



Registration Number: DAP 019:2022



Ceramic Floor Tiles

ISSUE DATE: 28/10/2022

VALID UNTIL: 27/10/2027

CINCA - COMPANHIA INDUSTRIAL DE CERÂMICA, S.A. (FIÃES 1, FIÃES 2 AND FIÃES 3 UNITS)



Index


1. GENERAL INFORMATION	1
1.1. THE DAPHABITAT SYSTEM.....	1
1.2. EPD OWNER.....	1
1.3. INFORMATION CONCERNING THE EPD.....	3
1.4. DEMONSTRATION OF THE VERIFICATION.....	3
1.5. EPD REGISTRATION	3
1.6. PCR OF REFERENCE	4
1.7. INFORMATION CONCERNING THE PRODUCT/PRODUCT CLASS	5
2. ENVIRONMENTAL PERFORMANCE OF THE PRODUCT	7
2.1.1. FLOW DIAGRAM OF INPUT AND OUTPUT OF THE PROCESSES.....	8
2.1.2. DESCRIPTION OF THE SYSTEM BOUNDARIES	11
2.2. PARAMETERS DESCRIBING ENVIRONMENTAL IMPACTS	13
2.3. PARAMETERS DESCRIBING RESOURCE USE.....	14
2.4. OTHER ENVIRONMENTAL INFORMATION DESCRIBING DIFFERENT WASTE CATEGORIES.....	15
2.5. OTHER ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS	15
3. SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION.....	16
3.1. A4 TRANSPORT TO THE BUILDING SITE – CONSTRUCTION PROCESS STAGE.....	16
3.2. A5 INSTALLATION OF THE PRODUCT IN THE BUILDING – CONSTRUCTION PROCESS STAGE	16
3.3. B1 USE STAGE.....	16
3.4. B2 MAINTENANCE.....	16
3.5. B3 REPAIR.....	17
3.6. B4 REPLACEMENT.....	17
3.7. B5 REFURBISHMENT	17
3.8. B6 USE OF ENERGY	17
3.9. B7 USE OF WATER	17
3.10. [C1 – C4] END OF LIFE OF THE PRODUCT.....	17
3.10.B BENEFITS AND LOADS BEYOND THE PRODUCT SYSTEM BOUNDARY (D):.....	18
3.11. ADDITIONAL INFORMATION ON RELEASE OF DANGEROUS SUBSTANCES TO INDOOR AIR, SOIL AND WATER DURING THE USE STAGE.....	18
3.12. OTHER ADDITIONAL INFORMATION	19
REFERENCES	20

1. GENERAL INFORMATION

1.1. The DAPHabitat System

Program operator:	Associação Plataforma para a Construção Sustentável www.centrohabitat.net centrohabitat@centrohabitat.net	 Plataforma para a Construção Sustentável
Address:	Departamento Engenharia Civil Universidade de Aveiro 3810-193 Aveiro	
Email address:	deptecnico@centrohabitat.net	
Telephone number:	(+351) 234 401 576	
Website:	www.daphabitat.pt	
Logo:		

1.2. EPD owner

Name of the owner:	CINCA - Companhia Industrial de Cerâmica, S.A.
Production site:	Rua Principal, nº 39 – 4505-374 Fiães
Address (head office):	Rua Principal, nº 39 – 4505-374 Fiães
Telephone:	(+351) 227 476 400
E-mail:	cinca@cinca.pt
Website:	www.cinca.pt
Logo:	
Information concerning the applicable management Systems:	ISO 9001:2015 – Quality Management Systems ISO 14001:2015 – Environmental Management Systems
Specific aspects regarding the production:	NACE/CAE _{Rev.3} n.º 23312 – Manufacture of ceramic tiles and flags

Organization's environmental policy:

CINCA - Companhia Industrial de Cerâmica, S.A.:

Mission:

CINCA is an industrial company producer of wall and floor tiles whose mission is to meet the needs of customers and users of their products by providing a wide range of high-quality wall and floor tiles with competitive prices and lead times, complemented by an extensive customer service.

Policy:

The Integrated Quality, Environment and Safety at Work policy at CINCA is based on the participation of all employees of the organization in the planning department, implementation and maintenance, targeting actions for continuous improvement:

- of quality. By manufacturing, developing and implementation of products and services that meet the requirements of markets and customers, satisfying their needs within the highest standard of quality, exceeding the requirements of applicable norms;
- of environmental performance. Through the identification and control of environmental aspects and impacts of the company, ensuring the reduction and prevention of pollution as well as conservation of natural resources;
- of energy performance. By identifying and monitoring the energy consumptions, establishing plans for the rational use, improvement of efficiency and reduction of consumption in order to reduce costs, greenhouse gas emissions and other related environmental impacts;
- of safety at work. For the prevention of hazards, accidents and occupational diseases, based on continuous training, qualification and appreciation of its employees.

