



ENVIRONMENTAL PRODUCT DECLARATION

Product Name: PORCELAIN STONEWARE SLABS

Site Plant: FIORANO SLABS

Via Ghiarola Nuova n° 29 – 41042 Fiorano M.se (MO) Italy

in compliance with ISO 14025 and EN 15804


| | |
|--------------------------|----------|
| Program Operator: | EPDItaly |
| Publisher: | EPDItaly |

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| Valid to: | 08/04/2026 |



1. GENERAL INFORMATIONS

| | |
|--------------------------------------|---|
| EPD OWNER: | Marazzi Group Srl a socio unico Via Regina Pacis, n° 39 - 41049, Sassuolo (MO), Italy |
| PLANT INVOLVED IN THE EPD: | Plant of Fiorano SLABS via Ghiarola Nuova n° 29 – 41042 Fiorano M.se (MO), Italy |
| FIELD OF APPLICATION: | Porcelain stoneware slabs, 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. <input type="checkbox"/> Internal <input checked="" type="checkbox"/> 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 - Marazzi Group Srl a socio unico via Regina Pacis, n° 39 - 41049, Sassuolo (MO), Italy silvia.serri@marazzigroup.com |
| TECHNICAL SUPPORT: | thinkstep Italia  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: | Marazzi Group relieves EPDItaly from any non-compliance with the environmental legislation self-declared by Marazzi Group. 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 rev2.1 IBU PCR Part B:30-11-2017 V1.6 The EN 15804 standard constitutes the framework reference for the PCR. |

2. THE COMPANY



Marazzi Group - Headquarter

Marazzi Group is an international leader in the design, manufacturing and sales of ceramic and porcelain stoneware floor and wall tiles.

Present in more than 140 countries with Marazzi and Ragno brands, the group is universally recognized as synonymous with quality ceramic tiles and symbolizes the best of Italian style and manufacturing in the interior decoration and design sector.

A constant vocation for research and experimentation, the introduction of significant product and process innovation, the ownership of dozens of patents, some of which represent pieces of the history of modern ceramics, the ability to stay one step ahead, evolving home styles, architecture and design, the attention to the environment: these are the qualities that have enabled Marazzi Group to rise to the top in the sector, both in Italy and worldwide, and to strengthen such leadership over time.

Marazzi, founded in 1935 at Sassuolo, Modena, in an area which was to become the world's leading-edge hub in the creation of high-end ceramic tiles, has been responsible for the main process and product innovations in the ceramic tile industry, which have made the company and the district a benchmark for the entire ceramics world.

Today Marazzi Group can have highly sophisticated systems, capable of ensuring in addition to high levels of productivity, significantly above the average of the sector, a considerable production flexibility, which allows to vary the production quickly according to the trends of the various markets.

Marazzi Group ceramic and stoneware tiles are used on the floors and walls of residential buildings and, thanks to their outstanding technical and aesthetic characteristics, increasingly also in public spaces and major architectural projects.

Marazzi Group responds to the needs of contemporary home decoration and architecture with an assortment of over 10 thousand products in porcelain stoneware, crystallized porcelain stoneware, single-fired tiles, large-size ceramics and slabs, in addition to mosaic, marble, granite and natural stones, available in a variety of sizes, colors, thicknesses and surfaces.






Through its Engineering Division, Marazzi Group also provides the planning and construction industries with consultancy and support for the creation of wall and floor covering systems for indoors and outdoors, ventilated walls and raised floors.

Marazzi Group was acquired in April 2013 by Mohawk Industries Inc, the world's biggest flooring manufacturer, listed on the New York Stock Exchange. Marazzi Group also manufactures products for the Mohawk, Daltile and American Olean brands.

MANAGEMENT SYSTEMS, ENVIRONMENTAL AND QUALITY LABELS:

Marazzi Group was the first company in the industry to achieve certification of its Quality Management System to ISO 9001 back in 1994 and ISO 14001 certification for its Environmental Management System in 2003. In 2018, Marazzi also obtained certification for its Occupational Health and Safety management system to the BS OHSAS 18001 standard, which will be replaced in 2020 by the new international ISO 45001 standard.

