



## ENVIRONMENTAL PRODUCT DECLARATION

Product name:

Porcelain Stoneware  
Ceramic Tiles and Slabs

Site Plant:

Via I Maggio, 22  
42013 Casalgrande (RE), Italy

in compliance with ISO 14025 and EN 15804

Program Operator	EPDIItaly
Publisher	EPDIItaly
Declaration Number	EPD-03-REF
EPDIItaly Registration Number	EPDITALY0034
ECO EPD Registration Number	00000759
Issue Date	01/09/2018
Valid to	01/09/2023



<p><b>Owner of the program</b></p> <p>EPDItaly</p>	<p><b>Owner of the declaration</b></p> <p><b>Ceramiche Refin S.p.A.</b></p> <p>Via I Maggio 22, 42013 Casalgrande (RE), Italy</p>
<p><b>Declaration number</b></p> <p>EPD-03-RFN</p>	<p><b>Date of issue</b> September 1, 2018</p> <p><b>Valid until</b> September 1, 2023</p>
<p><b>Audit</b></p> <p>Independent audit of the EPD and of the data contained therein</p> <p>conducted in accordance with ISO 14025</p> <p><input type="checkbox"/> internal      <input checked="" type="checkbox"/> external</p> <p>Performed by ICMQ S.p.A. – Via de Castilla, 10 – 20124</p> <p>Milan (<a href="http://www.icmq.it">www.icmq.it</a>)</p>	<p><b>Field of application</b></p> <p>This document refers to an average product “ceramic tiles and slabs”, manufactured at:</p> <p>Ceramiche Refin S.p.A. – Via I Maggio 22 - 42013 Casalgrande (RE).</p>
<p><b>Comparability</b></p> <p>Environmental declarations published within the same product category but coming from different programs may not be comparable. In particular, EPDs of construction products may not be comparable if not compliant with EN 15804.</p>	<p><b>Responsibility</b></p> <p>Ceramiche Refin S.p.A. holds EPDItaly harmless for any failure to comply with the environmental legislation declared by the manufacturer itself.</p> <p>The holder of the declaration will be responsible for the information and supporting evidence; EPDItaly disclaims any liability with regard to the manufacturer's information, the data and any results of the life cycle assessment.</p>

## SECTION 2 - GENERAL INFORMATION

### THE COMPANY

Ceramiche Refin was founded in 1962 and over the years has become a reference point for the ceramics market achieving product and production excellence, thus becoming more and more competitive on the international market.



Refin's mission is to produce surface solutions with high technological quality, image and Italian design for the ceramic tile market, particularly focusing on lightweight commercial and high level residential designs, managing the company ethically and respecting the environment.

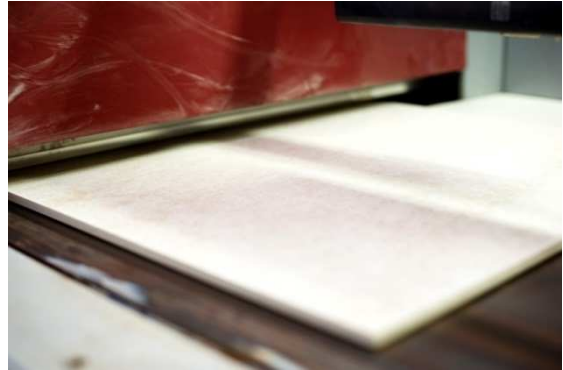
Refin interprets "Made in Italy" as a productive model combining the creative flair typical of the company culture with the work ethics that have always characterized Italian manufacturing tradition. For this reason Refin has adhered to the Made in Italy ethical code promoted by Confindustria Ceramica, stating, with clarity and transparency, the origin of the products.

Ceramiche Refin has a productive capacity of more than 7 million sqm of tiles per year, supported by avant-garde machinery for the creation of surface graphics and post-manufacturing processes, as well as a modern laboratory committed to the research of new technological solutions. All the phases of the production process undergo strict control procedures and the excellent quality standards of the products are certified by the most important international certifications.

Today Refin offers a broad range of porcelain stoneware solutions for floors and walls, able to enhance the multitude of contemporary architectural styles for residential settings and for the world of design.

### CERAMIC TILES

The ceramic tiles are produced by dry pressing natural raw materials like clay, feldspar, sand and kaolin. The type of tiles produced is porcelain stoneware, distinguished by a very compact structure and high level of performance. For this study an average product was identified and adopted, representative of Ceramiche Refin's entire product range.