Quality, Environment and Safety at Work:

Conscious of its role in building a future based on sustainability, CINCA has developed, implemented and maintains an Integrated Management System covering the vectors Quality, Environment, Energy and Safety that is based on the international recognition of the reference norms ISO 9001, ISO 14001, ISO 50001 and ISO 45001.

The permanent monitoring of processes and systems enables to improve the quality with minimum waste and maximum resources in order to minimize the environmental impacts of their activity.

Commitment:


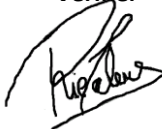
CINCA, which is part of a healthy guideline in a social and industrial environment, strives for the welfare of those who relate to them (customers, suppliers, employees and society in general) and works on a continuous improvement of its products, manufacturing processes and methods of work, without ignoring the environment and in strict compliance with the required norms, laws and regulations.

Therefore, the Board of CINCA commits to inform the present integrated policy to the whole organization, as well as to maintain and continuously improve its Integrated Management System, so that it is appropriate, effective and publicly acknowledged in pursuit of the guidelines here expressed.

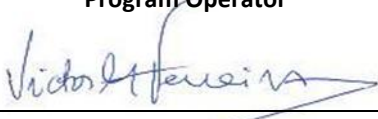
1.3. Information concerning the EPD

Authors:	<ol style="list-style-type: none"> 1. Centro Tecnológico da Cerâmica e do Vidro 2. CINCA - Companhia Industrial de Cerâmica, S.A.
Contact of the authors:	<ol style="list-style-type: none"> 1. CTCV materials: habitat iParque – Parque Tecnológico de Coimbra - Lote 6 3040-540 Antanhol - Portugal (T) +351 239 499 200 Marisa Almeida: marisa@ctcv.pt 2. CINCA - Companhia Industrial de Cerâmica, S.A., Rua Principal, nº 39 – 4505-374 Fiães (T) +351 227 476 400
Emission date:	28/10/2022
Registration date:	31/10/2022
Registration number:	DAP 019:2022
Valid until:	27/10/2027
Representativity of the EPD (location, manufacturer, group of manufacturers):	EPD of one (1) product class, produced in three (3) industrial plants (CINCA - Companhia Industrial de Cerâmica, S.A. – units of Fiães 1, Fiães 2 and Fiães 3)).
Where to consult explanatory material:	www.cinca.pt
Type of EPD:	EPD from 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
	
(CERTIF – Associação para a Certificação)	(Ricardo Mateus)


1.5. EPD Registration

Program Operator

(Plataforma para a Construção Sustentável)

1.6. PCR of reference

Name:	<ol style="list-style-type: none"> 1. PCR: Basic module for construction products and services 2. PCR: Floor covering 3. PCR: Wall covering 4. EN 17160:2019 - Product category rules for ceramic tiles
Issue date:	<ol style="list-style-type: none"> 1. November 2020 2. November 2020 3. November 2020 4. 27-Feb-2019, in force since 15-Apr-2019
Number of registration on the data base:	<ol style="list-style-type: none"> 1. PCR-mb001 2. RCP001:2014 3. RCP002:2014 4. --
Version:	<ol style="list-style-type: none"> 1. Version 2.1 2. Version 1.1 3. Version 1.1 4. --
Identification and contact of the coordinator (s):	<ol style="list-style-type: none"> 1. PCR: basic module for construction products and services <ul style="list-style-type: none"> • Marisa Almeida marisa@ctcv.pt • Luís Arroja arroja@ua.pt • José Silvestre jds@civil.ist.utl.pt 2. PCR: Floor coverings <ul style="list-style-type: none"> • Luís Arroja arroja@ua.pt • Marisa Almeida marisa@ctcv.pt 3. PCR: Wall coverings <ul style="list-style-type: none"> • Luís Arroja arroja@ua.pt • Marisa Almeida marisa@ctcv.pt
Identification and contact of the authors:	<ol style="list-style-type: none"> 1. PCR: basic module for construction products and services <ul style="list-style-type: none"> • 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: Floor coverings <ul style="list-style-type: none"> • Marisa Almeida marisa@ctcv.pt • Luís Arroja arroja@ua.pt • Ana Cláudia Dias acdias@ua.pt 3. PCR: Wall coverings <ul style="list-style-type: none"> • Marisa Almeida marisa@ctcv.pt • Luís Arroja arroja@ua.pt • Ana Cláudia Dias acdias@ua.pt
Composition of the Sectorial Panel:	<ol style="list-style-type: none"> 2. RCP: Floor coverings <ul style="list-style-type: none"> • 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 3. RCP: Wall coverings <ul style="list-style-type: none"> • 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.
Consultation period:	<ol style="list-style-type: none"> 1. 18/11/2015 - 18/01/2016 2. 01/08/2013 - 30/11/2013 3. 12/08/2013 - 30/11/2013
Valid until:	<ol style="list-style-type: none"> 1. December 2022 2. December 2022 3. December 2022 4. --

