ENVIRONMENTAL PRODUCT DECLARATION

Product Name: CERAMIC TILES

Site Plant: FIORANO – tiles line
Via Ghiarola Nuova n° 29 – 41042 Fiorano M.se (MO) Italia

in compliance with ISO 14025 and EN 15804

Program Operator:	EPDItaly
Publisher:	EPDItaly

Declaration Number:	EMI_FIO_18_0001
EPDItaly Registration Number:	EPDItaly0103

Issue Date:	11/02/2020
Valid to:	11/02/2025

1. GENERAL INFORMATIONS

EPD OWNER:	Emilceramica S.r.l. a socio unico via Ghiarola Nuova, n° 29 - 41042, Fiorano M.se (MO), Italy
PLANT INVOLVED IN THE EPD:	Plant of Fiorano – tiles line via Ghiarola Nuova n° 29 – 41042 Fiorano M.se (MO), Italy
FIELD OF APPLICATION:	Ceramic tiles, object of this study, are intended to be applied to both floor and wall claddings and to be installed both indoors and outdoors for residential, non-residential and commercial use.
PROGRAM OPERATOR:	EPDITALY **(www.epditaly.it)** via Gaetano De Castillia n° 10 - 20124 Milano, Italy
EXTERNAL AUDIT:	This declaration has been developed referring to EPDItaly, following the General Program Instruction; further information and the document itself are available at: www.epditaly.it. CEN standard EN 15804 served as the core PCR (PCR ICMQ-001/15 rev 2.1). PCR review was conducted by Daniele Pace - info@epditaly.it Independent verification of the declaration and data, according to EN ISO 14025:2010. ❒ Internal ☒ External Third party verifier: ICMQ S.p.A., via Gaetano De Castillia n°10 - 20124 Milano, Italy (www.icmq.it). Accredited by: Accredia.
CPC CODE:	37370
COMPANY CONTACT:	Silvia Serri via Ghiarola Nuova, n° 29 - 41042, Fiorano M.se (MO), Italy info@emilceramicagroup.it
TECHNICAL SUPPORT:	thinkstep Italia sphera via Bovini n°41, Ravenna (IT) **www.thinkstep.com**
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.
LIABILITY:	Emilceramica S.r.l. relieves EPDItaly from any non-compliance with the environmental legislation self-declared by Emilceramica. The holder of the declaration will be responsible for the information and supporting evidence; EPDItaly disclaims any liability regarding the manufacturer's information data.
REFERENCE DOCUMENT:	This declaration is based on the EPDItaly regulation, available on the website www.epditaly.com
PRODUCT CATEGORY RULES (PCR):	PCR ICMQ-001/15 rev. 2.1 IBU PCR Parte B:30-11-2017 V1.6 The EN 15804 standard constitutes the framework reference for the PCR.

2. THE COMPANY

Emilceramica – Headquarter

Founded in 1961, Emilceramica is a company that in over 50 years of history has established itself as one of the benchmarks of the Italian ceramic industry. Its strategy of constant technological innovation and commercial openness has over time contributed to consolidating its leadership, positioning the company in the market segment defined as "top of the range". In its production facilities, with a capacity of over 9 million square metres per year, it designs, develops, produces and distributes porcelain stoneware tiles and slabs.

Today the company is very actively involved at an international level, with a percentage of exports exceeding 80% of its products marketed through the EMILCERAMICA, ERGON, PROVENZA, VIVA and LEVEL brands. Present in over 5500 sales outlets in more than 70 countries around the world, in order to promptly satisfy requests from 4 continents, Emilceramica has set up a number of subsidiaries that operate in full synergy with the Italian headquarters: Emil Germany, covering the German market; Emil America, serving the North American market with 4 distribution hubs located throughout the country and a dedicated sales team; Emil Asia, based in Hong Kong to serve the Asian market; Emil Russia and Emil India complete Emilceramica international presence.

The company has about 450 employees and two production sites in Italy; every year it invests and dedicates specialized technicians to the development of new refined and original ceramic solutions, drawing inspiration from materials of various kinds - woods, quartzes, cements, marbles, textiles - to express creativity and elegance in the name of Made in Italy excellence. Attention to detail is Emilceramica great passion, curiosity and attention to new trends are fundamental elements for its innovative ideas and original proposals.

With dedication, the research and development team transform ideas into new projects and products, paying attention to every detail in the various phases of design and industrial production.
After a careful selection of the most valuable raw materials, production goes live with meticulous mixing, grinding, drying, glazing and digital printing operations using cutting-edge technology. The materials are then fired and finally individually controlled by optical systems of absolute precision, under the supervision of specialized operators.

Since April 2017 Emilceramica has been part of Mohawk Industries Inc., the world's leading industrial group in the flooring sector, listed on the New York Stock Exchange.

Management systems, environmental and quality labels:

Emilceramica obtained in 1997 the certification of its Quality Management System in compliance with ISO 9001: the guiding principle of all company activities is the satisfaction of its customers' needs with products of innovative design and reliable quality standards, obtained through the continuous improvement of products and processes.

