EPD

CERTIFICATION

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DAPHabitat System

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ENVIRONMENTAL PRODUCT DECLARATION

[according to ISO 14025, EN 15804:2012+A1:2013 and EN 15942]

DECLARATION NUMBER: DAP 001:2021

PORCELAIN STONEWARE

ISSUE DATE: 2021-04-07 **VALID UNTIL: 2026-04-06**

GRES PANARIA PORTUGAL, S.A. – Divisão MARGRES (Ílhavo site)

Version 1.1, Edition July 2015

1. GENERAL INFORMATION

1.1. The DAPHabitat System

Program operator:	Associação Plataforma para a Construção Sustentável www.centrohabitat.net centrohabitat@centrohabitat.net
Address:	Departamento Engenharia Civil Universidade de Aveiro 3810-193 Aveiro
Email address:	deptecnico@centrohabitat.net
Telephone number:	(+351) 234 401576
Website:	www.daphabitat.pt
Logo:	

1.2. EPD OWNER

Name of the owner:	Gres Panaria Portugal, S.A.
Production site:	Gres Panaria Portugal, S.A.- Industrial Unit Margres, 3830-133 Ílhavo
Address (head office):	Chousa Nova 3830-133, Ílhavo- Aveiro
Telephone:	Gres Panaria: +351 234329700 Catarina Dias: +351 961537048
E-mail:	catarina.dias@grespanaria.pt; geral@grespanaria.pt;
Website:	www.grespanaria.pt;
Logo:	
Information concerning the applicable management Systems:	Certification scope: Design, production and marketing of ceramic tiles NP EN ISO 9001:2015- Environmental Management Systems- Certifying entity APCER, Certificate of conformity number 2005/AMB.0244 NP EN ISO 14001:2015- Quality Management- Certifying entity APCER, Certificate of conformity number 2000/CEP.1049 EMAS III- Eco-Management and Audit Scheme- Certifying entity APCER, Register number PT- 000051
Specific aspects regarding the production:	$CAE_{Rev.3}$ n.º23312 - Manufacture of tiles, mosaics and ceramic tiles
Organization's environmental policy:	Gres Panaria Portugal S.A., aware of its environmental and social responsibilities, is committed to the principles of strategic orientation that are crucial for the continuous improvement of the Integrated Management System, as well as the sustainable development of the business and the return on invested capital.

Thus, the management of Gres Panaria Portugal assumes the following commitments:

- Satisfaction of customers and other stakeholders, seeking the internationalization of its brands and products in the various markets;
- Innovation and product development, anticipating the expectations of its customers and ensuring the sustainability of its products throughout their life cycle;
- Implementation of a culture of operational excellence that maximizes the efficiency of processes.
- Involvement and motivation of its employees as they are a decisive asset for the success of the company;
- Protection of the environment, including the prevention of pollution, contributing to the minimization of environmental impacts and opting whenever possible and economically viable for the best available technologies, in order to improve environmental performance.
- Prevention and minimization of risk to the health and safety of employees in order to contribute to their integrity and quality of life.
- Compliance with applicable compliance obligations, inherent to its activities, products and services;

It thus undertakes to implement, document, communicate, review and disclose this Sustainability Policy, as well as the other strategic assumptions, to all employees and other stakeholders from a perspective of organizational transparency, seeking to involve employees, customers, suppliers, the local community and society in general in its Management System.

THE STORY OF PANARIAGROUP

Ceramica Panaria began as an industrial company in 1973, with the purchase of the land that now houses the Finale Emilia production facilities (province of Modena).

In 1976 the company was founded, and the first two production lines were installed and tested and in December the first tiles were produced. Full capacity production was reached in 1977. In the late eighties, the old kilns were replaced with single-layer roller kilns, which were more efficient and had greater productivity. At the same time, the presses were renewed, with more powerful machines capable of faster production cycles.

In 1990 Panariagroup upgraded its production from red single firing to white single firing production using mixtures of the finest clays.

In 1992 the ceramics firm Lea based in Fiorano Modenese was acquired, consisting of two kilns, one for flooring and one for wall-cladding.

In 1993 the Cotto d'Este brand was launched, a company marketing product of the very highest quality, employing production methods with the very best technical and aesthetic characteristics. Initially, the products were white body single-fired, and subsequently they were also made in Porcelain Stoneware.

In 1995 work began on the construction of a new production site in Fora di Cavola, in the municipality of Toano (province of Reggio Emilia), for the production of Porcelain Stoneware. Initially two kilns were put into operation, later (in 1999) this number would rise to three, with an atomizer and a continuous mill for the grinding of raw materials.

In 1996 the Fiordo brand was born, a company marketing product made exclusively of Porcelain Stoneware.

In 2000, with the construction of new installations for the third atomizer and a continuous grinding mill, as well as the installation of new kilns, the production of Porcelain Stoneware also began at the Finale Emilia plant.

In 2002 the Panaria group is expanded, incorporating the Company Maronagrés, a leading Portuguese ceramics manufacturing company, leader in the production of technical porcelain stoneware.

In 2004 Panaria Industrie Ceramiche S.p.A. changed its company name, maintaining its registered office, to Panariagroup Industrie Ceramiche S.p.A. incorporating the Cotto d'Este Companies - Antica Ceramica d'Arte S.p.A., Fiordo Industrie Ceramiche S.p.A., Ceramiche Artistiche Lea S.p.A. and GMG S.r.l. which maintained their administrative offices.

2004 is the year in which Panariagroup decided to go public and on 19 November 2004, the Group was listed in the Star segment of the Italian Stock Exchange.

In December 2005 Panariagroup acquired 100% of Novagrés S.A., a leading Portuguese company in the production and distribution of ceramic material for floors and walls.

In February 2006 Panariagroup acquires the brand and the main assets of Florida Tile Industries Inc., a well-known US company specializing in the production and distribution of ceramic material for floors and walls in the US market.

In October 2007, Panariagroup acquired the company Montanari S.r.l., a retail outlet for ceramic materials and complementary products based in Crespellano (BO).

In November 2008 an important restructuring phase began at the Fiorano plant, which involved the installation of a production line for a technologically innovative product called "Laminated Porcelain Stoneware" consisting of slabs measuring 1000x3000 mm and with a thickness of 3 mm. The project involved the total replacement of a production line (the first installed at the plant) consisting of machines used to produce glazed porcelain stoneware.

In May 2010 a new division was created within the Group called Panariagroup Trade, which deals with business development in the regions of the Middle East, Far East and Oceania, marketing the products of the Panaria, Cotto d'Este, Lea and Fiordo brands.

In May 2012, a Joint Venture Company (JVC) was set up in Ahmedabad, in the Indian state of Gujarat, a company 50% owned by Panariagroup and 50% by Asian Granito India Ltd. The JVC products are sold on the Indian market with the new "Bellissimo - STILE ITALIANO" brand owned by Panariagroup.