1.7. Information concerning the product/product class

Identification of the product:	Ceramic floor tiles (Glazed and Unglazed Floor Tiles). Group Bla (EN 14411 Annex G).																																																																														
Illustration of the product:	 <p>white 5500 M 20 x 20 x 0,6 cm ☆ 5</p> <p>Glazed Porcelain Stoneware - Nova Architectura M20x20x0.6cm, Ref. 5500 White</p>																																																																														
Brief description of the product:	<p>CINCA designs, develops, manufactures and sells ceramic floor tiles for public and private areas covering (indoor and outdoor), including residential, retail and service buildings. This product is available in the market in a panoply of aesthetic and dimensional options, as much in visual effects as of texture and colours.</p>																																																																														
Main technical characteristics of the product:	<p style="text-align: center;">Table 1: Technical characteristics</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #2c4e64; color: white;"> <th style="text-align: left;">Essential Characteristics</th> <th style="text-align: left;">Performance</th> <th style="text-align: left;">Test Standard</th> <th style="text-align: left;">Harmonized Technical Specification</th> </tr> </thead> <tbody> <tr> <td>Reaction to Fire</td> <td>Class A1 / A1_{FL}</td> <td>CWT (Dec. 96/603/EC)</td> <td></td> </tr> <tr> <td>Release of Dangerous Substances, for:</td> <td></td> <td></td> <td></td> </tr> <tr> <td>- Cadmium</td> <td>NPD</td> <td>EN ISO 10545-15</td> <td></td> </tr> <tr> <td>- Lead</td> <td>NPD</td> <td>EN ISO 10545-15</td> <td></td> </tr> <tr> <td>Breaking Strength, for:</td> <td></td> <td></td> <td></td> </tr> <tr> <td>- Thickness ≥ 7,5 mm</td> <td>≥ 1300 N</td> <td>EN ISO 10545-4</td> <td></td> </tr> <tr> <td>- Thickness < 7,5 mm</td> <td>≥ 700 N</td> <td>EN ISO 10545-4</td> <td></td> </tr> <tr> <td>Bond Strength / Adhesion, for:</td> <td>See Note (1)</td> <td></td> <td></td> </tr> <tr> <td>- Cementitious Adhesives (Type C2)</td> <td>> 1 N/mm²</td> <td>EN 12004 4.1</td> <td rowspan="3">EN 14411:2012</td> </tr> <tr> <td>- Dispersion Adhesives (Type D1)</td> <td>> 1 N/mm²</td> <td>EN 12004 4.2</td> </tr> <tr> <td>- Reaction Resin Adhesives (Type R2)</td> <td>> 2 N/mm²</td> <td>EN 12004 4.3</td> </tr> <tr> <td>Thermal Shock Resistance</td> <td>Pass</td> <td>EN ISO 10545-9</td> <td></td> </tr> <tr> <td>Slipperiness, for:</td> <td></td> <td></td> <td></td> </tr> <tr> <td>- Barefoot (Ramp Test, Annex A)</td> <td>NPD</td> <td>CEN/TS 16165</td> <td></td> </tr> <tr> <td>- Shod (Ramp Test, Annex B)</td> <td>NPD</td> <td>CEN/TS 16165</td> <td></td> </tr> <tr> <td>Tactility</td> <td>NPD</td> <td>CEN/TS 15209</td> <td></td> </tr> <tr> <td>Durability, for:</td> <td></td> <td></td> <td></td> </tr> <tr> <td>- Internal Uses:</td> <td>Pass</td> <td>-</td> <td></td> </tr> <tr> <td>- External Uses: Freeze-thaw Resistance</td> <td>Pass</td> <td>EN ISO 10545-12</td> <td></td> </tr> </tbody> </table> <p>Note (1): The laboratorial determination regarding the adhesion of ceramic tiles to mortar / cement glue is merely indicative and relevant only under certain specific circumstances, namely, according to the harmonized standard, "only when the tile is used on walls subject to requisites against the fall of objects in trafficable areas". The results obtained and declared are a result of tests carried out under ideal laboratorial conditions, and therefore a correlation between the declared adhesion results and the performance of the tile in use may not exist, since application techniques and the different types of support can strongly influence the final performance.</p> <p>Note (2): Under Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18th of December 2006 (REACH), article 3, number 3, floor and wall tiles are considered articles and are not expected to release any substances when used in normal and reasonably predicted conditions, reason why any safety data sheet for its fixing, transport or use in the market, is not necessary.</p> <p>Note (3): Wall and floor tiles are not classified as hazardous according to the Regulation (EC) No. 1272/2008 of the European Parliament and of the Council of 16th of December 2008.</p> <p>NPD: No Performance Determined</p>	Essential Characteristics	Performance	Test Standard	Harmonized Technical Specification	Reaction to Fire	Class A1 / A1 _{FL}	CWT (Dec. 96/603/EC)		Release of Dangerous Substances, for:				- Cadmium	NPD	EN ISO 10545-15		- Lead	NPD	EN ISO 10545-15		Breaking Strength, for:				- Thickness ≥ 7,5 mm	≥ 1300 N	EN ISO 10545-4		- Thickness < 7,5 mm	≥ 700 N	EN ISO 10545-4		Bond Strength / Adhesion, for:	See Note (1)			- Cementitious Adhesives (Type C2)	> 1 N/mm ²	EN 12004 4.1	EN 14411:2012	- Dispersion Adhesives (Type D1)	> 1 N/mm ²	EN 12004 4.2	- Reaction Resin Adhesives (Type R2)	> 2 N/mm ²	EN 12004 4.3	Thermal Shock Resistance	Pass	EN ISO 10545-9		Slipperiness, for:				- Barefoot (Ramp Test, Annex A)	NPD	CEN/TS 16165		- Shod (Ramp Test, Annex B)	NPD	CEN/TS 16165		Tactility	NPD	CEN/TS 15209		Durability, for:				- Internal Uses:	Pass	-		- External Uses: Freeze-thaw Resistance	Pass	EN ISO 10545-12	
Essential Characteristics	Performance	Test Standard	Harmonized Technical Specification																																																																												
Reaction to Fire	Class A1 / A1 _{FL}	CWT (Dec. 96/603/EC)																																																																													
Release of Dangerous Substances, for:																																																																															
- Cadmium	NPD	EN ISO 10545-15																																																																													
- Lead	NPD	EN ISO 10545-15																																																																													
Breaking Strength, for:																																																																															
- Thickness ≥ 7,5 mm	≥ 1300 N	EN ISO 10545-4																																																																													
- Thickness < 7,5 mm	≥ 700 N	EN ISO 10545-4																																																																													
Bond Strength / Adhesion, for:	See Note (1)																																																																														
- Cementitious Adhesives (Type C2)	> 1 N/mm ²	EN 12004 4.1	EN 14411:2012																																																																												
- Dispersion Adhesives (Type D1)	> 1 N/mm ²	EN 12004 4.2																																																																													
- Reaction Resin Adhesives (Type R2)	> 2 N/mm ²	EN 12004 4.3																																																																													
Thermal Shock Resistance	Pass	EN ISO 10545-9																																																																													
Slipperiness, for:																																																																															
- Barefoot (Ramp Test, Annex A)	NPD	CEN/TS 16165																																																																													
- Shod (Ramp Test, Annex B)	NPD	CEN/TS 16165																																																																													
Tactility	NPD	CEN/TS 15209																																																																													
Durability, for:																																																																															
- Internal Uses:	Pass	-																																																																													
- External Uses: Freeze-thaw Resistance	Pass	EN ISO 10545-12																																																																													
Description of the products' application:	<p>Ceramic tiles for indoor and outdoor wall and floor coverings, excluding the use as wall coverings when subject to specific regulations on hazardous substances (ex: when glazed products are used on surfaces where they have direct contact with food). This product can have the following applications:</p> <ul style="list-style-type: none"> • 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 (CEN,2012). 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 the realistic service life for the tiles.
Placing on the market / Rules of application in the market / Technical rules of the product:	<ul style="list-style-type: none"> • 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:	Quality control according to the technical standards of the product.
Special delivery conditions:	Not applicable
Components and substances to declare:	Not applicable
History of the LCA studies:	--