In 2011 Emilceramica certified its Environmental Management System implemented in accordance with ISO 14001. The company is committed to defining products and processes aimed at constantly reducing their environmental impact through the recovery of wastewater, the reuse of processing waste and sludge, the cogeneration of electricity, the predominant use of recycled materials in paper and plastic packaging, the conscious choice of raw materials, plants and machinery, and process optimization.

In addition to complying with the provisions of current health and safety legislation, Emilceramica has strengthened its commitment by adopting the additional requirements of the BS OHSAS 18001 standard and obtained certification of its Management System for the Health and Safety of Workers in 2014.

Lastly, in 2016, Emilceramica certified its Energy Management System implemented in accordance with ISO 50001, a tangible sign of its daily commitment to the conscious, careful and responsible use of energy.

Products by Emilceramica comply with the following standards:

- /2014/C 259/01 Regulation (EU) No 305/2011/ of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC.
- /ISO 13006/ Ceramic tiles - Definitions, classification, characteristics and marking
- /EN 14411/ Ceramic tiles - Definitions, classification, characteristics, evaluation of conformity and marking
- /QB32 Marque QB/ Annexe technique et administrative de la certification QB: Carreaux céramiques pour revêtements de sol
- /DEVL1104875A/ Ministère de l'écologie, du développement durable, des transports et du logement - Arrêté du 19 avril 2011 relatif à l'étiquetage des produits de construction ou de revêtement de mur ou de sol et des peintures et vernis sur leurs émissions de polluants volatils
- /GREENGUARD GOLD/ Indoor Air Quality Certification - ASTM Standards D-5116 and D-6670;
- /SAUDI QUALITY MARK/ SASO-ISO 13006 and QMS – CR – 10 – 14 (Saudi Standards, Metrology and Quality Organization, Process of Granting Utilization Permit for a Ceramic Tiles)
- /CNCA-C21-01/ Implementation rules for porcelain tiles
- /TIS.2508-2555/ Thai Industrial Standard - Ceramic tiles

3. SCOPE AND TYPE OF EPD

The entire life cycle of the product (type of EPD: « cradle-to-grave ») and the Modules described below are considered:

*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, water consumption, ancillary materials, as well as waste processing, liquid and gas emissions (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 and material substitution are declared in module D.*

*Module **B1** considers the use of tiles. During the use of ceramic tiles, no hazardous indoor emissions are expected to occur.*

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

*Modules **B3-B4-B5** are related to the repair, replacement and refurbishment of the tiles. If the tiles are properly installed no repair, replacement or refurbishment processes are necessary. For this reason, Modules B3-B4-B5 are not considered.*

*Modules **B6-B7** consider energy use for operating building integrated technical systems (B6) and operational water use for technical building-related systems. No operational energy or water use are considered. Cleaning water is declared under B2.*

*Module **C1** is not relevant for the environmental impacts, as it regards demolition and de-construction process of the tiles from the building.*

*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 (Module 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

TYPE OF EPD:

This declaration refers to a ceramic porcelain tile as average between the products Emilceramica S.r.l. manufactured at the production plant Fiorano, with the exclusion of the series realized with the technology of the "Large Slabs" production line.

GEOGRAPHICAL VALIDITY:

Performance has been calculated in reference to the plant of Fiorano. The reference market is "global".

DATABASE USED: GaBi 2019 SP39

SOFTWARE:

EPD process Creator, implemented using the GaBi professional 9.2 e GaBi Envision 3.0 software. The identification code of the EPD process tool used is: **Marazzi Group EPD Process Tool – V3 of 28/01/2020.**

EPD PERFORMED WITH VALIDATED CALCULATION ALGHORITM:

In 2020 Emilceramica S.r.l. implemented and certified a process for the drafting of EPDs based on data processed by a calculation algorithm validated and certified by ICMQ S.p.A., in accordance with EPDItaly requirements. The process is based on automatic data collection at the plants, subsequently integrated, verified and validated in accordance with internal procedures.
This EPD has been prepared using the results generated automatically by the Tool, for the selected product(s), in order to assess the environmental impacts in relation to their specific use.

4. DETAILED PRODUCT DESCRIPTION

Emilceramica ceramic tiles are manufactured mainly from natural raw materials as clay, feldspar and sand. Specifically, porcelain stoneware has a water absorption level of less than 0.5%.

DESCRIPTION OF THE PRODUCTION PROCESS:

The manufacturing process of the Fiorano site is a partial ceramic cycle which begins with the pressing stage of the spry dried powder received by other plants of Emilceramica S.r.l. and Marazzi Group S.r.l. The data relating to the spray dry production phases are included in the "Marazzi Group EPD Process Tool – V3" and considered in the calculation of impacts.

Entry, storage and production of raw materials

The incoming raw materials are stored in piles inside covered sheds. The dosing of the components for the input in the production cycle is carried out by automatically controlled weighing systems, which implement previously programmed recipes.