### INTENDED APPLICATION

The ceramic tiles analyzed here are intended to be used for both floors and walls and to be installed both indoors and outdoors, both for floors and walls, for residential and commercial use.

## EPD PURPOSE AND TYPE

In accordance with the PCRs of reference, the LCA study is of the **cradle-to-grave** type. The system analyzed takes into account all the stages from the production of raw materials to the production of the finished and packaged product (A1-A3), distribution to the final customer (A4), as well as the end of the product's life including transport (C2), energy recovery (C3) and landfill disposal (C4), with the addition of any energy credits (D).

To produce the LCA the tool "EPD tool creator for Ceramic Tile - V5 (13-07-18) - DB version 2018 SP36" was used by thinkstep AG, Leinfelden-Echterdingen, 2016, validated by ICMQ and IBU Institut Bauen und Umwelt.

The declaration is classified as:

- 1 a: Manufacturer environmental product declaration (product EPD) for a specific product by a specific manufacturer

Furthermore this declaration was developed according to the EPDItaly program and is based on product category rules (PCR):

- IBU PCR Part B:30-11-2017 V1.6
- EPDItaly - PCR ICMQ-001/15 rev. 2 21/04/2017

The EN 15804 standard constitutes the framework of reference for the PCRs.

Product declared / Unit of measurement declared:

**1 m<sup>2</sup> of ceramic tiles.**

The data relating to the LCA study (life cycle assessment) refer to the entire production of 2016.

## SECTION 3 - DESCRIPTION OF THE PRODUCT AND THE PRODUCTION PROCESS

### BASIC MATERIALS / AUXILIARY MATERIALS

#### Main raw materials for ceramic tiles:

- Clay 41%
- Sand 23%
- Feldspar 25%

#### Main components of the glaze:

- Clay powder
- Alumina
- Natural pigments
- Frits

#### Main auxiliary additives:

- Dispersing agents
- Binding agents
- Fluidifying agents
- Leveling agents
- Air release agents

### PRODUCTION PROCESS

The manufacturing process of the ceramic tiles covered by this EPD is illustrated and described below.

The required composition of raw materials – including therefore recycled waste – is mixed and milled in wet milling plants: the slip produced (a suspension with about 25-30% of water) is treated in spray dryers (atomizers) that use thermal energy generated by natural gas and high atmospheric pressure to produce a dry powder with spherical granules of suitable size distribution, ready to be pressed.

For the drying process energy is produced through cogeneration.

The ceramic tiles are formed by dry pressing with the aid of special molds (isostatic pressing).

Glazing and decoration are carried out on the surfaces of the dried tiles.

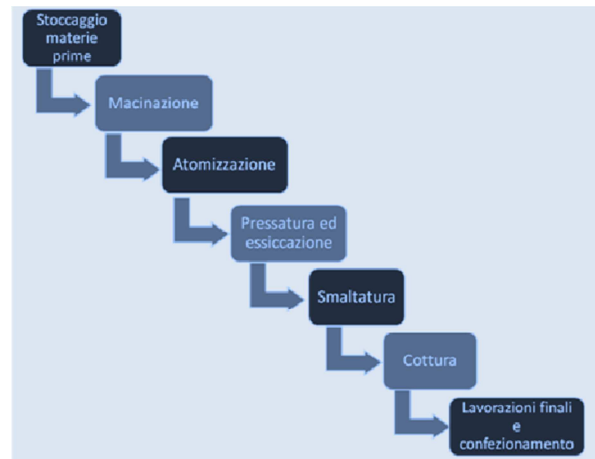
Both wet and dry application techniques are used.

The firing stage is carried out at different temperatures (depending on the ceramic tiles produced, between 1000°C and 1300°C) to obtain the typical characteristics of abrasion, resistance to water and to chemical products and durability of the ceramic tiles.

Before arriving at the sorting and packaging lines, the rectified products are cut and squared to the desired size.

The final product is packaged in cardboard boxes, stacked on wooden pallets and protected by PET film. The tiles are stored in the warehouse until the order is ready for shipment to the customer.

The monitoring of manufacturing performance is mainly carried out through the quality management system and certification of processes in accordance with ISO 9001 and OHSAS 18001 international standards.



### TECHNICAL DATA

The ceramic tiles produced comply with the regulations and specifications listed below:

Pursuant to European EN 14411 and international ISO 13006 standards, ceramic tiles are classified in attachment B1a, with water absorption  $E \leq 0.5\%$ .

