycle Assessment). Basic information on all declared modules can be found in chapter 3.
You can convert the results per kg using the following conversion factor: 0.062

Environmental Impact indicators for 1m^2 of ceramic tile													
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP total	kg CO_2-eq.	2.24E+00	8.53E-01	5.17E+00	8.51E-01	2.90E+00	0.00E+00	1.18E-02	0.00E+00	1.41E-02	6.54E-02	3.87E-02	9.85E-02	-1.73E-01
GWP fossil	kg CO_2-eq.	2.23E+00	8.17E-01	5.89E+00	8.15E-01	1.93E+00	0.00E+00	8.90E-03	0.00E+00	1.35E-02	6.25E-02	3.88E-02	9.79E-02	-1.72E-01
GWP biogenic	kg CO_2-eq.	1.48E-02	3.58E-02	-7.18E-01	3.59E-02	9.73E-01	0.00E+00	2.85E-03	0.00E+00	6.16E-04	2.85E-03	-4.01E-04	2.74E-04	-6.61E-04
GWP luluc	kg CO_2-eq.	5.15E-04	5.18E-05	8.19E-04	5.07E-05	1.02E-03	0.00E+00	1.34E-06	0.00E+00	8.44E-07	3.99E-06	2.97E-04	3.09E-04	-1.06E-04
ODP	kg CFC-11-eq.	5.74E-12	2.60E-13	1.67E-12	9.62E-14	4.33E-12	0.00E+00	4.19E-14	0.00E+00	1.59E-15	7.49E-15	6.61E-14	2.53E-13	-1.39E-12
AP	mole of H^+-eq.	4.65E-03	3.47E-03	3.05E-03	1.81E-03	2.92E-03	0.00E+00	1.55E-05	0.00E+00	6.75E-05	9.37E-05	2.06E-04	7.05E-04	-3.30E-04
EP - freshwater	kg P eq.	2.06E-06	2.12E-07	1.73E-06	1.99E-07	8.67E-06	0.00E+00	3.56E-06	0.00E+00	3.25E-09	1.53E-08	1.34E-07	2.00E-07	-4.86E-07
EP - marine	kg N eq.	1.35E-03	1.50E-03	1.41E-03	5.16E-04	1.08E-03	0.00E+00	1.75E-05	0.00E+00	3.20E-05	3.75E-05	9.45E-05	1.82E-04	-1.08E-04
EP - terrestrial	mole of N eq.	1.49E-02	1.65E-02	1.56E-02	5.76E-03	1.22E-02	0.00E+00	4.59E-05	0.00E+00	3.51E-04	4.13E-04	1.04E-03	2.00E-03	-1.17E-03
POCP	kg NMVOC eq.	4.47E-03	3.12E-03	3.89E-03	1.45E-03	2.53E-03	0.00E+00	1.94E-05	0.00E+00	9.05E-05	8.96E-05	2.57E-04	5.49E-04	-3.37E-04
ADPE	kg Sb eq.	2.99E-05	1.08E-08	1.15E-04	1.01E-08	1.22E-05	0.00E+00	3.96E-10	0.00E+00	1.66E-10	7.85E-10	4.23E-08	4.59E-09	-1.36E-08
ADPF	MJ	1.21E+02	1.20E+01	6.56E+00	1.18E+01	1.68E+01	0.00E+00	1.98E-01	0.00E+00	1.93E-01	9.11E-01	7.77E-01	1.32E+00	-3.61E+00
WDP	m^3 world eq.	1.33E-01	3.35E-03	3.52E-01	1.97E-03	1.33E-01	0.00E+00	1.56E-03	0.00E+00	3.23E-05	1.53E-04	7.68E-03	1.09E-02	-1.21E-02