Products by Marazzi Group 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
- /ISO 10545-1÷15/ methods for test
- /DIN 51130/ Testing of floor coverings. Determination of the anti-slip properties. Workrooms and fields of activities with slip danger, walking method-ramp test
- /DIN 51097/ ramp method barefoot test
- /BS 7976:2/ pendulum test
- /British Ceramic Research Association LTD/: Method for the determination of the coefficient of friction of floor tiles and floor surfaces
- /ENV 12633/ pendulum test
- /ANSI 326.3/ digital tribometer
-  /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)
-  /SONCAP/ Standards organization of Nigeria conformity assessment program - Exporter and importer guidelines
-  /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 porcelain stoneware slab as average between the products Marazzi Group manufactured at the production plant Fiorano Slabs, with the exclusion of the series realized with the technology of the "ceramic tiles" production line.

GEOGRAPHICAL VALIDITY:

Performance has been calculated in reference to the plant of Fiorano Slabs. 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 ALGORITHM:

In 2020 Marazzi Group 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 EPDIItaly 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

Marazzi Group ceramic slabs 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 Slabs is a partial ceramic cycle which begins with the pressing stage of the spray dried powder received by other plants of Marazzi Group S.r.l. and Emilceramica 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 spray-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.

Continuous pressing and Drying:

Pressing is the stage in the production process that provides the atomized powder with sufficient mechanical consistency for its subsequent handling, creating the raw slab. Slab forming is carried out using a continuous pressing line. The atomized powders are loaded onto a conveyor belt where the continuous compaction of the layer of powders takes place and a slab is created, which then undergoes a flying cut to obtain the desired length. The pressed ceramic substrate is brought to a residual moisture content of no more than 0.1%, thanks to drying systems that use hot air currents at temperatures of around 200°C.

Preparation of glazes and glazing:

Glazes and decorations are applied on the dried ceramic support before the cooking phase. Glazes are "conveyed" by preparing them in aqueous suspensions and applying them along the glazing lines; the need to apply different types of glazes and decorations involves the installation of long transport lines, on which the semi-finished application stations are activated (aerography, rotating disc devices, ink-jet station etc.). The preparation of the glazes is carried out by wet grinding of the various constituents (frits, kaolin, sand, etc.), dosed in mills according to specific recipes. In plant it is also present tintometers, that is systems which automatically mixed wet colored oxides with glaze bases in order to obtain the appropriate applications for the glazing.

Firing:

It is the thermal process that allows to obtain the greification of the ceramic product. In a thermal cycle lasting about 45 minutes, the tiles are brought to a temperature of about 1,200 ° C and then cooled.

Squaring, sorting and packing:

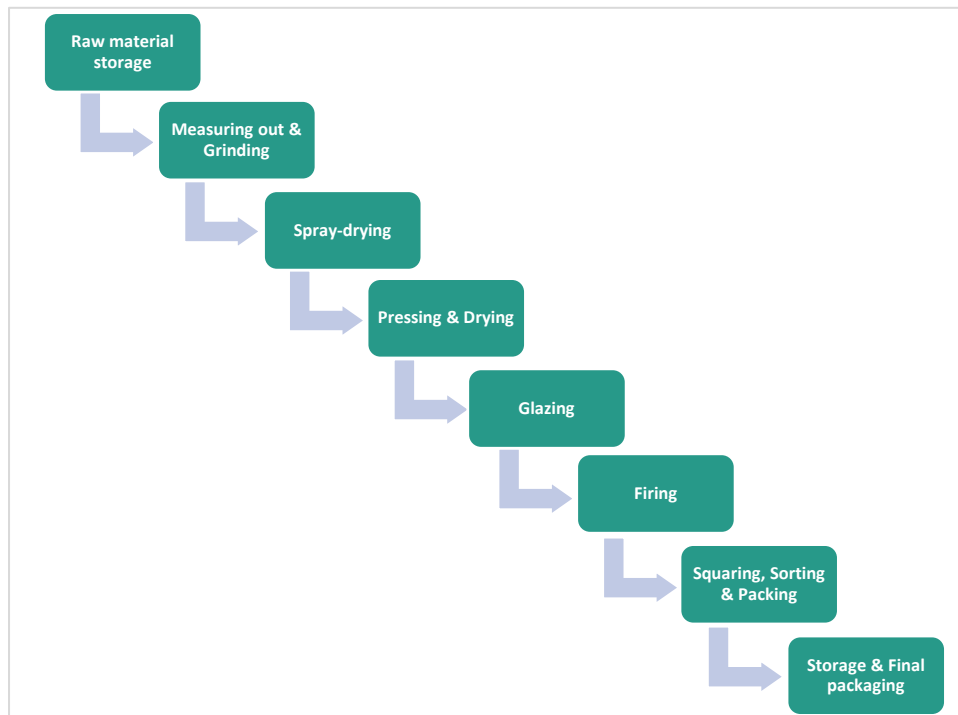
Before being sent for final selection, the fired slabs may undergo additional processing such as cutting, squaring, lapping.

The final stage of the process is selection: each individual slab is checked according to pre-established criteria, in terms of size and quality; depending on the results of the checks carried out, the slabs are divided into selection classes and coded. The slabs are then placed by means of automatic suction cups on trestles or inside wooden crates which, once completed, are picked up by laser-guided vehicles and transported to a storage area where airbags are placed inside the crate on the sides of the slabs or cardboard corners on the sides of the slabs placed on the trestle.

The packaging is placed on roller conveyors, through which it is hooded by applying a suitable cap and then conveyed to the oven for the application of shrink film. On leaving the oven, the boxes and stands are transported by forklift to the storage areas (lung areas), before being transferred to the finished product warehouse.

Shipping warehouse:

The finished product arrives at the warehouse by means of shuttles and is stowed in the storage area allocated to that particular item, available for the next stages of shipment.



WORKERS HEALTH AND SAFETY:

In 2018, Marazzi obtained certification for its Occupational Health and Safety Management System, according to the BS OHSAS 18001 standard, which will be replaced in 2020 by the international ISO 45001 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:

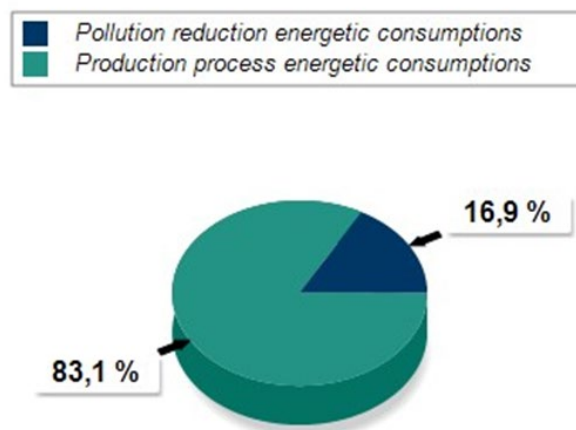
Marazzi Group decided to adhere to the international standard ISO 14001 in 2003, developing and maintaining an Environmental Management System over the years.

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 Sabs plant recycles all the wastewater that is recovered internally and externally.