The requirements listed in attachments A to L of the ISO 13006 and EN 14411 standards are:

length and width (ISO 10545/ 2 - sec. 2),  
thickness (ISO 10545/ 2 - sec. 3),  
straightness of sides (ISO 10545/ 2 - sec. 4),  
rectangularity (ISO 10545/ 2 - sec. 5),  
edge curvature and warpage (ISO 10545/ 2 - sec. 6).

Surface quality (ISO 10545/ 2 - sec. 7): a minimum of 95% of the tiles shall be free from visible defects that would impair the appearance of a major area of tiles.

STANDARD	Value	Unit of measure
Dimensional characteristics and surface quality according to ISO10545-2	Compliant	
Water absorption according to ISO10545-3	Compliant	
Breaking load according to ISO 10545-4	8 – 35 (min)	N/mm <sup>2</sup>
Modulus of rupture according to ISO 10545-4	200-1300 (min)	N/mm <sup>2</sup>
Resistance to surface abrasion - Glazed tiles according to ISO 10545-7	0 - 5	Abrasion class
Linear thermal expansion coefficient according to ISO 10545-8	9 E10-6 (max)	1/K
Resistance to thermal shock according to ISO 10545-9	Resistant	
Crazing resistance according to ISO 10545-11	Resistant	
Frost resistance according to ISO 10545-12	Resistant	
Anti-slip properties (class A, B or C) according to /CEN/TS 16165/	Resistant	
Cohesive/adhesion strength according to EN 12004	Resistant	
Impact resistance according to ISO 10545-5	Resistant	
Fire resistance without test (CWT)	A1-A1FL	
Chemical resistance according to ISO 10545-13	A-C	
Resistance to household chemicals and pool additives according to ISO 10545-13	B (min)	
Resistance to low and high concentrations of acids and alkalis according to ISO 10545-13	Resistant	
Resistance to stains according to ISO 10545-14	Resistant	
Release of lead and cadmium - Glazed tiles according to ISO 10545-15	Where Required	

Moisture expansion according to ISO 10545-10	Resistant
Resistance to deep abrasion (unglazed tiles) according to ISO 10545-6	<175 mm <sup>3</sup>

#### APPLICABLE STANDARDS

For sales in EU/EFTA, with the exception of Switzerland, EU Regulation no. 305/2011 applies.

The products require a Declaration of Performance that takes into account the EN 14411 standard "Ceramic tiles - Definition, classification, characteristics, assessment and verification of constancy of performance and marking".

#### STATE OF DELIVERY

The dimensions of the products can vary according to the various formats; the thickness varies from 6 mm to 20 mm.

#### ENVIRONMENT AND HEALTH - MANUFACTURE

Workers are informed about the physical and chemical risks associated with their profession and workplace. They receive appropriate training and personal protective equipment.

Ceramiche Refin is certified BS OHSAS 18001

#### Water / soil

The production process does not cause any contamination of water and soil: All wastewater produced is recycled or fed into internal treatment plants in order to reuse it internally or externally.

#### Air

Natural gas is used only to produce energy. Emissions generated by the combustion process are monitored and kept below strict limits. Environmental protection measures are adopted.

In addition, the company uses self-produced electricity through cogeneration.

#### PRODUCT INSTALLATION

The tiles are anchored to the wall and floor surfaces by means of different materials and quantities, for example dispersion/cementitious adhesives and mortar, sealants or applied liquid membranes. During installation no emissions are generated and the

ceramic tile installations do not cause health or environmental hazards.

## PACKAGING

The tiles are packed in cardboard boxes, wrapped in polyethylene film and plastic straps, then stacked on wooden pallets. The amount of packaging material varies according to the size of the tiles.

The end-of-life stage of packaging includes (according to Eurostat 2013):

- Paper: recycling, energy recovery, disposal.
- Plastic: recycling, energy recovery, disposal.
- Wood: reuse, energy recovery, landfill.

## CONDITIONS OF USE

Ceramic tiles are robust and inert having been fired at high temperatures. The environmental impacts generated during stage B1 are very low and therefore not worthy of note.

## ENVIRONMENT AND HEALTH - USE

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

## USEFUL LIFE OF REFERENCE

The useful life of tiles is generally more than 50 years (BNB 2011). Moreover, according to the US Green Building Council, the useful life of tiles could be the same as the useful life of the building itself. Therefore, 60 years could represent an alternative useful life for tiles according to the US GBC.

The results reported take into account the use of the tiles for 1 year, therefore by multiplying the

B2 values by 50 or 60 it is possible to obtain B2 values for 50 or 60 years.