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

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Resource use indicators for 1m^2 of ceramic tile														
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	[MJ]	3.42E+00	1.25E-01	6.94E+00	7.55E-02	0.00E+00	0.00E+00	2.42E-02	0.00E+00	1.24E-03	5.88E-03	7.23E-02	2.16E-01	-8.47E-01
PERM*	[MJ]	0.00E+00	0.00E+00	4.45E-01	0.00E+00	-4.45E-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
PERT	[MJ]	3.42E+00	1.25E-01	7.39E+00	7.55E-02	3.66E+00	0.00E+00	2.42E-02	0.00E+00	1.24E-03	5.88E-03	7.23E-02	2.16E-01	-8.47E-01
PENRE	[MJ]	1.21E+02	1.20E+01	6.49E+00	1.18E+01	1.69E+01	0.00E+00	1.98E-01	0.00E+00	1.94E-01	9.14E-01	7.79E-01	1.32E+00	-3.61E+00
PENRM*	[MJ]	0.00E+00	0.00E+00	8.16E-02	0.00E+00	-8.16E-02	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]	1.21E+02	1.20E+01	6.57E+00	1.18E+01	1.68E+01	0.00E+00	1.98E-01	0.00E+00	1.94E-01	9.14E-01	7.79E-01	1.32E+00	-3.61E+00
SM	[kg]	3.82E+00	0.00E+00	2.38E+00	0.00E+00	4.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E+01
RSF	[MJ]	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	[kg]	5.32E-03	1.71E-04	9.32E-03	8.80E-05	4.21E-03	0.00E+00	5.62E-05	0.00E+00	1.45E-06	6.84E-06	2.22E-04	3.34E-04	-7.32E-04

* In order to balance the values of the PENRM and the PERM associated with the use of packaging, the values in module A5 (end-of-life of packaging) are negative.

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

Wastes input/output flows for 1m^2 of ceramic tile														
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3-B7**	**C1**	**C2**	**C3**	**C4**	**D**
HWD	[kg]	2.05E-07	4.30E-11	1.38E-09	2.23E-11	1.37E-08	0.00E+00	1.03E-11	0.00E+00	3.56E-13	1.68E-12	-2.02E-12	2.88E-11	-1.44E-10
NHWD	[kg]	1.67E-01	1.24E-03	2.30E-01	1.18E-03	1.20E+00	0.00E+00	6.04E-03	0.00E+00	1.93E-05	9.11E-05	2.05E-04	6.62E+00	-6.25E-01
RWD	[kg]	4.16E-04	7.67E-05	1.33E-04	1.96E-05	2.51E-04	0.00E+00	4.49E-06	0.00E+00	3.23E-07	1.52E-06	1.04E-05	1.51E-05	-1.69E-04
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	0.00E+00	0.00E+00	0.00E+00
MFR	[kg]	0.00E+00	0.00E+00	1.75E-02	0.00E+00	2.31E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E+01	0.00E+00	0.00E+00
MER	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E-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
EEE	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.56E-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
EET	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.96E-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

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

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Biogenic carbon content of product and packaging for 1m^2 of ceramic tile		
Parameter	**Unit**	**Value**
Biog. C in product	[kg]	0.00E+00
Biog. C in packaging	[kg]	1.19E-02

Caption	Biog. C in packaging = Biogenic carbon content in packaging; Biog. C in product = Biogenic carbon content in product

Additional indicators (PM, IR, ETF-fw, HTP-c, HTP-nc and SQP) have been calculated and can only be seen in the /Background Report/.

Disclaimer for EN 15804+A2: additional indicators

(1) Potential Human exposure efficiency relative to U235 (IRP): 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.

(2) The results of the environmental impact indicator: ADP, WDP, ETP-fw, HTP-c, HTP-nc, SQP shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

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6. Calculation rules

In Life Cycle Assessment (LCA), various impact categories are utilized to evaluate the potential environmental effects of a product or process throughout its entire life cycle.

REFERENCE FLOW:

Name	Value	Unit
Declared unit	1	m^2
Grammage	16.05	kg/m^2
Conversion factor to 1 kg	0.062	-

ASSUMPTIONS:
The modules from A5 to C4 are scenarios based on average data included into the PCR created by the “European Ceramic Tile Manufacturers Federation” /CET PCR 2014/ and subsequently implemented in the PCRb of the IBU program operator "Ceramic tiles and panels".

ELECTRICITY EMISSION FACTOR:
The emission factor used for electricity consumption in the production phase (modules A1–A3), referring to the Climate Change – total indicator (according to EN15804+A2, EF 3.1), is 2.66E-01 kg CO_2-eq / kWh.