2. ENVIRONMENTAL PERFORMANCE OF THE PRODUCT

2.1. Calculation rules of the LCA

Declared unit:	--												
Functional unit:	1 m ² of ceramic floor tiles (average of all floor tiles manufactured) and for a reference service life (RSF) of 50 years.												
	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Value</th> <th>Unit of measure</th> </tr> </thead> <tbody> <tr> <td>Unit of measurement</td> <td>1</td> <td>m²</td> </tr> <tr> <td>Weight</td> <td>15.08</td> <td>kg/m²</td> </tr> <tr> <td>Conversion factor to 1 kg</td> <td>0.0663</td> <td>m²/kg</td> </tr> </tbody> </table>	Parameter	Value	Unit of measure	Unit of measurement	1	m ²	Weight	15.08	kg/m ²	Conversion factor to 1 kg	0.0663	m ² /kg
Parameter	Value	Unit of measure											
Unit of measurement	1	m ²											
Weight	15.08	kg/m ²											
Conversion factor to 1 kg	0.0663	m ² /kg											
System boundaries:	EPD from cradle to grave												
Criteria for the exclusion:	<p>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.</p> <p>The following cases were not considered in this study, as they may fall under the exclusion criteria:</p> <ul style="list-style-type: none"> • 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. <p>All flows in known inputs and outputs were considered</p>												
Assumption and limitations:	<p>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.</p> <p>The dataset used to model the production of electricity and natural gas was adapted to the national reality. The electric mix was updated for the year 2019 through information from the National Energy Networks (<i>Redes Energéticas Nacionais</i> - REN), the Energy Services Regulatory Authority (<i>Entidade Reguladora dos Serviços Energéticos</i> - ERSE) and the General Board of Energy and Geology (<i>Direção-Geral de Energia e Geologia</i> - DGEG) in order to obtain more up-to-date results regarding the environmental impacts caused 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.</p> <p>The environmental impacts indicated in this EPD are a weighted average of all Fiães Units (1, 2 and 3) ceramic wall and floor tiles produced in 2019.</p> <p>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.</p>												
Quality and other characteristics about the information used in the LCA:	<p>The production data collected correspond to the year 2019 and are in line with reality. The generic data used belong to the Ecoinvent v3.3 databases and meet the quality criteria (age, geographical and technological coverage, plausibility, etc.) of generic data.</p> <p>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, which is specific and is checked. Carbon dioxide emissions (related to carbonate oxidation) are collected through the ETS (Emissions Trading Scheme) declaration.</p> <p>Detailed data were obtained for mixtures of raw materials (collected with primary data from the company) and for dyes, frits, and other raw materials for glaze production.</p> <p>The overall quality of the data can be considered good.</p>												
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 considered.