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

At the Fiorano Slabs plant, 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 Slabs 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 Slabs 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:

Porcelain stoneware slabs produced in the site of Fiorano Slabs comply with the following standards and specifications:

| Name/Test method | Typical Value | Unit |
|--|---|-------------------|
| Water adsorption / ISO 10545-3 | Eb ≤0,5 | % |
| Breaking strength / ISO 10545-4 | ≥ 1300 for thickness ≥ 7,5 mm ≥ 700 for thickness < 7,5 mm | N |
| Modulus of rupture/ ISO 10545-4 | ≥ 35 average value ≥ 32 single value | N/mm ² |
| Impact test resistance /ISO 10545-5 | 0,80 | - |
| Resistance to deep abrasion /ISO 10545-6/ Unglazed tiles | Maximum 175 | mm ³ |
| Resistance surface abrasion /ISO 10545-7/ (PEI value) Glazed tiles | II-III-IV-V | - |
| Coefficient of Linear thermal expansion /ISO 10545-8 | ≤ 9 | MK ⁻¹ |
| Thermal shock resistance /ISO 10545-9 | compliant | - |
| Crazing resistance GL TILES /EN ISO 10545-11/ | compliant | |
| Frost resistance /ISO 10545-12/ | compliant | - |
| Resistance to chemicals for household use and swimming-pool salts /ISO 10545-13/ | Class B minimum | - |
| Resistance to acids and bases /ISO 10545-13/ | from LA to LB - from HA to HB | - |
| Stain resistance /ISO 10545-14/ | Class 3 minimum | - |
| Color resistance to light exposure /DIN 51094 | compliant | - |
| Slip resistance-Ramp Method /DIN 51130/ BGR 181 | NC; R9-R10-R11 | - |
| Slip resistance-Ramp Method /DIN 51097/ GUV 207-006 | NC; A; A+B; A+B+C | - |
| Coefficient of friction B.C.R. /D.M. 236 14/6/89 | NC; μ>0,40 | - |
| Slip resistance-Pendulum /BS EN13036-4/BS 7976-2:2002 | NC; PTV>36 | - |
| Slip resistance-Pendulum /ENV 12633/ BOE N°74 of 2006 | NC, Class 1-2- 3 | - |

BASE MATERIALS / ANCILLARY MATERIALS:
Main raw materials for ceramic slabs:

| White mix | Technical mix |
|------------------------|------------------------|
| Clay 36% | Clay 36% |
| Sand 13% | Sand 14% |
| Feldspar 34% | Feldspar 35% |
| Melting materials 7% | Melting materials 10% |
| Other raw materials 7% | Other raw materials 5% |

Main glaze components:

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

Main auxiliary additives:

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

Porcelain stoneware slabs made in the Fiorano Slabs site are composed of 53% white mix and 47% technical mix.

INSTALLATION/LAYING:

The slabs 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). Porcelain stoneware slabs 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 porcelain stoneware slabs for wall and floor covering, for a period of 1 year. The mass of the considered area is on average 18,8 kg.

REFERENCE SERVICE LIFE (RSL):

The service life of the porcelain stoneware slabs as for ceramic 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 and slabs. The results reported take into account the use of the slabs 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 slabs 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 slabs, in case of fire, reduces heat on them and thus the risk of collapse.

Water: Ceramic slabs cannot react with water because they are an insoluble material.

END OF LIFE AND MECHANICAL DESTRUCTION:

Porcelain stoneware slabs can be mechanically crushed, and no significant environmental impact is expected.

REUSE:

After the demolition and deconstruction phase, ceramic slabs 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 slabs 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: 0,0532.