CUT-OFF CRITERIA:
All significant material and energy flows within the system boundaries have been included. In accordance with the exclusion criteria set by the EN 15804 standard, material flows considered non-relevant, accounting for less than 1% of the total input mass, have been omitted. Specifically, the following CER codes have not been considered: 150203, 160213, 160304, 161106.

DATA QUALITY:
Most of the information (energy and water consumption, pollutant emissions, atomized dust, and ceramic production) are measured or calculated directly at the company level. Carbon dioxide emissions (related to carbonate oxidation) are collected through ETS (emissions trading system) reporting.

Detailed data were obtained not only for raw material mixtures (collected with company-specific primary data) but also for dyes, frits and other raw materials used.
The overall quality of the data can be considered satisfactory.

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PERIOD UNDER REVIEW:
The primary data collected in the study refer to the period between July 2023 and June 2024.

ALLOCATION:
Energy and material supplies have been allocated to the product based on annually produced mass of ceramic tiles. No further allocations have been applied within the subsequent module.

Moreover, some ceramic wastes are internally recycled; credits from energy recovery of packaging materials from the end-of-life of the product are taken into account.

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7. Scenarios

The following technical information about declared modules and related scenarios is based on average data, according to the “European Ceramic Tile Manufacturers Federation” and and subsequently implemented in the PCRb of the IBU program operator "Ceramic tiles and panels".

TRANSPORT (A4):
For transport distances of less than 300 km, trucks shall be assumed to make the return trip empty, whereas for distances exceeding 300 km, they will return full with other goods, so that the return trip is not included in the inventory of the system analysed.

Name	Quantity	Unit
Truck with domestic destination having a capacity of 27 tons (20.5% of tiles sold)	300	km
Truck with European destination having a capacity of 27 tons (48.5% of tiles sold)	1390	km
Transoceanic transport shipment (31% of tiles sold)	6520	km

INSTALLATION INTO THE BUILDING (A5):
Three options are defined for the installation phase, in which different materials can be used.

- Option 1: adhesives, mortar and water;
- Option 2: mortar and polysulphide dispersion adhesives;
- Option 3: cement adhesives (different quantities for different tile sizes).

These considerations are based on average data provided by different ceramic tile manufacturers in Europe. In this EPD it is assumed that tiles are installed with cementitious adhesive (Option 3).

Option 3 (large format tiles)	Quantity	Unit
Cementitious adhesives	6	kg

For the treatment of packaging waste, an average European scenario is used, taken from "Eurostat, 2020"; thus end-of-life consists of recycling, energy recovery and landfill for plastic and paper, and reuse, energy recovery and landfill for wood.
The loss of ceramic material considered is 6.5%.

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MAINTENANCE (B2):
Only stage B2, the maintenance phase, is considered in terms of impact generation. Throughout its lifetime, the ceramic cladding product must be cleaned regularly, to a greater or lesser extent, depending on the type of building (residential, commercial, etc.) in which it is installed. If the surface is dirty or greasy, cleaning agents such as detergents or bleach can be added. In this way, the consumption of water and disinfectant chemicals has been taken into account.

Name	Value	Unit
Water consumption	0.1	l
Detergent	0.2	ml
Floor tile Maintenance cycle	52	Number/LS
Wall tile Maintenance cycle	4	Number/LS

END-OF-LIFE (C1-C4):
C1: This module considers the demolition phase considering an excavator (100kW) with a consumption of diesel of 1.72E-04 per kg of product and all the emissions connected with the fuel burning process.
C2: The ceramic tile demolition waste is transported from the building site to a container or treatment plant by truck and an average distance of 20 km is considered. The return trip shall be included in the system. It can be considered an average distance of 30 km from the container or treatment plant to final destination.
C3-C4: the table below show the end-of-life stage.

Name	Value	Unit
Recycling percentage (C3)	70	%
Landfill percentage (C4)	30	%

BENEFITS AND LOADS BEYOND THE PRODUCT SYSTEM BOUNDARY (D):
Module D includes credits from materials recycling of products and packaging, energy credits from thermal recovery of the packaging.