No life reference is reported according to ISO 15686.

## EXTRAORDINARY CONDITIONS

**Fire:** According to EN 13501-1:2007+A1:2009, ceramic tiles can be classified as belonging to fire resistance class A1 or A1fl since they do not contribute to the spread of fire.

**Water:** Ceramic tiles do not absorb surface water because they are waterproof and chemically inert.

**Mechanical destruction:** Ceramic tiles can be mechanically crushed but no damage to the environment is expected.

## REUSE STAGE

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

## DISPOSAL

According to the European Waste Catalog (EWC), ceramic tiles belong to group 17 "Construction and demolition waste", Tiles and ceramics (code: 17 01 03).

## MORE INFORMATION

More information can be found at the following websites:

[www.refin.it](http://www.refin.it)

[www.confindustriaceramica.it](http://www.confindustriaceramica.it)

[www.laceramicaitaliana.it](http://www.laceramicaitaliana.it)

## SECTION 4 - LCA (LIFE CYCLE ASSESSMENT): RESULTS

The following tables illustrate the results of the LCA (life cycle assessment). Basic information on all declared modules is given in the previous section.

### DESCRIPTION OF SYSTEM LIMITS

PRODUCTI ON STAGE			INSTALLA TION STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS BEYOND THE BOUNDARIE S OF THE SYSTEM	
Supply of raw materials	Transport	Manufacturing	Transportation from the gate to	Installation	Use	Maintenance	Repair	Replacement	Renovation	Use of operating energy	Use of operating water	Disassembly	Demolition	Transport	Waste treatment	Disposal	Potential of reuse-recovery-recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

(X = INCLUDED IN THE LCA; MND = MODULE NOT DECLARED)

### LCA RESULTS

ENVIRONMENTAL IMPACT: 1m<sup>2</sup> OF MEDIUM CERAMIC TILES (24.,4 kg/m<sup>2</sup>)

Parameter	GWP	ODP	AP	EP	POCP	ADPE	ADPF	
Unit of Measure	[kg CO2-eq.]	[kg CFC11-eq.]	[kg SO2-eq.]	[kg PO43-eq.]	[kg ethene-eq.]	[kg Sb-eq.]	[MJ]	
LIFE CYCLE STAGE	A1-3	9,60E+00	4,02E-11	3,75E-02	2,88E-03	2,27E-03	3,04E-05	1,56E+02
	A4	6,49E-01	2,37E-14	5,35E-03	5,96E-04	2,75E-04	4,72E-08	8,60E+00
	A5	2,51E+00	5,00E-12	4,75E-03	7,60E-04	3,33E-04	6,05E-06	1,79E+01
	B1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B2	4,04E-02	7,63E-12	5,85E-05	4,47E-05	6,56E-06	1,33E-08	3,46E-01
	B3	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B4	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B5	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B6	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B7	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C2	5,27E-02	1,86E-15	2,31E-04	5,86E-05	-9,09E-05	5,59E-09	9,27E-01
	C3	5,10E-02	2,29E-14	3,64E-04	8,77E-05	3,97E-05	6,73E-08	9,92E-01
C4	1,38E-01	3,12E-14	8,15E-04	1,13E-04	6,34E-05	5,29E-08	1,78E+00	
D	-2,25E-01	-7,19E-13	-5,79E-04	-9,50E-05	-5,85E-05	-9,20E-08	-3,86E+00	
Legend	GWP = global warming potential ODP = stratosphere ozone depletion potential AP = soil and water acidification potential EP = eutrophication potential			POCP = tropospheric photochemical ozone creation potential ADPE = non-fossil abiotic resource depletion potential ADPF = fossil abiotic resource depletion potential				



**LCA RESULTS - USE OF RESOURCES:**

 1m<sup>2</sup> OF MEDIUM CERAMIC TILES (24.4 kg/m<sup>2</sup>)