Comparability of EPD for construction products:

The EPDs for construction products and services are not comparable if they are not produced in accordance with EN 15804 and EN 15942 and in accordance with the comparability conditions determined by ISO 14025.

For each ceramic product, manufactured in the Cinca - Fiães Industrial Units (1, 2 and 3), the environmental impacts were determined by multiplying the results of this study by mass scale factors

2.1.1. Flow diagram of input and output of the processes

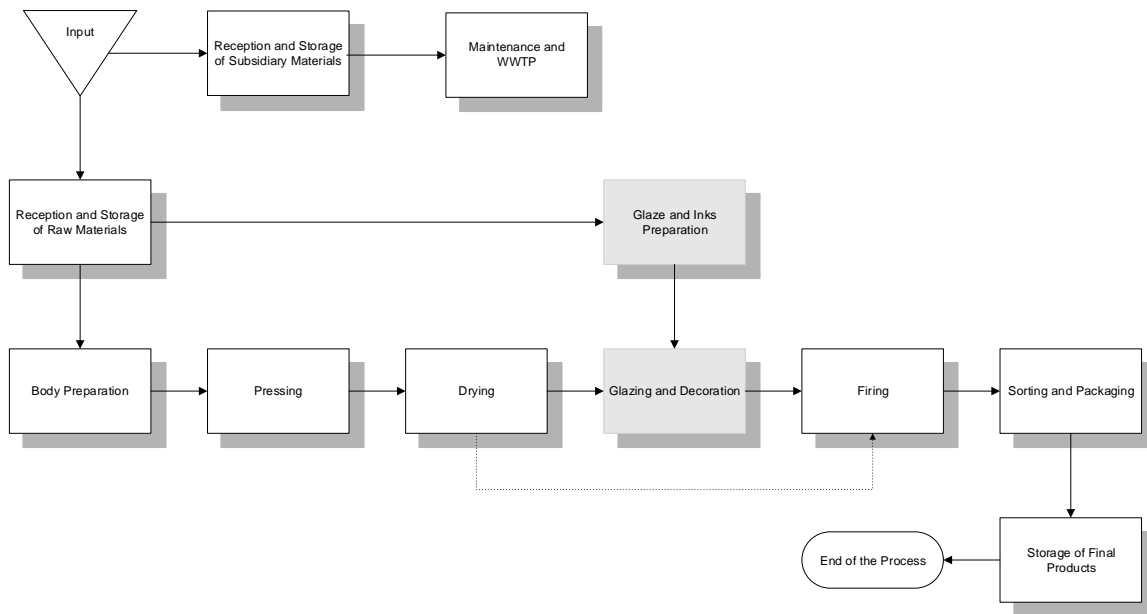


Figure 1 - Production process of the ceramic tile covered by this EPD.

Production Unit Fiães 1

Body Preparation

The raw materials are stored in the bins.

In the paste section there are mills, thinners, mixers, agitators and atomizers. There is a distinction based on the colour of the pastes ("white" and "red"), whose manufacturing processes follow separate paths, in order to avoid mixtures between the light and dark colours that may alter the tone of the pastes.

The process starts with the weighing of raw materials (hard and soft materials).

The raw materials of the feldspar and sand type are ground.

Raw materials such as clays and kaolin are dispersed in water in dilution tanks.

The products of the mills and thinners are discharged to the mixers, where the paste is homogenized. From the mixers the paste is pumped to the agitators, passing through fine mesh sieves and deferrisers in order to remove magnetic impurities.

The agitators maintain the homogeneity of the paste.

Drying is done by the atomization process. The paste is injected at high pressure into the atomizer chamber where the water vaporizes, leaving a spherical particulate powder at the bottom of the atomizer. This powder is transported to silos where it is stored.

Manufacture of tiles

From the silos, the paste is transported in trolleys to feed the hydraulic presses.

The shaping of the mosaics is done by dry pressing the powder in steel moulds. The mosaics are placed in refractory material boxes. These boxes are stored in cars headed for the tunnel dryer.