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8. Other Additional Enviromental Information

MINIMUM ENVIRONMENTAL CRITERIA (MEC - CAM):
With the Italian Decree of June 23, 2022, published in the Official Gazette on August 6, 2022, and in force since December 4, 2022, the Italian Ministry of Ecological Transition (now the Ministry of Environment and Energy Security) updated the Minimum Environmental Criteria (MEC - CAM) for public procurement related to the design, construction, and maintenance of buildings.

The MEC are a key tool within the national Green Public Procurement (GPP) strategy, aimed at promoting the production and use of products and services with a lower environmental impact.

In accordance with Article 34 of Legislative Decree No. 50 of April 18, 2016 (Public Procurement Code), contracting authorities must include in the tender documents specific technical specifications and contractual clauses defined by the Decree of June 23, 2022, prioritizing solutions that promote environmental sustainability.
Starting from January 1, 2024, ceramic tiles must comply with the criteria set out in Decision 2021/476, which establishes the criteria for granting the European Union Eco-label (EU Ecolabel) to products for hard coverings.
For ceramic tiles, the following minimum environmental criteria are provided:

- **1.1 Extraction of industrial and construction minerals:** The applicant must provide an environmental impact assessment, relevant permits for extraction, a site recovery plan, and a map showing the location of the quarry. Additionally, they must submit declarations in compliance with EU regulations on invasive species and the Habitat and Birds directives.

- **1.2 Restricted Substances:** Manufacturers must assess all chemical substances used in the production process and verify their compliance with applicable hazard classifications. Substances of Very High Concern (SVHC), as well as those classified under specific CLP hazard classes, must not be present above defined thresholds unless derogations apply. Supporting documentation must be collected and available for review.

- **1.3 VOC emissions**: The use of surface treatments containing volatile organic compounds (VOC), especially formaldehyde-based resins, is restricted. Products subject to such treatments must undergo emission testing in accordance with EN

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16516, and must comply with specific indoor air quality limits. Products not treated or considered inherently emission-free are exempt from testing.

- **1.4 Fitness for use:** Construction products must meet the technical performance requirements relevant to their intended application. Manufacturers are required to apply quality control systems, hold CE marking where applicable, and provide documentation on product conformity. A system for managing customer complaints must also be in place.

- **1.5 User information:** Clear and accessible information must be provided to end users to ensure correct installation, use, maintenance, and disposal of the product. This includes technical performance data, recommended materials and techniques, and environmental guidance on end-of-life management and packaging waste.

- **1.7 Environmental management system:** The presence of a certified environmental management system, such as ISO 14001 or EMAS, demonstrates a structured approach to monitoring and improving the environmental performance of the production site.

- **4.1 Fuel consumption for drying and firing:** This criterion establishes limits on the specific fuel consumption in energy-intensive phases of production. The use of high-impact fuels (e.g. coal, petroleum coke, heavy fuel oil) is prohibited. Consumption must be monitored and reported per unit of product using standardized methodologies.

- **4.2 CO_2 emissions:** CO_2 emissions from thermal processes must be calculated using standardized emission factors based on the type and amount of fuel used. The resulting emission values must comply with defined thresholds to support climate mitigation objectives.

- **4.3 Process water consumption:** To promote efficient water use, manufacturers must implement systems that reduce freshwater consumption through the collection and reuse of process water. Closed-loop systems are encouraged and considered best practice.

- **4.4 Air emissions:** Emissions to air, including dust, fluorides (HF), nitrogen oxides (NO_x), and sulfur oxides (SO_x), must be controlled through appropriate abatement technologies. Emission levels must remain below defined thresholds and be verified through regular monitoring.

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- **4.5 Wastewater management:** Manufacturers must manage process wastewater through either full internal reuse (zero-liquid discharge) or treatment systems that ensure compliance with specific quality parameters prior to discharge or external transfer.

- **4.6 Recycling of process waste:** A significant share of the solid waste generated during production must be reused within the process or recovered externally. The criterion aims to reduce landfilling and promote circular economy approaches in the sector.

- **4.7 Glazes and inks:** For products that are glazed or decorated, the composition of glazes and inks must meet strict limits on the content of hazardous substances, particularly lead and cadmium. Compliance must be demonstrated through documentation from suppliers and/or laboratory analysis.

The products manufactured by Gresmalt comply with all applicable Minimum Environmental Criteria for ceramic tiles.