Raw material grinding

The raw materials are finely chopped with a wet milling process in continuous drum mills, with the use of suitable grinding bodies. The slip obtained at the end of the grinding (called "barbottina") is stored in tanks out of ground in reinforced concrete and continuously moved by agitators.

Spray Drying

This phase consists of spray drying in streams of hot air (about 600 ° C) of the slip to obtain the semi-finished "mixture" (powders), having dimensional characteristics and water contents suitable for the subsequent phase of pressing the tiles. The residual humidity of the spry-dried powder mix obtained is normally between 5% and 6.5%. The product is stored in silos, from which it is transferred to the pressing departments.

Pressing

The forming process (pressing) consists in the transformation of the atomized powders into real ceramic bodies, the shape and size of the tile are determined by moulds on hydraulic presses. The atomized powders arrive at the presses from the storage plants located upstream, after having been sieved and stationed in a hopper that acts as a lung for loading the presses themselves. Under the hopper runs the charging slide which, at each pressing cycle, has the double function of loading the atomized powders into the cells of the fixed part of the mould and then ejecting the newly formed tiles. The pressing phase consists in the descent of the mobile part of the mould towards the fixed part in which the atomized powder has been loaded. The movable part impresses a pressing force that compacts and thus forms the atomized powders; the newly pressed tiles are transported to the dryer by means of roller conveyors.

Drying

The drying process has the function of removing residual moisture from the mix (necessary during the forming phase of the ceramic piece) in a controlled manner, to respect the integrity of the piece and its dimensional regularity. The drying of the support is carried out by means of a flow of hot air, generated by fans and burners which, exploiting the convection exchange with the tiles, allows to obtain a product suitable for the following processing phases (glazing and firing). The tiles come out of the dryer while still hot and are transported to the glazing lines by means of trapezoidal belts.

Preparation of glazes

The technological process of glaze production consists of the transformation of mixtures of natural and synthetic raw materials into an aqueous suspension. The latter must meet all the rheological requirements necessary to be applied to the tile during the glazing process. The mixture of raw materials must respect, both from a qualitative and quantitative point of view, the indications contained in a recipe commonly called formulation.
The glaze grinding process involves the introduction inside the mill (a cylinder arranged to rotate around a central axis and filled for about half of its internal volume with the so-called grinding charge) of the solid raw materials defined in the formulation and a well determined quantity of water. The glazes are stored in tanks or tubs and are ready to be sent to the production lines.

Glazing

The glazes are delivered to a special storage area or directly to the glazing department by pumping or transferring them into tubs where they are kept in constant movement by means of mechanical stirrers, or in bins. The raw tiles leaving the dryer proceed along the glazing line where they are glazed with traditional technology and/or decorated with digital printing. Wet and dry glaze applications follow one another along the line until the desired raw product is obtained ready to be transferred to the kiln for firing. Often, in order to reduce the humidity given to the tiles by wet glazing, it is necessary that the tiles are placed inside the drying cells before moving on to the firing phase.

Firing

The firing of ceramic tiles has the purpose of carrying out the chemical-physical reactions that give the piece its final mechanical resistance (firing of the support) and the surface its final technical-aesthetic characteristics.
The firing technique used at the site in question is that of "Single firing" (simultaneous firing of glaze and support) and continuous firing: the material enters the kiln, passes through different areas of the kiln in succession:

- Preheating (800°C)
- Combustion of organic substances
- Cooking (1200°C)
- Cooling (500°C)

The fired material, on leaving the kiln, is properly stored in special storage areas.

Mechanical processing

The grinding (also called squaring) is an operation of removing material from the sides of the fired tile, with the aim of bringing all the tiles to the same size. The purpose of the process is to eliminate all differences in size due to the variables of the upstream processes, in particular those of pressing and firing.
After firing, in addition to squaring, the tiles can undergo 2 other processes: lapping and/or cutting.
The first is divided into the actual lapping phases where, through a series of abrasives with decreasing grits, the surface roughness is reduced, and polishing, where continuing with finer and finer abrasives, a mirrored surface is obtained.
Lapping is carried out in plants consisting of automatic lines, equipped with rotating diamond abrasive tools, which work in a wet environment.
The cutting (split or disc cutting), starting from medium and large size tiles, allows to obtain smaller sizes called "under sizes".