Parameter	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW	
Unit of Measure	[MJ]	[MJ]	[MJ]	[MJ]	[MJ]	[MJ]	[kg]	[MJ]	[MJ]	[m3]	
LIFE CYCLE STAGE	A1-3	30,7	8,1	38,8	161	1,03	162	0	0	0	0,0449
	A4	3,51E-01	0,00E+00	3,51E-01	8,64E+00	0,00E+00	8,64E+00	0,00E+00	0,00E+00	0,00E+00	6,49E-04
	A5	1,43E+01	-8,63E+00	6,71E+00	2,00E+01	-1,10E+00	1,90E+01	0,00E+00	0,00E+00	0,00E+00	6,79E-03
	B1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B2	1,87E-02	0,00E+00	1,87E-02	3,67E-01	0,00E+00	3,67E-01	0,00E+00	0,00E+00	0,00E+00	2,84E-04
	B3	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B4	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B5	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B6	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B7	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C2	5,13E-02	0,00E+00	5,13E-02	9,30E-01	0,00E+00	9,30E-01	0,00E+00	0,00E+00	0,00E+00	9,45E-05
	C3	6,93E-02	0,00E+00	6,93E-02	1,03E+00	0,00E+00	1,03E+00	0,00E+00	0,00E+00	0,00E+00	3,13E-04
	C4	2,29E-01	0,00E+00	2,29E-01	1,85E+00	0,00E+00	1,85E+00	0,00E+00	0,00E+00	0,00E+00	3,53E-04
	D	-1,69E+00	0,00E+00	-1,69E+00	-4,57E+00	0,00E+00	-4,57E+00	1,97E+01	0,00E+00	0,00E+00	-1,15E-03

Legend	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials;	PENRM = Use of non-renewable primary energy resources as raw materials;
	PERM = Use of renewable energy resources as raw materials; PERT = Total use of renewable primary energy resources;	PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary materials;
	PENRE = Use of non-renewable primary energy resources excluding non-renewable primary energy resources used as raw materials;	RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of fresh water

**LCA RESULTS – OUTGOING FLOWS AND WASTE CATEGORIES:**  
 1m<sup>2</sup> OF MEDIUM CERAMIC TILES (24.4 kg/m<sup>2</sup>)

Parameter	HWD	NHWD	RWD	CRU	MFR	MER	EEE	EET
Unit of Measure	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]	[MJ]	[MJ]
<b>LIFE CYCLE STAGE</b>	A1-3	4,43E-04	6,85E-01	2,32E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	A4	3,49E-07	5,44E-04	1,62E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	A5	2,90E-05	1,81E+00	4,33E-04	1,89E-01	1,32E-01	0,00E+00	6,24E-01 9,14E-01
	B1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B2	2,54E-03	5,72E-03	8,51E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B3	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B4	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B5	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B6	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	B7	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C2	5,38E-08	7,79E-05	1,27E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	C3	3,33E-08	2,19E-04	1,58E-05	0,00E+00	2,02E+01	0,00E+00	0,00E+00
	C4	3,18E-08	8,67E+00	2,67E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	D	-2,58E-08	-8,19E-01	-2,84E-04	-	-	-	-

Legend	HWD = Hazardous waste disposed of; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of; CRU = Components for reuse;	MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Electrical energy exported; EET = Thermal energy exported
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**LCA RESULTS - TRACE INDICATORS**  
 1m<sup>2</sup> OF MEDIUM CERAMIC TILES (24.4 kg/m<sup>2</sup>)

Parameter	Global Warming Air	Ozone Depletion Air	Acidification Air	Eutrophication	Smog Air	
Unit of Measure	[kg CO2-eq.]	[kg CFC11-eq.]	[kg SO2-eq.]	[kg N-eq.]	[kg O3-eq.]	
<b>LIFE CYCLE STAGE</b>	A1-A3	9,60E+00	4,04E-11	3,72E-02	1,59E-03	4,56E-01
	A4	6,49E-01	2,37E-14	5,67E-03	2,50E-04	1,04E-01
	A5	2,51E+00	5,02E-12	5,11E-03	6,55E-04	7,93E-02
	B2	4,04E-02	8,12E-12	8,71E-05	8,87E-05	1,31E-03
	C2	5,27E-02	1,86E-15	3,09E-04	2,74E-05	6,77E-03
	C3	5,10E-02	2,29E-14	4,87E-04	3,54E-05	1,62E-02
	C4	1,38E-01	3,12E-14	8,93E-04	7,53E-05	1,75E-02
	D	-2,25E-01	-7,19E-13	-6,56E-04	-6,83E-05	-1,41E-02

## SECTION 5 - LCA (LIFE CYCLE ASSESSMENT): CALCULATION RULES

### DECLARED UNIT OF MEASURE

The declared unit of measure is 1 m<sup>2</sup> of ceramic tiles for walls and floors with an average mass of 24.4 kg.

Declared unit of measure	1	m <sup>2</sup>
Weight	24.4	kg/m <sup>2</sup>
Conversion factor at 1 kg	0.0409	

### SYSTEM LIMITS

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

**Modules A1-A3** include processes that envisage the input of energy and materials for the system (A1), transport to the plant factory gate (A2), manufacturing processes and waste treatment (A3).