In May 2012 Emilia Centrale was hit by violent earthquakes with peaks on the 20th and 29th with a magnitude 5.9 and 5.8 respectively on the Richter scale, the first with its epicentre in Finale Emilia; the Panariagroup No.1 production site suffered significant damage some production lines and buildings. Immediate reparation works were organized and after only three months the plants returned to full production.

In January 2016, the installation of the third complete line for the production of Laminated Porcelain Stoneware was completed at the Fiorano plant.

Panariagroup currently has a structure that includes 6 production plants (3 in Italy, 2 in Portugal, 1 in the United States) and 3 logistics hubs (2 in Italy and 1 in the United States). Specialised in the production of porcelain and laminated porcelain stoneware, the Group has focused on the high-end and luxury segments of the market that it caters for by means of brands like: Panaria Ceramica, Lea Ceramiche, Cotto d'Este, Blustyle, Florida Tile, Margres, Love Tiles and Bellissimo (see figure 1.1).

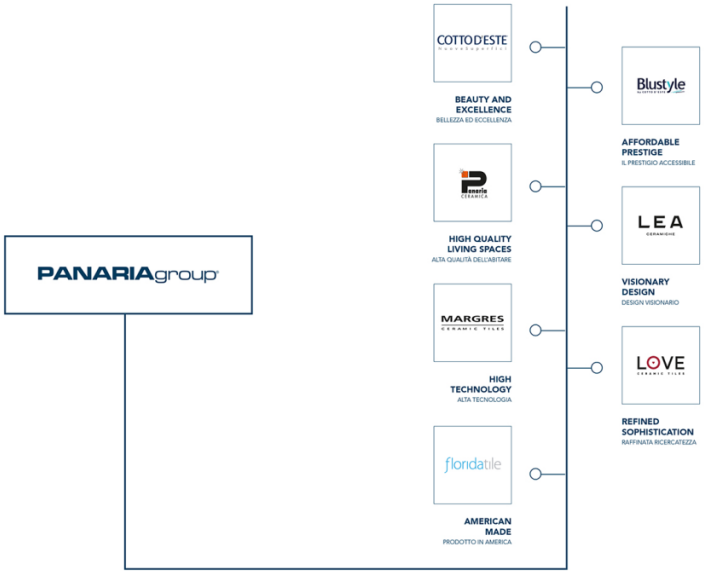


Figure 1.1- Panariagroup brands

The group employs around 1600 people and produces about 20 million m^2 of tiles each year (see figure 1.2).

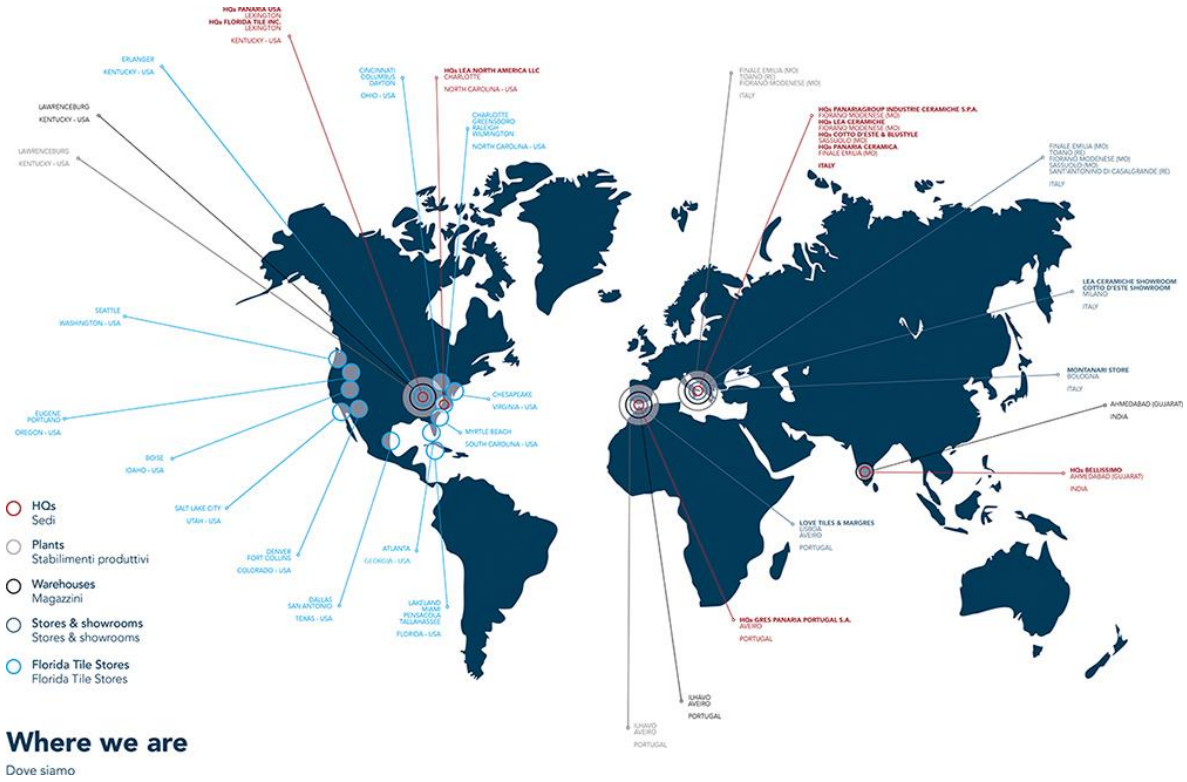


Figure 1.2- Panariagroup around the world

ÍLHAVO PRODUCTION SITE

The Panariagroup site of Ílhavo, is located in Chousa Nova, in the municipality of Ílhavo, few kilometers from the town.

The production site is spread over an area of 54 000 m^2.

The annual production of glazed and unglazed tiles is around 2 500 000 m^2, with a staff of around 180.

The company's history began in the 80's with the then called Maronagrês - Pavimentos Porcelânico Limited, founded in 1981 with the objective of producing porcelain and related articles, as well as its trade and export.

The acquisition of operational control of Margres (eg Maronagrês) by Panariagroup, one of the main Italian ceramic groups present in the international market with a series of prestigious brands (Panaria, Cotto D´Este, Fiordo, LEA), in 2002.

Figure 1.3 presents the general view of the preparation unit of Margres.