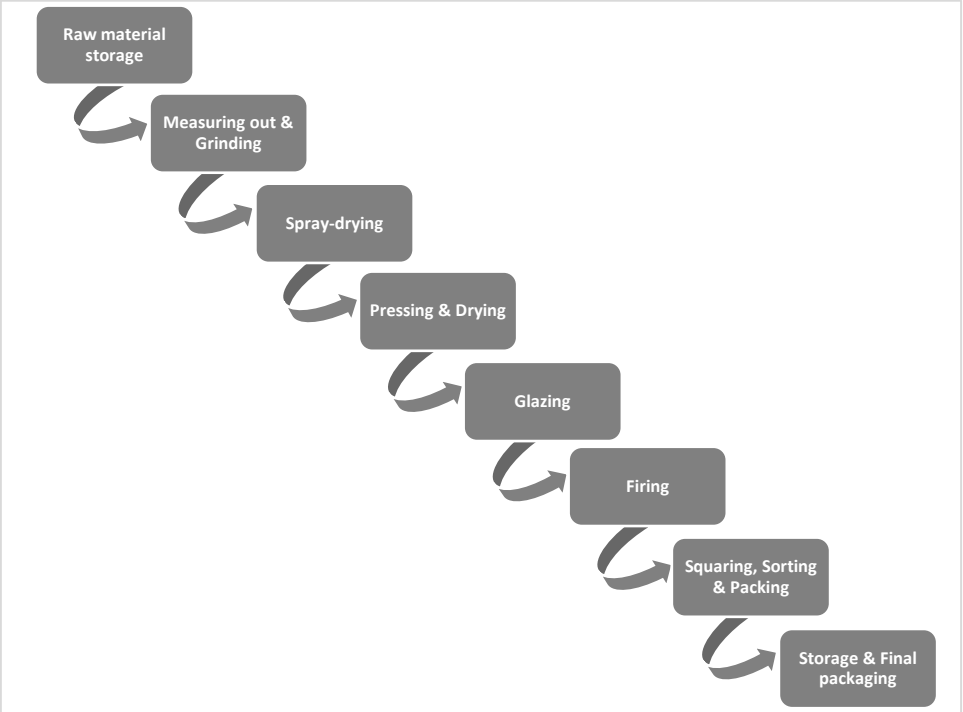
Sorting, calibration and packing

The product to be sorted and then packaged is transferred from the storage area to the sorting line by laser guided vehicles.
By means of a belt conveyor system, the tiles arrive at the sorting line. An automatic sorting machine carries out the visual sorting of the product by dividing it into "classes". The tiles then pass under the planar, which checks the flatness of each tile and downgrades the defective ones.
The selected tiles are transported and channeled into the pile forming machines (stacking machines), which produce packs of tiles of a precise number, divided by specific choice, tone and work size. These machines directly feed the automatic boxing machines that use die-cut cardboard. The boxing machine automatically packages the tile box with the aid of liquid glue injectors and since it is equipped with printers for box coding, it delivers to the palletizing area the packages already marked with the appropriate identification codes. The boxes already packaged are transported to the palletizers by means of roller conveyors and there they are divided on the various pallets according to the characteristics of the articles they contain.
The pallets are extracted from the palletizers by pallet trucks, forklifts and/or LGVs and are transported to the thermo shrinking machine. The pallets are covered with suitable hoods and finally conveyed to the machine for the application of the shrink film. The pallet is then picked up at the exit of the oven with a forklift truck or

LGV and transported to the storage areas (lung areas), from where it will be subsequently picked up to be transferred to the finished product warehouse.

Shipping warehouse

The finished product arrives at the warehouse from the plants by means of shuttles where the forklift-truck operator unloads the trucks. The pallets of finished product are then stowed in the outdoor storage area allocated to that particular item available for the next stages of shipment.



WORKERS HEALTH AND SAFETY:

In 2014, Emilceramica S.r.l obtained certification for the Occupational Health and Safety Management System, according to the BS OHSAS 18001 standard.
Workers are informed about the physical and chemical risks associated with their profession and workplace. They receive appropriate training and personal protective equipment

ENVIRONMENTAL PROTECTION:

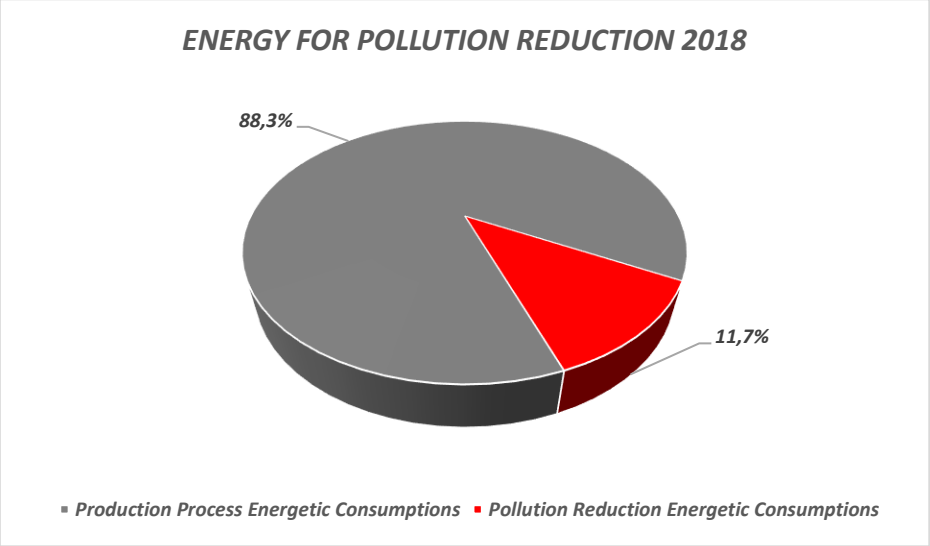
Emilceramica S.r.l. decided to adhere to the international standard ISO 14001 in 2011, developing and maintaining an Environmental Management System over the years.