Then, the material is subjected to a drying operation in order to reduce its moisture.

After drying, the mosaic is fired in an electric oven.

After firing, a pre-choice is made where the batches are defined.

With proper identification, the boxes go to a warehouse, from which they will be sent to the lines of choice and packaging, where the qualitative choice of material is made.

Production Unit Fiaes 2 and 3

Body Preparation

It starts by weighing the raw materials, on two fixed scales, one being used for weighing hard materials (pegmatites and sand) and the other for clay materials (clays and kaolin).

The hard materials, after being weighed, are sent to the mill's preload hoppers by means of web conveyors.

From the hoppers, hard materials enter Alsing-type or a continuous mill and grind.

After the end of the grinding, the mills are discharged to the mixer diluters.

The clay materials after weighing are transported to dosing feeders mounted on the thinners, being dispersed in water and mixed with the hard materials from the mills.

After the dilution and mixing process is finished, the paste is screened through a sieve to separate impurities. Then the slip passes to agitators, which are tanks, with the objective of maintaining homogeneity.

The liquid paste is pumped to the atomiser's service stirrer, being sieved and deferrized once more, after which it is ready to be atomized.

Drying is done by the atomization process. The liquid paste is injected at high pressure into the atomiser chamber, which is heated. In this chamber water vaporization takes place, leaving a spherical particulate powder with a residual humidity of 5% from the atomizer.

The powder travels on a belt conveyor to the elevator, which deposits in the silos. In these, there is a 24-hour stay so that moisture is homogenized.

There is a recovery of technological waters. In effect, all the water used in the manufacturing process is recycled, being reincorporated into the circuit again.

Glazes Preparation

This unit consists of mills coated with high density alumina, which use balls of the same material for grinding, and vats with an individual capacity corresponding to the load of a mill.

Enamels and dyes are ground together with deflocculants.

Then the discharge is made to the vats, passing the material through a sieve.

If necessary, the glass is deferrized and sieved again.

Pending its use in glazing, the glass is kept under agitation in the vats.

Manufacture of Tiles

The atomized paste is automatically transported from the silos where it is stored to the press silos, passing through a classification sieve.

In the presses, the dies with the desired shapes for production are assembled.

The pressing is done dry, the number of outputs of the press depends on the format in production. A line unifying device is used to optimize the dryer performance.

The drying cycle reduces the moisture content of the material to less than 1%.

This is followed by the glazing operation, which can include several applications. Depending on the type of mosaic to be produced, various application techniques can be used: disc, pistol, hoods and digital printing machines.

After glazing, the mosaic is placed in cars that are transported to the park by computerized robots.

Before entering the oven, the mosaics pass through a dryer to remove any remaining moisture.

Cooking takes place in three rapid refractory roller ovens running on gas.

The selection phase comprises three stages: pre-selection, choice and palletizing.

In the pre-choice, the direct analysis of the cars with cooked material is made, to determine the lots to be chosen and to detect deficiencies.

The choice (properly speaking) involves operators and electronic equipment, the material being classified according to lots, gauges, defects, etc.

The automatic packaging of the mosaic follows in boxes, which are duly identified by inscriptions carried out by printers.

Finally, the boxes are palletized, that is, properly arranged on pallets, after which they go to the warehouse.

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	Rehabilitation	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. Three scenarios were considered for the transport: 300 km (truck), 1390 km (truck) and 6520 km (ship) according to EN 17160.

Module **A5** considers all tile installation steps (like adhesives consumption) also packaging waste processing (recycling, incineration, disposal). The default values were according to EN 17160. 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 according to EN17160.

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. According to EN17160 it is considered negligible.

Module **C2** considers transportation of the discarded tile to a recycling or disposal process. It was considered 20 km.

Module **C3** considers every process (collection, crushing process etc.) properly for recycling the tiles (70% following EN17160).

Module **C4** includes all the landfill disposal processes, including pre-treatment and management of the disposal site (20 km) (30% following EN17160).