Figure 1.3 - General view of preparation unit

1.3. Information concerning the EPD

Authors:	1. Gres Panaria Portugal, S.A. 2. Centro Tecnológico da Cerâmica e do Vidro (CTCV)
Contact of the authors:	1. Gres Panaria Portugal, S.A. – Chousa Nova, 3830-133 Ílhavo- Portugal (T) +351 234329700; geral@grespanaria.pt 2. CTCV materials: habitat | iParque – Parque Tecnológico de Coimbra - Lote 6 | 3040-540 Antanhol- Portugal | (T) +351 239499200 | Marisa Almeida: marisa@ctcv.pt
Issue date:	2021-04-07
Registration date:	30/04/2021
Registration number:	DAP 001:2021
ECOPlatform registration number:	001:2021
Valid until:	06/04/2026
Representativity of the EPD (location, manufacturer, group of manufacturers):	DAP of PORCELAIN STONEWARE, produced in Ílhavo – Portugal production site, belonging to one producer, Gres Panaria Portugal, S.A.. The Panariagroup site in ÍLHAVO is dedicated to the production of "Porcelain stoneware" that is mainly used for flooring and wall cladding. The products are distributed by the Commercial divisions of the group's brands - MARGRES - BLUSTYLE - COTTO D'ESTE - LEA CERAMICHE - PANARIA CERAMICA - LOVE TILES - FLORIDA TILE - PANARIAGROUP
Where to consult explanatory material:	www.grespanaria.pt
Type of EPD:	DAP - Cradle to Grave (A1-D)

1.4. Demonstration of the verification

External independent verification, accordingly with the standard ISO 14025:2009 and EN 15804:2012+A1:2013

Certification Body	**Verifier (s)**
(CERTIF – Associação para a Certificação)	(Ricardo Mateus)

1.5. EPD Registration

Program Operator

(Plataforma para a Construção Sustentável)

1.6. PCR of reference

Name:	1. PCR: Basic module for construction products and services 2. PCR: Floor covering 3. PCR: Wall covering 4. EN 17160 - Product category rules for ceramic tiles
Issue date:	1. November 2020 2. November 2020 3. November 2020 4. 27-Feb-2019, entry into force 15-Apr-2019
Number of registration on the database:	1. PCR-mb001 2. RCP001:2014 3. RCP002:2014 4. --
Version:	1. Version 2.1 2. Version 1.1 3. Version 1.1 4. --
Identification and contact of the coordinator (s):	1. PCR: basic module for construction products and services • Marisa Almeida | marisa@ctcv.pt • Luís Arroja | arroja@ua.pt • José Silvestre | jds@civil.ist.utl.pt 2. PCR: Wall coverings • Luís Arroja | arroja@ua.pt • Marisa Almeida | marisa@ctcv.pt 3. PCR: Floor coverings • Luís Arroja | arroja@ua.pt • Marisa Almeida | marisa@ctcv.pt
Identification and contact of the authors:	1. PCR: basic module for construction products and services • Marisa Almeida; Luis Arroja; José Silvestre; Fausto Freire; Cristina Rocha; Ana Paula Duarte; Ana Cláudia Dias; Helena Gervásio; Victor Ferreira; Ricardo Mateus e António Baio Dias 2. PCR: Wall coverings • Marisa Almeida | marisa@ctcv.pt • Luís Arroja | arroja@ua.pt • Ana Cláudia Dias | acdias@ua.pt 3. PCR: Floor coverings • Marisa Almeida | marisa@ctcv.pt • Luís Arroja | arroja@ua.pt • Ana Cláudia Dias | acdias@ua.pt
Composition of the Sectorial Panel:	1. RCP: Wall coverings • RMC - Revestimentos de Mármore Compactos, S.A. • APICER – Associação Portuguesa da Indústria de Cerâmica • Sonae Indústria, SGPS, S.A. • Gyptec Ibérica - Gessos Técnicos, S.A. 2. RCP: Floor coverings • RMC - Revestimentos de Mármore Compactos, S.A. • Dominó – Indústrias Cerâmicas, S.A. • MAS – Manuel Amorim da Silva, Lda. • Sonae Indústria, SGPS, S.A. • APICER – Associação Portuguesa da Indústria de Cerâmica
Consultation period:	1. 18/11/2015 - 18/01/2016 2. 12/08/2013 - 30/11/2013 3. 01/08/2013 - 30/11/2013
Valid until:	1. January 2022 2. January 2022 3. January 2022 4. --

1.7. Information concerning the product/product class

Identification of the product:	Porcelain Stoneware
Illustration of the product:	 Porcelain stoneware, serie JUNGLE BEIGE 40X120.
Brief description of the product:	At its plants, Gres Panaria Portugal produces ceramic porcelain stoneware tiles. In particular, the porcelain stoneware denomination refers to an extremely, compact, dry-pressed ceramic product characterized by excellent technical specifications (high mechanical strength and resistance to wear, chemicals and stains) and very low porosity. Due to these characteristics, the product, during the firing stage (at a temperature of over 1,200° C), reaches complete vitrification, acquiring extremely low water absorption properties and consequently frost resistance, making it suitable for outdoor installation. In this EPD the results are given per functional unit (1 m^2). However, since the production process is the same, regardless of the thickness or shape of the products, it is possible to convert these results to other units - kg, for example - using conversion factors, according to the weight per reference. The average weight of one square meter of porcelain stoneware is 23,6 kg/m^2, considering the production mix of 2019. GEOGRAPHICAL VALIDITY: Performance has been calculated in reference to the plant in ÍLHAVO - Portugal.
Main technical characteristics of the product:	**Table 1: Technical characteristics**