To reduce the impacts on habitats and natural resources, the raw materials for ceramic mixtures are extracted from quarries authorized for mining, with an environmental recovery plan, compliant with EU Directive 92/43 / EEC (conservation of natural habitats and semi-natural and wild flora and fauna), EU Directive 79/409 / EEC (conservation of wild birds) and the 1992 United Nations Convention on Biological Diversity.

The Fiorano site recycles all the wastewater that is recovered internally and externally.

More than 95% of the waste of the Fiorano Emil site is sent to the recovery. Furthermore, most of the unfired waste coming from the internal production process is reused externally.

At the Fiorano site, the environmental impact of emissions into the atmosphere, generated during the production process, is reduced using bag filters that retain particulate matter. The energy consumption to reduce these emissions is shown in the figure and is defined by subtraction starting from the consumption directly measured by specific instrumentation.



To minimize the fluorine emissions caused by the firing process, hydrated lime is used.
Carbon dioxide emissions are closely monitored with reference to the ETS (European Emissions Trading Scheme) Directive.

At the Fiorano site the noise sources are periodically monitored. In many cases the acoustic emissions coming from the site are lower than the surrounding environmental sources (traffic etc. ...).

At least 30% of the Italian electricity grid used within the plant comes from renewable sources.
In terms of energy savings, the Fiorano site has adopted the heat recovery from cooling air flows inside the kilns for re-use as an energy carrier in the dryers and in the pre-kiln drying cells.

TECHNICAL DATA:

Ceramic tiles produced in the site of Fiorano comply with the following standards and specifications:

Name	Value	Unit
Water adsorption /EN ISO 10545-3/	BIa ≤0,5	%
Bending strength /ISO 10545-4/	>35	N/mm^2
Thermal shock resistance /ISO 10545-9/	resistant	-
Modulus of rupture Breaking strength	≥1300	N
Shock resistance /ISO 10545-5/	0,80	-
Resistance surface abrasion /ISO 10545-7/ (PEI value)	I-II-III-IV-V	-
Frost resistance /ISO 10545-12/	resistant	-
Linear thermal expansion coefficient /ISO 10545-8/	≤9	MK^-1
Stain resistance /ISO 10545-14/	Class 3 minimum	-
Resistance to chemicals for household use and swimming-pool salts /ISO 10545-13/	UA	-
Resistance to acids and bases /ISO 10545-13/	from GLA/GLB - from GHA/GHB	-
Color resistance to light exposure /DIN 51094/	compliant	-
Skid resistance Ramp Method /DIN 51130/ BGR 181	NC; R9-R10-R11	-
Skid resistance Ramp Method /DIN 51097/ GUV 26.17	NC; A; A+B; A+B+C	-
Mean coefficient of friction B.C.R. /D.M. 236 14/6/89/	NC; μ>0,40	-
Skid resistance Pendulum /BS EN13036-4/	NC; PTV>36	-
Skid resistance Pendulum /ENV 12633/ BOE N°74 of 2006	NC, Class 1-2- 3	-
Skid resistance Digital tribometer (D-COF) /ANSI 326.3/	NC; >0,42	-
Skid resistance Ramp Method /DIN 51130/ BGR 181	NC; R9-R10-R11	-
Skid resistance Ramp Method /DIN 51130/ BGR 181	NC; R9-R10-R11	-

BASE MATERIALS / ANCILLARY MATERIALS:

Main raw materials for ceramic tiles:

Eco-glazed mix:

- Clay 35%
- Sand 17%
- Feldspar 33%
- Recycled scraps 12%
- Other raw materials 3%

Technical mix:

- Clay 34%
- Sand 14%
- Feldspar 34%
- Melting materials 16%
- Other raw materials 2%

Main glaze components:

- Clay powder
- Quartz
- Alumina
- Natural pigments
- Frits
- etc.

Main auxiliary additives:

- Dispersant
- Binder
- Fluidifying agents
- Pigments
- etc.

Ceramic tiles made in the Fiorano site are composed of 97.7% eco-glazed mix and 2.7% technical mix.

INSTALLATION/LAYING:

The tiles are fixed to the surfaces of walls and floors using specific materials and in different quantities (for example: dispersion adhesives, cementitious adhesives and mortar, sealants or applied liquid membranes). ceramic tile installations do not cause health or environmental hazards and no emissions are generated during installation.

FUNCTIONAL UNIT AND REFERENCE FLOWS:

The functional unit is 1 m2 of ceramic tiles for wall and floor covering, for a period of 1 year. The mass of the considered area is on average 22,6 kg.