Criterion	Compliance Summary
1.1 Extraction of raw materials	Raw materials come from authorized quarries. All applicable environmental documentation is collected and available.
1.2 Restricted substances	No substances of very high concern (SVHC) above 0.10% w/w are used. Safety data sheets and supplier declarations are verified and archived.
1.3 VOC emissions	No VOC-based surface treatments are applied. Tiles are inert and emission-free due to high-temperature firing.
1.4 Fitness for use	Products are CE marked (EN 14411). The company operates an ISO 9001-certified quality system, with process and product controls and complaint handling.
1.5 User information	Information on performance, installation, cleaning, maintenance, and disposal is available through product documentation and the company website.
1.7 Environmental management system	The production site is certified under ISO 14001, demonstrating structured environmental performance management.
4.1 Fuel consumption	Fuel used for spray drying, drying, and firing is monitored and complies with MEC thresholds.
4.2 CO_2 emissions	CO_2 emissions are calculated based on actual fuel use and remain below MEC limits.
4.3 Process water consumption	All process water is collected and reused through a closed-loop system, ensuring zero liquid discharge.
4.4 Air emissions	Emissions of dust, HF, NO_x, and SO_x are controlled through abatement systems and regular monitoring. All values meet MEC requirements.

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4.5 Wastewater management	Wastewater is not discharged or treated externally. It is entirely reused in the production cycle.
4.6 Recycling of process waste	More than 90% of process waste is reused internally or sent for external recovery, with traceability ensured.
4.7 Glazes and inks	Glazes and inks comply with MEC thresholds for lead and cadmium. Compliance is verified through SDS and supplier declarations.

The following table documents compliance with the threshold values set by the MEC for all criteria with quantitative requirements.

Requirement	Parameter	Declared Value	Exclusion threshold	Excellence threshold	Unit
4.1 Fuel consumption	Spray drying	< 1.3	1.8	1.3	MJ/kg
	Drying and firing	< 4.3	5.5	4.3	MJ/kg
4.2 CO_2 emissions	Spray drying	< 54	84	54	$kgCO_2/t$
	Drying and firing	< 290	360	290	$kgCO_2/t$
4.4 Air emissions	Dust (spray drying)	< 90	90		mg/kg
	Dust (kiln)	< 10	50	10	mg/kg
	HF (kiln)	< 6	20	6	mg/kg
	NO_X (kiln)	< 170	250	170	mg/kg
4.6 Recycling of process waste		> 90	90		%
4.7 Glazes and inks	Lead	< 0.10	0.10		%
	Cadmium	< 0.10	0.10		%

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Reference

EN 15804+A2	EN 15804:2012+A2:2019: Sustainability of construction works -Environmental Product Declarations - Core rules for the product category of construction products
EN ISO 14025	EN ISO 14025:2011-10 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
EN ISO 14040	EN ISO 14040:2009-11 Environmental management - Life cycle assessment - Principles and framework
EN ISO 14044	EN ISO 14044:2006-10 Environmental management - Life cycle assessment - Requirements and guidelines
LCA for Expert (GaBi)	Life cycle assessment software (version 10), by Sphera Solutions GmbH, Leinfelden-Echterdingen, 2023 https://sphera.com/life-cycle-assessment-lca-software/
Managed LCA Content (GaBi database)	Life cycle assessment database, by Sphera Solutions GmbH, Leinfelden-Echterdingen, 2023 https://sphera.com/life-cycle-assessment-lca-database/
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BNB 2011	BBSR table "useful lives of components for Life Cycle Analysis by BNB ", Federal Institute for Building, Urban Affairs and Spatial Development, Division II Sustainable Building; available online at http://www.nachhaltigesbauen.de/baustoffundgebaeudedaten/useful lives-of-bauteilen.html; stand 12/2015
US GBC	US Green Building Council, Leed v3, 2009, Whole building life cycle assessment. LEED BD&C v4 (LEED Building Design & Construction).
PD CEN/TR 15941:2010	Sustainability of construction works – Environmental Product Declarations – Methodology for selection and use of generic data
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IBU PCR Part B	Part B: Requirements on the EPD for Ceramic tiles and panel 19/10/2023. www.ibu-epd.com
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