ISO13006_EN14411_GRUPOBIaUGL_GL

Technical features Caractéstiques Techniques Technische Eigenschaften Características técnicas	Test method Méthode d'essai Prueftmethode Norma	Prescribed value Valeur prescrite Vorgeschriebener Wert Valor prescrito	Typical Value Valeur Typique Typischer Wert Valor Típico
Size - Lenght and width Dimension - Longueur et largeur Abmessungen - Länge und Breite Dimensão - Comprimento e largura	ISO10545 - 2	Rectified ±0,3%, máx ± 1 mm Not Rectified ±0,6%, máx ± 2 mm	Conform Conforme Gemäß Conforme
Side straightness Rectitude des arêtes Kantengeradheit Rectilinearidade das arestas		Rectified ±0,3%, máx ± 0,8 mm Not Rectified ±0,5%, máx ± 1,5 mm	Conform Conforme Gemäß Conforme
Rectangularity Orthogonalité Rechtwinkligkeit Ortogonalidade		Rectified ±0,3%, máx ± 1,5 mm Not Rectified ±0,5%, máx ± 2 mm	Conform Conforme Gemäß Conforme
Warpage Planéité Ebenflächigkeit Planaridade		Rectified ±0,4%, máx ± 1,8 mm Not Rectified ±0,5%, máx ± 2 mm	Conform Conforme Gemäß Conforme
Thickness Epaisseur Dicke Espessura		±5%, máx ± 0,5 mm	±2% Conform Conforme Gemäß Conforme
Water absorption Absortion d'eau Wasseraufnahme Absorção de água	ISO10545-3	≤ 0,5%	Conform Conforme Gemäß Conforme
Modulus of rupture Module de rupture Biegung Modul Módulo de ruptura	ISO10545 - 4	≥35N/mm²	Conform Conforme Gemäß Conforme
Breaking strength (S) Résistance à la flexion (S) Biegefestigkeit (S) Resistência à flexão (S)		≥ 1300 N	Conform Conforme Gemäß Conforme
Deep abrasion resistance Résistance à l'abrasion profonde Widerstand gegen Tiefenverschleiß Resistência à abrasão profunda	ISO10545-6	≤ 175 mm³	Conform Conforme Gemäß Conforme
Abrasion resistance Résistance à l'abrasion Abrieb widerstand Resistência à abrasão	ISO10545-7	As indicated by manufacturer Comme indiqué par le producteur Wie wom hersteller angegeben Conforme indicado pelo fabricante	2 - 4
Linear thermal expansion Dilatation thermique linéaire Lineare Wärmeausdehnung Dilatação térmica linear	ISO10545-8	As indicated by manufacturer Comme indiqué par le producteur Wie wom hersteller angegeben Conforme indicado pelo fabricante	Conform Conforme Gemäß Conforme
Thermal shock resistance Résistance au chocs thermique Temperaturwechselbeständigkeit Resistência ao choque térmico	ISO10545 - 9	As indicated by manufacturer Comme indiqué par le producteur Wie wom hersteller angegeben Conforme indicado pelo fabricante	Resistant Résistant Beständing Resistente
Crazing resistance Résistance aux trésaillures Haarriß Beständigkeit Resistência ao fendilhamento	ISO10545 - 11	Required Nécessaire Anforderung Exigida	Resistant Résistant Beständing Resistente
Frost resistance Résistance au gel Frostbeständigkeit Resistência ao gelo	ISO10545 - 12	Required Nécessaire Anforderung Exigida	Resistant Résistant Beständing Resistente
Stain resistance Résistance aux taches Beständigkeit gegen Fleckenbildner Resistência às manchas	ISO10545 - 14	As indicated by manufacturer Comme indiqué par le producteur Wie wom hersteller angegeben Conforme indicado pelo fabricante	Resistant Résistant Beständing Resistente

The Panariagroup products manufactured at Ílhavo have achieved the following product certifications for Quality (QB-UPEC, CERTIF), Environment (GreenGuard) and Safety (CE, CCC).

	The Quality/Environment and Safety Integrated Management System of this production site is certified according to ISO 9001:2015, ISO 14001:2015 and EMAS.
Description of the products application:	Porcelain Stoneware intended to be applied to both floor and wall claddings and to be installed both indoor and outdoor for residential, non-residential and commercial use. Porcelain tiles for the following applications: • Floor covering • Wall covering • Indoor covering • Outdoor covering • Areas and residential buildings • Areas and public buildings • Areas and industrial buildings
Reference service life:	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, 50 years can be considered as a realistic service life for the tiles.
Placing on the market / Rules of application in the market / Technical rules of the product:	EN 14411:2012 - Ceramic tiles - Definitions, classification, characteristics, evaluation of conformity and marking. EN ISO 10545 – Ceramic wall and floor (several parts) DIN 51130:2014 - Slip resistance test for flooring DIN 51097:2016 - Ramp testing BS 7976-1:2002+A1:2013 - Pendulum testers Specification Regulation (UE) n.º 305/2011 from the European Parliament and of the Council, of 9 March 2011, laying down harmonized conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
Quality control:	According with the product technical standards, CERTIF and NF-UPEC.
Special delivery conditions:	Not applicable.
Components and substances to declare:	Not applicable.
History of the LCA studies:	---

The ceramic tile is subjected to a series of tests in order to determine the main technical characteristics of the product in the conformity with the applicable standards (see figure 1.4 as an example of compressive strength).

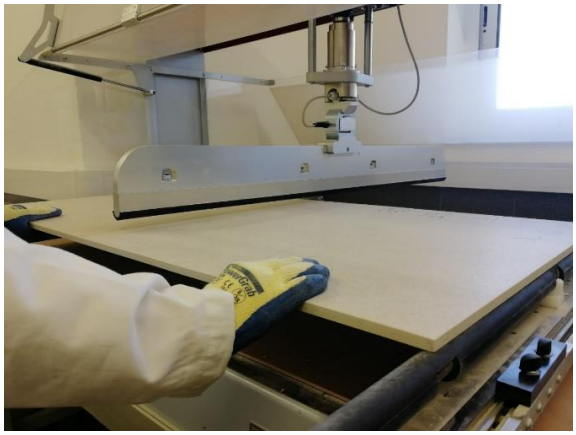


Figure 1.4 - Compressive strength

Declared unit:	--
Functional unit:	1 m^2 of porcelain tiles for wall and floor covering (average) for floor and wall cladding, and a 50-year reference life

Name	Value	Unit of measure
Unit of measurement declared	1	m^2
Weight	23,6	kg/m^2
Conversion factor to 1 kg	0,0424	-