REFERENCE SERVICE LIFE (RSL):

The service life of the tiles is generally more than 50 years (BNB 2011). In addition, according to the US Green Building Council, the service life of the tiles could have the same service life as the building itself. Therefore, 60 years can be considered as a realistic service life for the tiles. The results reported take into account the use of the tiles for 1 year, by multiplying the B2 values by 50 or 60 it is possible to obtain B2 values for 50 or 60 years. No RSL has been defined according to ISO 15686.

EXTRAORDINARY EFFECTS DURING USE PHASE:

Fire: According to /EN 13501-1:2007+A1:2009/, ceramic tiles can be classified as A1 class of fire resistance rating, because they do not contribute to fire.
It has been demonstrated that the coating of the ceramic tiles, in case of fire, reduces heat on them and thus the risk of collapse.
Water: Ceramic tiles cannot react with water because they are an insoluble material.

END OF LIFE AND MECHANICAL DESTRUCTION:

Ceramic tiles can be mechanically crushed, and no significant environmental impact is expected.

REUSE:

After the demolition and deconstruction phase, ceramic tiles can be crushed and used in a wide range of different applications, for example aggregates for concrete or road construction.

DISPOSAL:

According to the European Waste Catalogue (EWC), ceramic tiles belong to group 17 "Construction and demolition wastes", tiles and ceramics (code: 17 01 03) and are classified as no hazardous waste.

5. LCA RESULTS

The following tables illustrate the results of the LCA (Life Cycle Assessment) study. Basic information on all declared modules can be found in chapter 3.
It is possible to convert the results referring to kg using the following conversion factor: 0,0443.

LCA RESULTS - ENVIRONMENTAL IMPACTS of 1 m² of average ceramic tile (22,6 kg / m²)																
Parameter	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP	[kg CO_2-eq.]	1,17E+01	5,85E-01	2,54E+00	0,00E+00	1,32E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,03E-01	5,06E-02	1,28E-01	-4,67E-02
ODP	[kg CFC11-eq.]	1,93E-12	1,24E-16	1,21E-12	0,00E+00	6,32E-16	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,72E-17	2,27E-14	7,42E-16	-9,40E-16
AP	[kg SO_2-eq.]	3,91E-02	5,58E-03	4,74E-03	0,00E+00	1,65E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,45E-04	3,61E-04	7,65E-04	-2,18E-04
EP	[kg PO_4^{3-}-eq.]	4,18E-03	6,37E-04	7,94E-04	0,00E+00	2,69E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,13E-04	8,69E-05	8,67E-05	-4,33E-05
POCP	[kg ethene-eq.]	2,23E-03	2,88E-04	3,01E-04	0,00E+00	2,66E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,84E-04	3,94E-05	5,87E-05	-1,97E-05
ADPE	[kg Sb-eq.]	1,49E-03	4,06E-08	1,01E-04	0,00E+00	5,03E-09	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,03E-09	6,68E-08	4,70E-08	-1,54E-08
ADPF	[MJ]	1,87E+02	7,72E+00	1,67E+01	0,00E+00	1,81E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,41E+00	9,83E-01	1,79E+00	-5,62E-01
Caption	GWP = Global warming potential; ODP = Ozone depletion potential; AP = Acidification potential; EP = Eutrophication potential; POCP = Photochemical ozone creation potential; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources															

LCA RESULTS – RESOURCE USE of 1 m² of average ceramic tile (22,6 kg / m²)															
Parameter	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	[MJ]	3,29E+01	3,44E-01	1,24E+01	0,00E+00	1,66E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,22E-02	6,87E-02	2,34E-01	-1,83E-01
PERM	[MJ]	7,86E+00	0,00E+00	-8,37E+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
PERT	[MJ]	4,08E+01	3,44E-01	5,09E+00	0,00E+00	1,66E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	8,22E-02	6,87E-02	2,34E-01	-1,83E-01
PENRE	[MJ]	1,93E+02	7,75E+00	1,85E+01	0,00E+00	1,93E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,42E+00	1,02E+00	1,85E+00	-6,31E-01
PENRM	[MJ]	1,40E+00	0,00E+00	-1,49E+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
PENRT	[MJ]	1,94E+02	7,75E+00	1,72E+01	0,00E+00	1,93E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,42E+00	1,02E+00	1,85E+00	-6,31E-01
SM	[kg]	1,53E+00	0,00E+00	1,84E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,94E+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	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	0,00E+00	0,00E+00
FW	[m^3]	2,92E-01	5,80E-04	2,19E-02	0,00E+00	6,37E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,39E-04	3,10E-04	4,66E-04	-1,38E-04
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														