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	Depletion potential of the stratospheric ozone layer; ODP	Acidification potential of soil and water, AP	Eutrophication potential, EP	Formation potential of tropospheric ozone, POCP	Abiotic depletion potential for non-fossil resources	Abiotic depletion potential for fossil resources
		kg CO ₂ equiv.	kg CFC 11 equiv.	kg SO ₂ equiv.	kg (PO ₄) ³⁻ equiv.	kg C ₂ H ₄ equiv.	kg Sb equiv.	MJ, P.C.I.
Raw material supply	A1	-	-	-	-	-	-	-
Transport	A2	-	-	-	-	-	-	-
Manufacturing	A3	-	-	-	-	-	-	-
Total	Total	1.18E+01	1.97E-06	2.94E-02	3.52E-03	2.09E-03	3.45E-04	1.63E+02
Transport	A4 – Scenario 1 (a)	6.06E-01	1.12E-07	1.01E-03	1.19E-04	5.03E-05	2.60E-08	8.64E+00
	A4 – Scenario 2 (a)	2.81E+00	5.19E-07	4.66E-03	5.51E-04	2.33E-04	1.20E-07	4.00E+01
	A4 – Scenario 3 (a)	5.90E-01	9.87E-08	1.49E-02	1.46E-03	3.95E-04	4.97E-09	7.64E+00
Construction installation process	A5	1.11E+00	8.30E-08	2.60E-03	3.79E-04	1.81E-04	1.04E-05	8.04E+00
Use	B1	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Maintenance	B2	4.78E-01	5.75E-08	2.93E-03	2.19E-04	1.67E-04	2.47E-07	1.78E+01
Repair/Replacement/Refurbishment	B3 – B5	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Operational energy/water use	B6 – 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	4.04E-02	7.46E-09	6.71E-05	7.92E-06	3.35E-06	1.73E-09	5.76E-01
Waste processing	C3	4.09E-02	7.33E-09	3.16E-04	7.00E-05	6.17E-06	2.05E-09	5.70E-01
Disposal	C4	3.03E-02	5.44E-09	1.97E-04	4.27E-05	4.44E-06	1.48E-09	4.24E-01
Re-use, recovery, recycling potential	D	-2.16E-02	-3.21E-09	-1.36E-04	-2.84E-05	-4.24E-06	-6.63E-09	-2.86E-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 m²).

a) three transport scenarios were considered according to EN 17160: Scenario 1: 300km (truck); Scenario 2: 1390km (truck); Scenario 3: 6520km (ship)

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	4.08E+01	4.64E-21	4.08E+01	1.87E+02	2.98E-01	1.88E+02	0.00E+00	0.00E+00	0.00E+00	8.05E-02
Transport	A4 – Scenario 1 (a)	1.27E-02	0.00E+00	1.27E-02	9.19E+00	0.00E+00	9.19E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-04
	A4 – Scenario 2 (a)	5.90E-02	0.00E+00	5.90E-02	4.26E+01	0.00E+00	4.26E+01	0.00E+00	0.00E+00	0.00E+00	7.95E-04
	A4 – Scenario 3 (a)	1.00E-02	0.00E+00	1.00E-02	8.12E+00	0.00E+00	8.12E+00	0.00E+00	0.00E+00	0.00E+00	1.10E-04
Construction installation process	A5	2.01E+00	0.00E+00	2.01E+00	1.04E+01	0.00E+00	1.04E+01	0.00E+00	0.00E+00	0.00E+00	4.99E-03
Use	B1	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Maintenance	B2	2.60E-01	0.00E+00	2.60E-01	1.93E+01	0.00E+00	1.93E+01	0.00E+00	0.00E+00	0.00E+00	6.60E-03
Repair/Replacement/Refurbishment	B3 – B5	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Operational energy/water use	B6 – 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	8.49E-04	0.00E+00	8.49E-04	6.13E-01	0.00E+00	6.13E-01	0.00E+00	0.00E+00	0.00E+00	1.14E-05
Waste processing	C3	9.07E-04	0.00E+00	9.07E-04	6.06E-01	0.00E+00	6.06E-01	0.00E+00	0.00E+00	0.00E+00	1.44E-05
Disposal	C4	6.59E-03	0.00E+00	6.59E-03	4.53E-01	0.00E+00	4.53E-01	0.00E+00	0.00E+00	0.00E+00	2.29E-05
Re-use, recovery, recycling potential	D	-1.62E-01	0.00E+00	-1.62E-01	-4.65E-01	0.00E+00	-4.65E-01	0.00E+00	0.00E+00	0.00E+00	-3.92E-03

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

	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 (EPNR + RNR); MS = use of secondary material; CSR = use of renewable secondary fuels; CSNR = use of non-renewable secondary fuels.

NOTES: Units expressed by functional unit (1 m²).

P.C.I. – Net calorific value

a) three transport scenarios were considered according to EN 17160: Scenario 1: 300km (truck); Scenario 2: 1390km (truck); Scenario 3: 6520km (ship)

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	3.31E+00	1.22E-02	2.93E-04
Transport	A4 – Scenario 1 (a)	2.29E-05	3.62E-04	6.28E-05
	A4 – Scenario 2 (a)	1.06E-04	1.68E-03	2.91E-04
	A4 – Scenario 3 (a)	4.50E-06	3.66E-04	5.53E-05
Construction installation process	A5	9.92E-02	2.58E-01	4.08E-05
Use	B1	N.R.	N.R.	N.R.
Maintenance	B2	9.28E-06	1.39E-02	7.01E-06
Repair/Replacement/Refurbishment	B3 – B5	N.R.	N.R.	N.R.
Operational energy/water use	B6 – B7	N.R.	N.R.	N.R.
De-construction and demolition	C1	N.R.	N.R.	N.R.
Transport	C2	1.53E-06	2.41E-05	4.18E-06
Waste processing	C3	1.49E-06	3.57E-05	4.11E-06
Disposal	C4	1.11E-06	3.67E+00	3.07E-06
Re-use, recovery, recycling potential	D	-6.46E-07	-2.75E-01	-4.08E-06