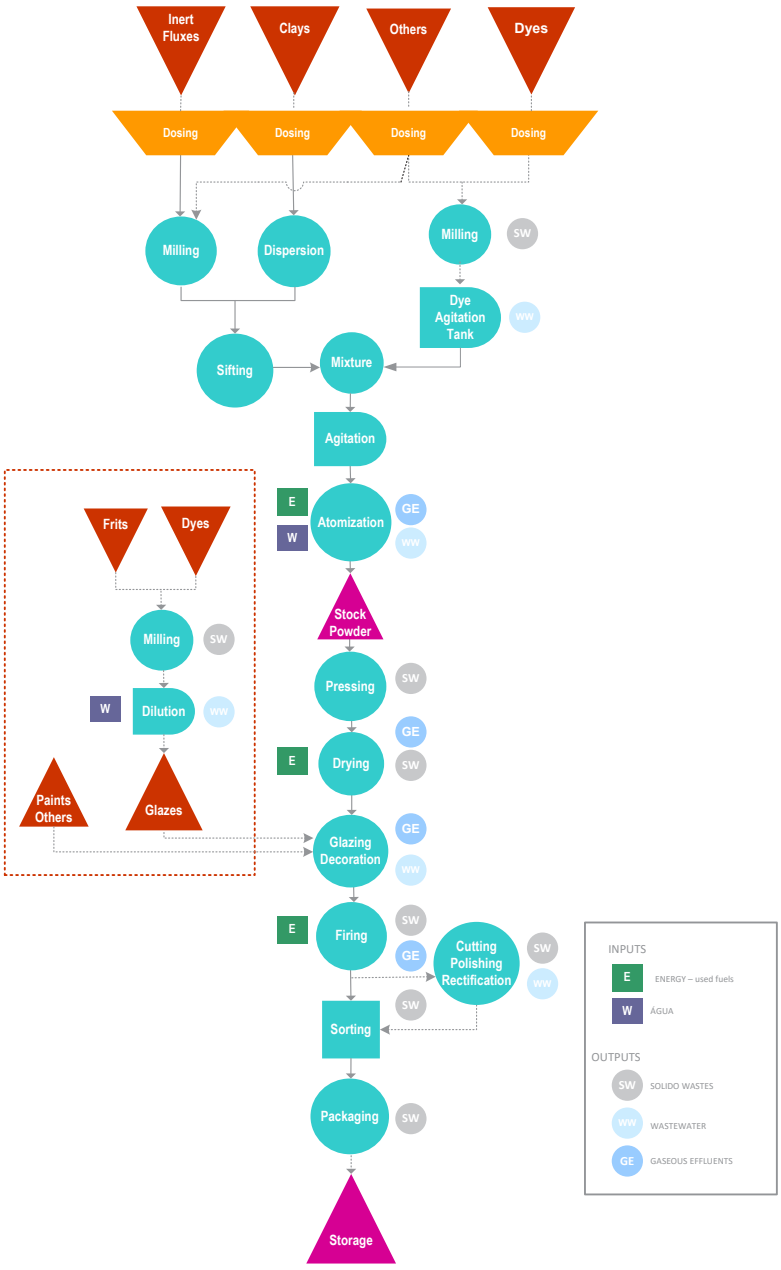
System boundaries:	EPD from cradle to grave
Criteria for the exclusion:	According to paragraph 6.3.5 of EN 15804, the exclusion criterion for unitary processes is 1% of the total energy consumed and 1% of the total mass of the inputs, paying particular attention not to exceed a total of 5% of energy and mass flows excluded in the product step. The following cases were not considered in this study, as they may fall under the exclusion criteria: • Environmental loads associated with the construction of industrial infrastructures and the manufacture of machinery and equipment; • Environmental loads relating to infrastructure (vehicle and road production and maintenance) for the transport of pre-products; • Long term emissions. All flows in known inputs and outputs were considered.
Assumption and limitations:	For processes over which producers have no influence or specific information, such as the extraction of raw materials, generic data from the Ecoinvent v3.3 databases were used. The dataset used to model the production of electricity and natural gas was adapted to the Portuguese context. The electric mix was updated for the year 2019 through information from the Redes Elétricas Nacionais (REN), the Entidade Reguladora dos Serviços Energéticos (ERSE) and the Direção Geral de Energia e Geologia (DGEG) in order to obtain more updated results regarding the environmental impacts generated by the electricity grid in Portugal. The natural gas process was modelled according to the information provided by the DGEG Energy Report in Portugal (2019), regarding the countries where the importation comes from. The environmental impacts indicated in this EPD are a weighted average of all porcelain tiles products fabricated in 2019, based on the production of Ílhavo industrial plant. 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 EN 17160 - Product category rules for ceramic tiles.
Quality and other characteristics about the information used in the LCA:	The production data collected correspond to the year 2019 and are in accordance with the reality. The generic data used belong to the Ecoinvent database v3.3 and comply with quality criteria (age, geographical and technological, coverage, plausibility, etc.) of generic data. The validity period of the background data from the Ecoinvent database is between 2013 and 2019. 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 EMAS Report and in the Sustainability Report, 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 dyes, frits and other raw materials for glaze production. The overall quality of the data can be considered optimal.
Allocation rules:	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.
Comparability of EPD for construction products:	EPD for construction products and services may not be comparable if they are not produced in accordance with EN 15804 and EN 15942 and in accordance with the conditions of comparability as determined by ISO 14025. For each Gres Panaria ceramic products, the environmental impacts can be determined by multiplying the results of this study by mass scale factors.

2. ENVIRONMENTAL PERFORMANCE OF THE PRODUCT

2.1. Calculation rules of the LCA

2.1.1. Flow diagram of input and output of the processes

The production process of the ceramic tile covered by this EPD is shown below and described.



The production process illustrated in the flowchart (figure 2.1) is divided into a series of operations and activities that are carried out consecutively. The individual phases of the production cycle are generally associated with a specific department, appropriately identified within the plant.

Figure 2.2- Raw materials preparation

Figure 2.3- Raw materials

The raw materials (clays, feldspar, kaolins, sands, pigments, amongst other), chosen in such a way as to give the mixture high mechanical strength, an appropriate vitrification temperature and a constant shrinkage, arrive at the plant and are stored in special areas in the raw materials warehouse (see figures 2.2 and 2.3).

The first phase of the process begins with the automated dosage of the raw materials that make up the various types of mixture.

The raw materials are wet milled, that is with the addition of water, in high powered continuous and discontinuous mills with significant power to obtain a liquid mixture with an aqueous fraction of about 30%, referred to as "ceramic slurry" in the ceramics sector.

The ceramic slurry obtained is pumped into spray driers, called "Atomizers"; here it is nebulized in special nozzles to obtain very fine droplets of different sizes which, when passed through a flow of air heated to about 600 °C, generate the "atomized" mixture of granules with controlled humidity and with appropriate granulometric distribution to obtain the ideal compaction of the powders in the subsequent pressing phase.

A large silos battery is set up for the storage of the powders, which will then be sent to the pressing phase.

The tile is formed through the compression of the atomized powders with very powerful hydraulic presses, which give it the shape (square, rectangular, strips, etc.), the productive size, the thickness, the surface type (smooth, structured, etc.), the shape of the edges (straight, rounded, split like stone, etc.) (see figure 2.4).

The tile formed in this way is transported from the presses to the drying kilns where it undergoes a drastic reduction in humidity and a decisive increase in “raw” mechanical strength, both factors that are necessary before undergoing the subsequent production phases. Generally, the drying process lasts 20-60 minutes at maximum temperatures of 200-220 °C.

The pressed tiles can be subjected to glazing and digital decoration applications (see figure 2.5), which give the product high-end aesthetic effects and colouring, similar to those of natural materials (stones, marbles, wood, etc.).

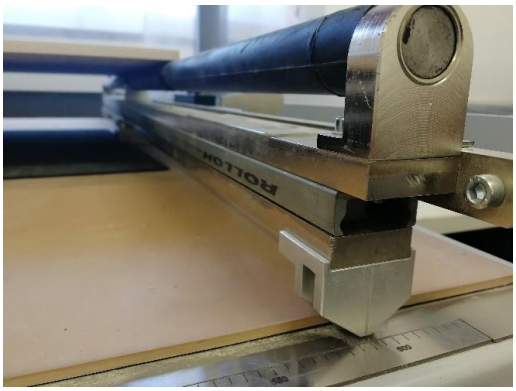


Figure 2.4- Ceramic tile testing

Figure 2.5- Glazing applications

The firing phase is carried out in industrial kilns that, thanks to sophisticated flame emission systems, make it possible to keep the temperature uniform in all the zones of the kilns, eliminating problems of varying tonalities and firing. The long periods spent at high firing temperatures (cycles up to 100 minutes at maximum temperatures of 1200-1220°C) ensures the material achieves complete vitrification throughout its mass: thus obtaining ceramic tiles with almost zero porosity, which are therefore completely frost resistant, with considerable mechanical strength (breaking strength, resistance to bending, abrasion, scratches) and resistance to aggressive chemicals.