LCA RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES of 1 m² of average ceramic tile (22,6 kg / m²)															
Parameter	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
HWD	[kg]	9,04E-07	3,16E-07	2,00E-07	0,00E+00	1,34E-10	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,92E-08	3,30E-08	3,15E-08	-1,36E-08
NHWD	[kg]	3,52E-01	4,92E-04	2,68E+00	0,00E+00	5,07E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,15E-04	2,17E-04	8,59E+00	-8,09E-01
RWD	[kg]	2,83E-03	1,41E-05	1,97E-04	0,00E+00	4,78E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,92E-06	1,57E-05	2,48E-05	-2,74E-05
CRU	[kg]	0,00E+00	0,00E+00	2,26E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	2,08E+00	0,00E+00	2,29E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,00E+01	0,00E+00	0,00E+00
MER	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE	[MJ]	0,00E+00	0,00E+00	6,03E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EET	[MJ]	0,00E+00	0,00E+00	8,51E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	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														

TRACI INDICATORS:

According to UL, USA program operator.

TRACI indicators (version 2.1), from EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts http://www.epa.gov/nrmrl/std/traci/traci.html, are listed below:

TRACI indicators: 1 m^2 Ceramic Tile (SL = 1 year)									
Parameter	**Unit**	**A1-3**	**A4**	**A5**	**B2**	**C2**	**C3**	**C4**	**D**
Global Warming Air	[kg CO_2-eq.]	1,17E+01	5,85E-01	2,54E+00	1,32E-02	1,03E-01	5,06E-02	1,28E-01	-4,67E-02
Ozone Depletion Air	[kg CFC11-eq.]	-5,24E-13	-1,89E-15	1,05E-12	-2,31E-16	-3,23E-16	2,27E-14	-5,24E-15	1,44E-16
Acidification Air	[kg SO_2-eq.]	4,13E-02	5,96E-03	5,26E-03	2,97E-05	6,01E-04	4,83E-04	8,18E-04	-2,67E-04
Eutrophication	[kg N -eq.]	2,08E-03	2,59E-04	5,47E-04	5,57E-05	4,95E-05	3,51E-05	3,75E-05	-2,21E-05
Smog Air	[kg O_3 -eq.]	6,89E-01	1,13E-01	9,66E-02	3,32E-04	1,33E-02	1,60E-02	1,55E-02	-7,32E-03

6. CALCULATION RULES

FUNCTIONAL UNIT:

Name	Value	Unit of measure
Declared unit	1	m^2
Weight	22,6	kg/m^2
Conversion factor to 1 kg	0,0443	-

ASSUMPTIONS:

The modules from A5 to C4 are scenarios based on average data, included in the PCR created by the “European Federation of ceramic tile manufacturers” /CET PCR 2014/ and subsequently implemented in the PCRb of the IBU program operator "Ceramic tiles and panels v1.6".

CUT OFF CRITERIA:

All flows in known inputs and outputs in the production process and in the system boundary were considered.

DATA QUALITY:

The validity period of the background data from the thinkstep database is between 2016 and 2021. Most of the information (energy and water consumption, emissions of pollutants, atomized powders and ceramic production) are measured or calculated directly at the company level and declared in the Italian IPPC document called AIA, which is specific and is checked for each plant involved in this study. Carbon dioxide emissions (related to carbonate oxidation) are collected through the ETS (Emissions Trading Scheme) declaration.
Detailed data was obtained not only for mixtures of raw materials (collected with primary data from the company) but also for pigments, frits and other raw materials for glaze production.
The overall quality of the data can be considered good.

PERIOD UNDER REVIEW:

Primary data collected in the context of this study refer to 2018.

ALLOCATION:

The consumption of energy and materials has been allocated to the product in question based on the mass of ceramic tiles produced annually. No further allocations were applied in the modules subsequent to the production phase. Some ceramic waste is recycled internally. Credits for energy recovery of packaging materials and end of life of the product have been taken into consideration.

7. SCENARIOS

The modules A1-A3 include all processes described in chapter 4.
The technical information concerning the declared modules beyond A1-A3 and related scenarios are based on average data, in accordance with the "European Federation of Ceramic Tile Manufacturers" and subsequently implemented by the PCRb of the IBU program operator "Ceramic tiles and panels v1.6".

Transport (A4):

For transport distances less than 300 km, the return journeys of the vehicles used are considered to be empty. Return journeys over 300 km covered by vehicles are considered at full load. This assumption is applied for any type of transport present in the analyzed system.

Name	Value	Unit of measure
Litres of fuel (per functional unit)	31	l/100 km
Capacity utilization volume factor (including empty runs)	0,85	_
National destination Truck with a capacity of 27 tons (20.5% of tiles sold)	300	km
European destination Truck with a capacity of 27 tons (48.4% of tiles sold)	1390	km
Transoceanic freight ship (31.1% of tiles sold)	6520	km

Installation into the building (A5):

For the installation stage, 3 options are defined, where different materials can be used. For option 1: adhesives, mortar and water; for option 2: mortar dispersion adhesives and polysulfides; for option 3: cementitious adhesives (different quantities for different tile size).
These considerations are based on average data from different manufacturers of ceramic tiles in Europe. In this EPD it is assumed that the tiles are installed using cementitious adhesive (option 3).
For the treatment of packaging waste, a European average scenario is used and shown, taken from “Eurostat, 2019”; therefore, the end of life is recycling, energy recovery and landfill for plastic and paper, instead reuse, energy recovery and landfill for wood.
The ceramic material loss considered is 6,5%.