| LCA RESULTS - ENVIRONMENTAL IMPACTS of 1 m ² of average porcelain stoneware slab (18,8 kg / m ²) | | | | | | | | | | | | | | | | |
|---|---|----------|----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|-----------|
| Parameter | Unit | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| GWP | [kg CO ₂ -eq.] | 1,08E+01 | 5,22E-01 | 4,97E+01 | 0,00E+00 | 1,32E-02 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 8,99E-02 | 4,39E-02 | 1,11E-01 | -4,06E-02 |
| ODP | [kg CFC11-eq.] | 7,23E-13 | 1,20E-16 | 2,24E-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 | 1,50E-17 | 1,98E-14 | 6,44E-16 | -8,16E-16 |
| AP | [kg SO ₂ -eq.] | 4,48E-02 | 2,72E-03 | -4,12E-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 | 3,87E-04 | 3,14E-04 | 6,65E-04 | -1,89E-04 |
| EP | [kg PO ₄ ³⁻ -eq.] | 5,29E-03 | 3,35E-04 | 2,88E-03 | 0,00E+00 | 2,69E-05 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 9,83E-05 | 7,55E-05 | 7,54E-05 | -3,76E-05 |
| POCP | [kg ethene-eq.] | 2,90E-03 | 1,33E-04 | 7,38E-03 | 0,00E+00 | 2,66E-06 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | -1,60E-04 | 3,42E-05 | 5,10E-05 | -1,71E-05 |
| ADPE | [kg Sb-eq.] | 1,36E-03 | 4,09E-08 | 9,09E-05 | 0,00E+00 | 5,03E-09 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 6,98E-09 | 5,80E-08 | 4,08E-08 | -1,34E-08 |
| ADPF | [MJ] | 2,19E+02 | 6,98E+00 | -9,98E+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 | 1,23E+00 | 8,54E-01 | 1,55E+00 | -4,88E-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 porcelain stoneware slab (18,8 kg / m²)

| Parameter | Unit | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|----------------|---|-----------|----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|
| PERE | [MJ] | -6,00E+02 | 3,64E-01 | 6,07E+02 | 0,00E+00 | 1,66E-02 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 7,14E-02 | 5,97E-02 | 2,04E-01 | -1,59E-01 |
| PERM | [MJ] | 6,80E+02 | 0,00E+00 | -7,24E+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 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| PERT | [MJ] | 7,95E+01 | 3,64E-01 | -2,91E+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 | 7,14E-02 | 5,97E-02 | 2,04E-01 | -1,59E-01 |
| PENRE | [MJ] | 2,25E+02 | 7,01E+00 | -1,36E+02 | 0,00E+00 | 1,93E-01 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,23E+00 | 8,89E-01 | 1,61E+00 | -5,49E-01 |
| PENRM | [MJ] | 1,88E+00 | 0,00E+00 | -2,00E+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 |
| PENRT | [MJ] | 2,27E+02 | 7,01E+00 | -1,38E+02 | 0,00E+00 | 1,93E-01 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,23E+00 | 8,89E-01 | 1,61E+00 | -5,49E-01 |
| SM | [kg] | 1,37E+00 | 0,00E+00 | 2,46E-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 | 1,69E+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] | 4,82E-01 | 6,14E-04 | 5,13E-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 | 1,21E-04 | 2,70E-04 | 4,05E-04 | -1,19E-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 m ² of average porcelain stoneware slab (18,8 kg / m ²) | | | | | | | | | | | | | | | | |
|---|---|----------|----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|
| Parameter | Unit | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| HWD | [kg] | 1,03E-06 | 3,38E-07 | 2,44E-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 | 6,88E-08 | 2,87E-08 | 2,74E-08 | -1,18E-08 |
| NHWD | [kg] | 5,26E-01 | 5,19E-04 | 1,48E+01 | 0,00E+00 | 5,07E-03 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,00E-04 | 1,88E-04 | 7,46E+00 | -7,03E-01 |
| RWD | [kg] | 3,18E-03 | 1,36E-05 | -1,52E-02 | 0,00E+00 | 4,78E-06 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | 1,67E-06 | 1,36E-05 | 2,16E-05 | -2,38E-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] | 1,71E+00 | 0,00E+00 | 2,84E-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 | 1,74E+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 | 4,82E+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 | 6,39E+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 of average porcelain stoneware slab (SL = 1 year) | | | | | | | | | |
|--|----------------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|
| Parameter | Unit | A1-3 | A4 | A5 | B2 | C2 | C3 | C4 | D |
| Global Warming Air | [kg CO2-eq.] | 1,08E+01 | 5,22E-01 | 4,97E+01 | 1,32E-02 | 8,99E-02 | 4,39E-02 | 1,11E-01 | -4,06E-02 |
| Ozone Depletion Air | [kg CFC11-eq.] | -2,16E-12 | -1,64E-15 | 3,29E-12 | -2,31E-16 | -2,81E-16 | 1,98E-14 | -4,55E-15 | 1,25E-16 |
| Acidification Air | [kg SO2-eq.] | 4,85E-02 | 2,92E-03 | -9,86E-04 | 2,97E-05 | 5,23E-04 | 4,20E-04 | 7,11E-04 | -2,32E-04 |
| Eutrophication | [kg N--eq.] | 2,51E-03 | 1,59E-04 | 8,59E-04 | 5,57E-05 | 4,30E-05 | 3,05E-05 | 3,26E-05 | -1,92E-05 |
| Smog Air | [kg O3-eq.] | 8,91E-01 | 5,47E-02 | 1,10E-01 | 3,32E-04 | 1,16E-02 | 1,39E-02 | 1,34E-02 | -6,36E-03 |