Before quality inspection, most of the material is subjected to mechanical processing, such as cutting (to obtain smaller sizes), rectification (to obtain tiles with highly linear and orthogonal sides, which allows installation with very narrow grout lines) and honing (mechanical abrasion of the surface with very high hard tools to obtain softer surfaces, pleasant to the touch, with different degrees of gloss).

In the quality inspection department each ceramic tile is checked with regards to:

- dimensions, flatness, orthogonality of the edges, using electronic readers set with tight tolerances;
- tonality and surface quality (absence of defects) through specialized operators and automatic selection machines.

The finished products are packaged in homogeneous batches by article, quality class, tone and "calibre", the boxes are then automatically placed on "debarked" pallet and treated according to FAO ISPM15 regulations.

Each pallet leaves the quality inspection department with a special pallet card glued on shrink-wrap, indicating for each article: code, description, format, selection class, tone, calibre, bar code (if required). The material, once loaded in the warehouse, is available to be used for customer orders. The management of the shipments takes place with a radio frequency system to minimize errors during shipping and obtain optimal warehouse management.

The Environmental Declaration and the Management System documents for Quality ISO 9001, Environment ISO 14001/EMAS report all the information regarding the company's Quality, Environment and Safety controls/requirements/provisions for the production cycle.

BASE MATERIALS / ANCILLARY MATERIALS

The ceramic tile is mainly compose of ceramic raw materials and also glaze materials. The main raw materials for ceramic tile are clay (20-40%), Kaolin (0-12%), feldspar (20-40 %), sand (0-30 %) and pigments (0-4 %). The main glaze components are clay powder; quartz; alumina; pigments; frits and feldspars. The main auxiliary additives consists of dispersant, binder and fluidifying agents.

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. No emissions are generated during installation and ceramic tile installations do not cause health or environmental hazards.

2.1.2. Description of the system boundaries

(✓= included; ✗= module not declared)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
Raw material supply	Transport	Manufacturing	Transport	Construction installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-constructions, demolition	Transport	Waste processing	Disposal	Re-use, recovery, recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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 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.

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, incl. waste water 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** refers to the 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.

2.2. Parameters describing environmental impacts

		Global warming potential; GWP kg CO_2 equiv.	Depletion potential of the stratospheric ozone layer; ODP kg CFC 11 equiv.	Acidification potential of soil and water, AP kg SO_2 equiv.	Eutrophication potential, EP kg $(PO_4)^{3-}$ equiv.	Formation potential of tropospheric ozone, POCP kg C_2H_4 equiv.	Abiotic depletion potential for non-fossil resources kg Sb equiv.	Abiotic depletion potential for fossil resources MJ, P.C.I.
Raw material supply	**A1**	-	-	-	-	-	-	-
Transport	**A2**	-	-	-	-	-	-	-
Manufacturing	**A3**	-	-	-	-	-	-	-
Total	**Total**	1,73E+01	2,70E-06	6,07E-02	5,27E-03	3,39E-03	6,91E-06	2,56E+02
Transport	**A4-a**	1,64E+00	3,03E-07	4,38E-03	7,43E-04	2,10E-04	3,38E-09	2,50E+01
	A4-b	4,56E+00	8,42E-07	1,22E-02	2,07E-03	5,83E-04	9,39E-09	6,95E+01
	A4-c	1,38E+00	2,58E-07	3,48E-02	2,95E-03	1,10E-03	2,57E-09	2,13E+01
Construction installation process	**A5**	1,56E+00	1,29E-07	5,09E-03	5,39E-04	2,40E-04	2,62E-07	1,40E+01
Use	**B1**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Maintenance	**B2**	2,82E-01	3,59E-08	1,83E-03	1,37E-04	1,02E-04	2,89E-07	1,02E+01
Repair	**B3**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Replacement	**B4**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Refurbishment	**B5**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Operational energy use	**B6**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Operational water use	**B7**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
De-construction and demolition	**C1**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Transport	**C2**	6,6E-02	1,2E-08	1,8E-04	3,0E-05	8,4E-06	1,4E-10	1,0E+00
Waste processing	**C3**	6,14E-02	1,15E-08	4,71E-04	1,02E-04	1,13E-05	1,19E-10	9,50E-01
Disposal	**C4**	6,68E-02	1,21E-08	4,64E-04	9,72E-05	1,47E-05	1,46E-10	1,02E+00
Re-use, recovery, recycling potential	**D**	-5,11E-02	-1,83E-08	-2,60E-04	-5,04E-05	-9,61E-06	-5,19E-08	-7,46E-01

N.R.– not relevant according to EN 17160 - Product category rules for ceramic tiles

LEGEND:

- Product stage
- Construction process stage
- Use stage
- End - of - life stage
- Benefits and loads beyond the system boundary

NOTES: P.C.I. – Net calorific value
Units expressed by functional unit (1 m^2).

2.3. Parameters describing resource use

		Primary energy						Secondary materials and fuels, and use of water			
		EPR	RR	TRR	EPNR	RNR	TRNR	MS	CSR	CSNR	Net use of fresh water
		MJ, P.C.I.	MJ, P.C.I.	MJ, P.C.I.	MJ, P.C.I.	MJ, P.C.I.	MJ, P.C.I.	kg	MJ, P.C.I.	MJ, P.C.I.	m^3
Raw material supply	**A1**	-	-	-	-	-	-	-	-	-	-
Transport	**A2**	-	-	-	-	-	-	-	-	-	-
Manufacturing	**A3**	-	-	-	-	-	-	-	-	-	-
Total	**Total**	2,94E+01	3,79E-01	2,98E+01	2,66E+02	0,00E+00	2,66E+02	0,00E+00	0,00E+00	0,00E+00	2,55E-03
Transport	**A4-a**	6,14E-02	0,00E+00	6,14E-02	2,51E+01	0,00E+00	2,51E+01	0,00E+00	0,00E+00	0,00E+00	4,22E-04
	A4-b	1,71E-01	0,00E+00	1,71E-01	6,99E+01	0,00E+00	6,99E+01	0,00E+00	0,00E+00	0,00E+00	1,17E-03
	A4-c	4,06E-02	0,00E+00	4,06E-02	2,14E+01	0,00E+00	2,14E+01	0,00E+00	0,00E+00	0,00E+00	3,54E-04
Construction installation process	**A5**	7,87E-01	0,00E+00	7,87E-01	7,42E+00	0,00E+00	7,42E+00	0,00E+00	0,00E+00	0,00E+00	8,74E-05
Use	**B1**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Maintenance	**B2**	1,51E-01	0,00E+00	1,51E-01	1,04E+01	0,00E+00	1,04E+01	0,00E+00	0,00E+00	0,00E+00	5,79E-05
Repair	**B3**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Replacement	**B4**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Refurbishment	**B5**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Operational energy use	**B6**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Operational water use	**B7**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
De-construction and demolition	**C1**	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Transport	**C2**	2,46E-03	0,00E+00	2,46E-03	1,01E+00	0,00E+00	1,01E+00	0,00E+00	0,00E+00	0,00E+00	1,69E-05
Waste processing	**C3**	1,71E-03	0,00E+00	1,71E-03	9,54E-01	0,00E+00	9,54E-01	0,00E+00	0,00E+00	0,00E+00	1,58E-05
Disposal	**C4**	4,32E-03	0,00E+00	4,32E-03	1,02E+00	0,00E+00	1,02E+00	0,00E+00	0,00E+00	0,00E+00	1,68E-05
Re-use, recovery, recycling potential	**D**	-2,52E-01	0,00E+00	-2,52E-01	-1,90E+00	0,00E+00	-1,90E+00	0,00E+00	0,00E+00	0,00E+00	-9,77E-05