Option 3 (large size tiles)	Value	Unit of measure
Cementitious adhesive	6	kg

Use (B1):

Ceramic tiles are robust and have a hard, abrasion-resistant surface.

There are no impacts on the environment during the use stage.

Maintenance (B2):

Ceramic covering products shall be cleaned regularly, to a greater or lesser degree, depending on the type of building: residential, commercial, healthcare. Thus, the consumption of water and disinfectant has been considered. The values declared in this stage refer to a time period of 1 year for the residential use.
Residential use: 0,2 ml of detergent and 0,1 l of water are used to wash 1 m2 of ceramic tiles once a week for flooring and every three months for wall coverings.
This stage scenario is based on average data from different manufacturers of ceramic tiles in Europe.

Name	Value	Unit of measure
Water consumption	0,1	l
Detergent	0,2	ml
Floor tile maintenance cycle	2600	Number/SL
Wall tile maintenance cycle	200	Number/SL

Repair, replacement and refurbishment (B3, B4, B5):

In general, the service life of ceramic tiles is the same as the building lifetime. No additional repair, replacement and refurbishment are required for ceramic tiles.

Operational energy and water use (B6, B7):

These modules are not relevant for ceramic tiles.

End of life (C1-C4):

C1: This module is not relevant for ceramic tiles.

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 end-of-life scenario is described in the following table:

Name	Value	Unit of measure
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 tiles and packaging, energy credits from thermal recovery of the packaging.

8. ENVIRONMENT AND HEALTH DURING USE

Ceramics are inherently inert, chemically stable and therefore, during use, do not emit pollutants or substances which are dangerous for the environment and for health, such as: VOC and radon.

9. OTHER ADDITIONAL ENVIRONMENTAL INFORMATION

MINIMUM ENVIRONMENTAL CRITERIA (CAM):

Ceramic tiles by Emilceramica Srl comply with the Italian Legislation Minimum Environmental Criteria (CAM), defined under the “Plan for environmental sustainability of consumption in the public administration sector” and adopted by Decree of the Minister of the Environment and Protection of the Territory and the Sea (11 October 2017).
The criteria for the ceramic tiles refer to the following parameters among those adopted at the European level for the allocation of the EU-Ecolabel ecological mark to the "hard covering" category (Decision 2009/607/EC):

4.2 *Consumption and use of water*: the water consumption at the manufacturing stage, from raw material preparation to firing operations, for the fired products shall not exceed the value of 1 litre/kg of product. The wastewater produced by the processes included in the production chain shall reach a recycling ratio of at least 90%.

4.3.b *Emissions to air* (for particulate matter and fluorides): The emissions to air for the firing stage only shall not exceed the following: Particulate matter (dust) 200 mg/m2 (test method EN 13284-1), Fluorides (as HF) 200 mg/m2 (test method ISO 15713); The total cold emissions to air shall not exceed the value: Particulate matter (dust) 5 g/m 2 (test method EN 13284-1).

4.4 *Emissions into the water*: in Emilceramica Srl plants waste industrial water are completely recycled into the production, without generate water emissions; therefore, the criterion is not applicable.

5.2 *Waste recovery:* at least 85 % (by weight) of the total waste generated by the processes shall be recovered according to the general terms and definitions established by Council Directive 75/442/EEC.

Requirement	Parameter	Declared value	Unit of measure	Test method
Consumption and use of water	Fresh water specific consumption in production (Cwp-a)	≤ 1	l/kg	-
	Rate of wastewater recycling in production	≥ 90	%	-
Emissions to air (the declared values are based on test reports and samples taken in 2019)	Particulate matter (dust) from cold emissions	≤ 5	g/m^2	EN 13284-1
	Particulate matter (dust) from firing stage	≤ 200	mg/m^2	EN 13284-1
	Fluorides (as HF) from firing stage	≤ 200	mg/m^2	ISO 15713
Emissions into the water	Suspended solid emission into water	≤ 40	mg/l	ISO 5667-17
	Cd emission into water	≤ 0.015	mg/l	ISO 8288
	Cr (VI) emission into water	≤ 0.15	mg/l	ISO 11083
	Pb emission into water	≤ 0.15	mg/l	ISO 8288
Waste recovery	Total process waste[1)]	≥ 85	% (by weight)	-

Note 1): assessed according to the general terms and definitions contained in Council Directive 75/442/EEC. Process waste does not include maintenance waste, organic waste and municipal waste generated by ancillary and administrative activities

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IBU PCR Part B:30/11/2017 V1.6
Product Category Rules for Building-Related Products and Services.
Part B: Requirements on the EPD for Ceramic tiles and panels

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