6. CALCULATION RULES

FUNCTIONAL UNIT:

| Name | Value | Unit of measure |
|---------------------------|--------|-------------------|
| Declared unit | 1 | m ² |
| Weight | 18,8 | kg/m ² |
| Conversion factor to 1 kg | 0,0532 | - |

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 2019.

ALLOCATION:

The consumption of energy and materials has been allocated to the product in question based on the mass of porcelain stoneware slabs 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 (40,1% of slabs sold) | 300 | km |
| European destination Truck with a capacity of 27 tons (45,2% of slabs sold) | 1390 | km |
| Transoceanic freight ship (14,7% of slabs sold) | 6520 | km |

Installation into the building (A5):

For the installation stage, 3 options are defined, where different materials can be used:

- Option 1: adhesives, mortar and water
- Option 2: mortar dispersion adhesives and polysulfides
- 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 slabs are installed using cementitious adhesive (option 3).

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

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%.

Use (B1):

Porcelain stoneware slabs 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 slabs 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 slabs is the same as the building lifetime. No additional repair, replacement and refurbishment are required for ceramic slabs.

Operational energy and water use (B6, B7):

These modules are not relevant for ceramic slabs.

End of life (C1-C4):

C1: This module is not relevant for ceramic slabs.

C2: The ceramic slabs 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 slabs 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):

Porcelain stoneware slabs by Marazzi Group 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/m² (test method EN 13284-1).

4.4 *Emissions into the water*: in Marazzi Group 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 2020) | 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

REFERENCES

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

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

ISO 14020:2000 Environmental labels and declarations -- General principles

ISPRA (2014) Rapporto rifiuti urbani, edizione 2014. Istituto Superiore per la protezione e la ricerca ambientale. Roma, Italia (*Urban waste report, 2014 edition. Higher institute for environmental protection and research. Rome, Italy*)

EN 15804:2012+A1:2014 Sustainability of construction works – Environmental product declarations Core rules for the product category of construction works

EUROSTAT 2019 Packaging waste statistics

GaBi LCA Database Documentation. Retrieved from thinkstep AG: <http://www.gabi-software.com/international/databases/gabi-databases/>

PCR ICMQ – 001/15 rev. 2.1 Prodotti da costruzione e servizi per costruzioni (EPDIItaly, 03/06/2019). (*Construction products and construction services*)

PD CEN/TR 16970:2016 Sustainability of construction works – Guidance for the implementation of EN 15804

BS EN 16757:2017 Sustainability of construction works – Environmental Product Declarations – Product category rules for concrete and concrete elements

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/baustoffundgebaeuedaten/useful_lives-of-bauteilen.html; stand 12/2015

PD CEN/TR 15941:2010 Sustainability of construction works – Environmental Product Declarations – Methodology for selection and use of generic data

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

US GBC: US Green Building Council, Leed v3, 2009, Whole building life cycle assessment. LEED BD&C v4 (LEED Building Design & Construction).