LEGEND:

- Product stage
- Construction stage
- Use stage
- End – of - life stage
- Benefits and loads beyond the system boundary

EPR = use of renewable primary energy excluding renewable primary energy resources used as raw materials;
RR = use of renewable primary energy resources used as raw materials;
TRR = total use of renewable primary energy resources (EPR + RR);
EPNR = use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
RNR = use of non-renewable primary energy resources used as raw materials;
TRNR = total use of non-renewable primary energy resources (EPRN + RNR);
MS = use of secondary material;
CSR = use of renewable secondary fuels;
CSNR = use of non-renewable secondary fuels.

NOTE: Units expressed by functional unit (1 m^2).
P.C.I. – Net calorific value
N.R.– not relevant according to EN 17160 - Product category rules for ceramic tiles

2.4. Other environmental information describing different waste categories

		Hazardous waste disposed kg	Non-hazardous waste disposed kg	Radioactive waste disposed ** kg
Raw material supply	**A1**	-	-	-
Transport	**A2**	-	-	-
Manufacturing	**A3**	-	-	-
Total	**Total**	6,11E-04	2,15E+00	3,97E-04
Transport	**A4-a**	4,13E-06	2,00E-04	1,72E-04
	A4-b	1,15E-05	5,55E-04	4,77E-04
	A4-c	3,72E-06	1,66E-04	1,45E-04
Construction installation process	**A5**	2,74E-06	9,15E-03	3,45E-05
Use	**B1**	N.R.	N.R.	N.R.
Maintenance	**B2**	4,47E-06	4,49E-03	8,52E-06
Repair	**B3**	N.R.	N.R.	N.R.
Replacement	**B4**	N.R.	N.R.	N.R.
Refurbishment	**B5**	N.R.	N.R.	N.R.
Operational energy use	**B6**	N.R.	N.R.	N.R.
Operational water use	**B7**	N.R.	N.R.	N.R.
De-construction and demolition	**C1**	N.R.	N.R.	N.R.
Transport	**C2**	1,7E-07	8,0E-06	6,9E-06
Waste processing	**C3**	1,57E-07	1,54E-05	6,50E-06
Disposal	**C4**	1,81E-07	8,11E+00	6,85E-06
Re-use, recovery, recycling potential	**D**	-2,71E-06	-4,30E-01	-2,18E-05

Values expressed by functional unit (1 m^2)

LEGEND:

- Product stage
- Construction stage
- Use stage
- End – of - life stage
- Benefits and loads beyond the system boundary

N.R. – not relevant according to EN 17160 - Product category rules for ceramic tiles

** The radioactive waste component does not come from the activity of MARGRÉS (A3). It is a component derived from the upstream activities (A1 and A2), namely from the production of electricity.

2.5. Other environmental information describing output flows

Parameters	Units*	Results
Components for re-use	kg	N/A
Materials for recycling	kg	1,79E+01
Materials for energy recovery	kg	8,58E-02
Exported energy	MJ by energy carrier	N/A
* expressed by functional unit (1 m^2)		

3. SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

3.1. A4 Transport to the building site – Construction process stage

The scenarios for A4 transport to the building site were according to EN 17160 regarding Product category rules for ceramic tiles.

Destination	Type of transport	Average distance (km)
National	Truck with a capacity of 25 tons	300
Europe	Truck with a capacity of 25 tons	1 390
International (Outside Europe)	Transoceanic freight ship	6 520

3.2. A5 Installation of the product in the building – Construction process stage

For the installation stage the scenario was also according to the options defined in EN17160 and Almeida, 2019. The option chosen was 3,5 kg of cementitious adhesive for each m^2 of ceramic tile. The ceramic material loss considered was 3%.

Option 3 (medium size tiles)	Value	Unit of measure
Cementitious adhesive	3,5	kg

3.3. B1 Use stage

According to the specific PCR for Product category rules for ceramic tiles - EN 17160, the environmental impacts generated during the use phase are very low and therefore can be neglected. Ceramic tiles are robust and have a hard, abrasion-resistant surface.

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

3.4. B2 Maintenance

Ceramic covering products shall be cleaned regularly, depending on the type of building: residential, commercial, healthcare. Thus, the consumption of water and cleaning agents has been considered. The values declared in this stage refer to a time period of 50 year. The scenario for maintaining ceramic floor and wall tiles was conservative and according to EN 17160. The scenario used for maintaining ceramic floor tiles was for residential use, with the use of 0,134 ml detergent once every two weeks and 0,1 l water are used to wash 1 m^2 of ceramic floor tiles once a week.

Name	Value	Unit of measure
Water consumption	0,1	l
Detergent	0,134	ml
Wall tile maintenance cycle	1300	Number per RSL

3.5. B3 Repair

In general the service life of ceramic tiles is the same as the building life time. Repair, replacement and refurbishment is not required for ceramic tiles.

Thus according to EN 17160, ceramic tiles require no repairing during the use phase and therefore no impacts should be declared in the repair phase.

3.6. B4 Replacement

In general the service life of ceramic tiles is the same as the building life time. Repair, replacement and refurbishment is not required for ceramic tiles.

3.7. B5 Refurbishment

In general the service life of ceramic tiles is the same as the building life time. Repair, replacement and refurbishment is not required for ceramic tiles.

Thus according to EN 17160, ceramic tiles require no repairing during the use phase and therefore no impacts should be declared in the refurbishment phase.

3.8. B6 Use of energy

These modules are not relevant for ceramic tiles, according to EN 17160.

3.9. B7 Use of water

These modules are not relevant for ceramic tiles, according to EN 17160.