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

LEGEND:

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

NOTES: Values expressed by functional unit (1 m²)

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

a) three transport scenarios were considered according to EN 17160: Scenario 1: 300km (truck); Scenario 2: 1390km (truck); Scenario 3: 6520km (ship)

2.5. Other environmental information describing output flows

Parameters	Units*	Results
Components for re-use	kg	N/A
Materials for recycling	Kg	1.10E+01
Materials for energy recovery	kg	8.10E-01
Exported energy	MJ by energy carrier	N/A

* expressed by functional unit or declared unit (kg)

N/A - not applicable

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 3.3 kg of cementitious adhesive for each m² of ceramic tile. The ceramic material loss considered was 3%. The waste included also the packaging waste.

Option 3 (medium size tiles)	Value	Unit of measure
Cementitious adhesive	3.3	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 tiles was conservative and according to EN 17160.

The scenario used for maintaining ceramic floor tiles was for residential use, using 0.134 ml detergent and 0.1 l water to wash 1 m² of ceramic floor tiles once a week.

Parameter	Value	Unit of measure
Water consumption	0.1	l
Detergent consumption	0.134	ml
Wall tile maintenance cycle	2600	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

This module is not relevant for ceramic tiles, according to EN 17160.

3.9. B7 Use of water

This module is 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:

Destination	Value	Unit of measure
Recycling (C3)	70	%
Landfill (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 and 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 are 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

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

Compound	Emission Factor ($\mu\text{g}/\text{m}^2\cdot\text{hr}$)
TVOC	BQL
Formaldehyde	BQL
Total Aldehydes	BQL

Target List Aldehydes at 24 Elapsed Exposure Hours		
CAS Number	Compound	Emission Factor ($\mu\text{g}/\text{m}^2\cdot\text{hr}$)
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

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. Other additional information

Environmental protection

The manufacturing of CINCA's floor tiles is based on Best Available Techniques (BAT) in the industry, with the aim of reducing natural resources and energy to a minimum.

100% of manufacturing recyclable residues are reutilized in the manufacturing. Production lines reutilize closed water circuits that are adequately treated resulting in total recovery of water for production with zero discharges to the environment. Gas emissions levels are analysed periodically to confirm its conformity with local and European rules and regulations. Whenever necessary appropriate treatment systems are in place.

The cardboard boxes and wooden pallets are non-reusable and therefore are sent to the respective recycling centres.

Permanent monitorization of all processes and systems allow for improved quality, minimizing waste and resources to reduce any environmental impact to a minimum. CINCA has strict environmental control systems implemented, which in many aspects, are beyond that required by National and European Union regulations.

CINCA's Integrated Management System is submitted periodically to third party evaluation that monitor CINCA's capacity to comply with legal regulations, as well as the achievement of targets set out by the company itself.

Under normal conditions of use, life span of ceramic floor tiles is higher than any other product conceived for the same use.

Ceramic products are considered inert and no particular care is required in its treatment as a residue. In the event of replacement, ceramic tiles are easy to recycle and may be used as raw materials for other industries.

All packaging materials (boxes, plastic and wooden pallets) are totally recyclable and easily reutilized.

REFERENCES

- ✓ **Almeida. M.** (2019). Desempenho ambiental de produtos no sector cerâmico em Portugal. Tese de doutoramento. Universidade de Aveiro.
- ✓ **Direção-Geral de Energia e Geologia (DGEG)** – Energy in Portugal Report (2019)
- ✓ **Direção-Geral de Energia e Geologia (DGEG)** – Monthly Data of Electrical Energy (2019). (in <http://www.dgeg.gov.pt?cr=15125>)
- ✓ **Ecoinvent database v3.7** (2019). (www.ecoinvent.org)
- ✓ **EN 15804:2012** Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products;
- ✓ **EN 15804:2012+A1:2013** 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.
- ✓ **EN 17160:2019** – “Product category rules for ceramic tiles”.
- ✓ **Entidade Reguladora dos Serviços Energéticos (ERSE)** – Special Regime Production (PRE) (2019) (in <http://www.erse.pt/pt/desempenhoambiental/prodregesp/2019/Paginas/2019.aspx>)
- ✓ **General Instructions of the DAPHabitat System**, Version 1.0, Edition March 2013 (in www.daphabitat.pt);
- ✓ **ISO 14025:2009** Environmental declarations and labels – Type III environmental declarations – Principles and procedures;
- ✓ **PCR – basic module for construction products and services**. DAPHabitat System. Version 1.0, 2013 (in www.daphabitat.pt);
- ✓ **Redes Energéticas Nacionais (REN)** – Information Centre – Monthly Statistics (2019). (in <http://www.centrodeinformacao.ren.pt/PT/InformacaoExploracao/Paginas/EstatisticaMensal.aspx>)
- ✓ **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).