3.10. [C1 – C4] End of life of the product

C1: This module, according to the PCR developed in EN 17160, 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, according to the default scenario of EN17160.

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	%

3.10.b 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.

According to EN 17160, after the demolition/deconstruction stage, ceramic tiles can be crushed and then used in a range of different applications:

- road construction in filled embankment;
- concrete aggregates;
- when ceramic tiles is crushed, it forms recycled ceramic aggregates which can be integrated as a partial substitute of natural aggregate in hot-mix asphalt [8];
- recycled ceramic aggregates can be used in the construction of landfills [8];
- recycled ceramic aggregates can be utilized in the construction of sub-based courses on secondary roads [8].

In this case, and according to the Environmental Nacional Agency (APA, 2020), in Portugal the valorization rate of ceramic materials in construction and demolition waste is aprox. 75%.

3.11. Additional information on release of dangerous substances to indoor air, soil and water during the use stage

Margres products have achieved the GREENGUARD Certification by third-party, which is related to indoor air pollution and the risk of chemical exposure.

Identified Volatile Organic Compounds at 24 elapsed Exposure Hours		
CAS Number	**Compound**	**Emission Factor (µg/m².hr)**
22531-20-0	Naphthalene, 6-ethyl-1,2,3,4-tetrahydro-*	3,3
42775-75-7	Naphthalene, 5-ethyl-1,2,3,4-tetrahydro-*	3,1

* indicates NIST/EPA/NIH best library match only based on retention time and mass spectral characteristics.

Target List Aldehydes at 24 Elapsed Exposure Hours		
CAS Number	**Compound**	**Emission Factor (µg/m².hr)**
4170-30-3	2-Butenal	BQL
75-07-0	Acetaldehyde	BQL
100-52-7	Benzaldehyde	BQL
5779-94-2	Benzaldehyde, 2,5-dimethyl	BQL
529-20-4	Benzaldehyde, 2-methyl	BQL
620-23-5 / 104-87-0	Benzaldehyde, 3- and/or 4-methyl	BQL
123-72-8	Butanal	BQL
590-86-3	Butanal, 3-methyl	BQL
50-00-0	Formaldehyde	BQL
66-25-1	Hexanal	BQL
110-62-3	Pentanal	BQL
123-38-6	Propanal	BQL

Analyses based on EPA Compendium Method TO-17 and ASTM D 6196 for VOCs by thermal desorption followed by gas chromatography/mass spectrometry (TD/GC/MS), and EPA Method TO-11A and ASTM D 5197 for selected aldehydes by high performance liquid chromatography (HPLC).

BQL denotes below quantifiable level of 0,04 µg based on a standard 18 L air collection volume for TVOC and individual VOCs and 0,1 µg based on a standard 45 L air collection volume for formaldehyde and total aldehydes

3.12. TRACI INDICATORS

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

TRACI INDICATORS of 1m² of porcelain tile (23,56 kg/m²)											
Parameter	**Unit**	**A1-A3**	**A4-a**	**A4-b**	**A4-c**	**A5**	**B2**	**C2**	**C3**	**C4**	**D**
Global Warming Air	kg CO_2 eq	7,43E-02	1,64E+00	4,56E+00	1,38E+00	1,09E+00	2,82E-01	6,57E-02	6,14E-02	6,68E-02	-5,11E-02
Ozone Depletion Air	kg CFC11 eq	1,86E-08	4,04E-07	1,12E-06	3,43E-07	7,57E-08	4,10E-08	1,61E-08	1,53E-08	1,61E-08	-2,11E-08
Acidification Air	kg SO^2 eq	7,32E-04	4,97E-03	1,38E-02	3,52E-02	3,59E-03	1,77E-03	1,99E-04	6,05E-04	5,87E-04	-3,06E-04
Eutrophication	kg N eq	6,35E-05	7,11E-04	1,98E-03	1,40E-03	3,12E-04	1,58E-04	2,85E-05	5,25E-05	5,24E-05	-3,96E-05
Smog Air	kg O_3 eq	2,24E-02	1,15E-01	3,19E-01	5,32E-01	6,07E-02	1,82E-02	4,60E-03	1,85E-02	1,75E-02	-7,68E-03

The stages B1, B3, B4, B5, B6, B7 and C1 are not relevant according to EN 17160 - Product category rules for ceramic tiles, and for that reason are not presented in the table above.

REFERENCES

✓ **Almeida. M.** (2019). Desempenho ambiental de produtos no sector cerâmico em Portugal. Tese de doutoramento. Universidade de Aveiro.

✓ General Instructions of the DAPHabitat System, Version 1.0, Edition March 2013 (in www.daphabitat.pt);

✓ **PCR – basic module for construction products and services.** DAPHabitat System. Version 1.0, 2013 (in www.daphabitat.pt);

✓ **ISO 14025:2009** Environmental declarations and labels – Type III environmental declarations – Principles and procedures;

✓ **EN 15804:2012** Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products;

✓ **EN 15942:2011** Sustainability of construction works – Environmental product declarations – Communication format business-to-business.

✓ **Ecoinvent database v3.3** (2016). (www.ecoinvent.org)

✓ **EN 15804:2012+A1:2015** Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products;

✓ **EN 15942:2011** Sustainability of construction works – Environmental product declarations – Communication format business-to-business.

✓ **Energy Services Regulatory Authority (ERSE)** – Special Regime Production (PRE) (2016) (in http://www.erse.pt/pt/desempenhoambiental/prodregesp/2016/Paginas/2016.aspx)

✓ **General Board of Energy and Geology (DGEG)** – Energy in Portugal Report (2015)

✓ **General Board of Energy and Geology (DGEG)** – Monthly Data of Electrical Energy (2016). (in http://www.dgeg.gov.pt?cr=15125)

✓ **Instruções Gerais do Sistema DAPHabitat**, Version 1.0, March 2013 (in www.daphabitat.pt);

✓ **National Energy Networks (REN)** – Information Centre – Monthly Statistics (2016). (in http://www.centrodeinformacao.ren.pt/PT/InformacaoExploracao/Paginas/EstatisticaMensal.aspx)

✓ **NP ISO 14025:2009** Rótulos e declarações ambientais – Declarações ambientais Tipo III – Princípios e procedimentos;

✓ **Regras para a Categoria de Produto (RCP) – Modelo base para produtos e serviços de construção**. DAPHabitat System. Version 2.0, September of 2015 (in www.daphabitat.pt);

✓ **Regras para a Categoria de Produto (RCP) – Revestimento de Paredes.** Wall covering. RCP002:2014. DAPHabitat System. Version 1.0, February 2014 (in www.daphabitat.pt);

✓ **Regras para a Categoria de Produto (RCP) – Revestimento de Pavimento.** Floor covering. RCP001:2014 DAPHabitat System. Version 1.0, February 2014 (in www.daphabitat.pt);