**Module A4** includes transport from the production plant to the customer or to the place of tile installation.

**Module A5** considers all the tile installation stages (such as the consumption of adhesives) and also the treatment of packaging waste (recycling, incineration, disposal). Energy replacement credits are declared in the module

D. During this stage a loss of ceramic material equal to 6.5% was considered.

**Module B1** considers the use of the tiles. During the use of ceramic tiles there is no generation of dangerous emissions indoors.

**Module B2** concerns the cleaning of the tiles. It considers the use of water, tile cleaning detergent – including the treatment of wastewater – for one year of use.

**Modules B3-B4-B5** refer to the repair, replacement and renovation of the tiles. If the tiles are installed correctly, no repair, replacement or renovation is required.

**Modules B6-B7** consider the use of energy for the operation of the technical systems integrated into the building (B6) and the use of operating water for technical installations related to the building. The use of operating energy or water is not considered. Cleaning water is declared in module B2.

**Module C1** concerns the process of demolition and deconstruction of the tiles from the building.

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

**Module C3** considers every process (collection, crushing process, etc.) necessary for tile recycling.

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

**Module D** includes the benefits deriving from all the net flows at the end of life stage that leave the product limit system after having passed the end of waste stage. Incineration of packaging and the resulting energy credits (electricity and thermal energy) are declared in module D.

### ESTIMATES AND HYPOTHESES

Modules 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.

For materials (composed of glaze, dyes and chemical additives) for which primary data were not available and whose exact chemical composition was not known (taken from the technical data sheets), an average composition was used and hypotheses were formulated based on common chemicals.

### BACKGROUND DATA

Background data for life cycle modeling were taken from the latest version of the GaBi 8 professional database.

Other sources of background data used are ELCD FEFCO, *Perry's Chemical Engineers' Handbook*, *Ceramic Glaze Handbook*, *European Ceramic Tile Manufacturers' Federation*.

**QUALITY OF DATA**

The period of validity of the background data used by the ver. 5 tool based on the thinkstep database is between 2012 and 2018. Most of the information (energy and water consumption, emissions of pollutants, atomized powders and ceramic production) are measured or calculated directly at the company level and declared in the Italian IPPC document called AIA, which is specific and is checked for each plant involved in this study. Carbon dioxide emissions (related to carbonate oxidation) are collected using the ETS (Emissions Trading Scheme) declaration.

Detailed data were obtained not only for mixtures of raw materials (collected with primary data specific to companies) but also for dyes, frits and other raw materials used in the manufacture of the glaze.

The overall data quality can be considered optimal.

**PERIOD EXAMINED**

The primary data collected for this study refer to the entire production for the year 2016.

**ALLOCATIONS**

If it is not possible to avoid using allocation, the aspect is managed according to the ISO standard of reference (14040, 14044) using mass allocation. In particular, the supply of energy and materials has been allocated to the product based on the mass of ceramic tiles produced annually. No further allocations were applied to the subsequent module.

Furthermore, some ceramic waste is recycled internally. Credits are taken into consideration from the energy recovery of packaging materials at the end of product life (module D).

**CUT-OFF**

All mass and energy inflows and outflows were considered.

**SECTION 5 - LCA: SCENARIOS AND FURTHER TECHNICAL INFORMATION**

The following technical information on the declared modules and related scenarios is based on average data, in accordance with the European Federation of Ceramic Tile Manufacturers and Confindustria Ceramica.

**Transportation to the building site (A4)**

Ceramiche Refin sells its ceramic tiles in Italy, Europe and the rest of the world. The average predefined transport scenarios are shown and illustrated below.

Name	Value	Unit of Measur
Liters of fuel (per functional unit)	31	l/100km
Volumetric factor of capacity utilization (including empty trips)	0.85	-
Truck with national destination with a capacity of 27 tons (51% of tiles sold)	300	Km
Truck with a European destination with a capacity of 27 tons (34% of tiles sold)	1390	Km
Transoceanic shipping	6520	Km

**Installation in a building (A5)**

For the installation stage, 3 options are defined, in which it is possible to use different materials. For option 1, adhesives, mortar and water, for option 2 adhesives with mortar and polysulfides, for option 3 also cementitious adhesives (different quantities for different tile formats). These considerations are based on average data provided by various ceramic tile manufacturers in Europe. In this EPD it is assumed that the tiles are installed by means of a cementitious adhesive (option 3).

For the treatment of packaging waste, an average European scenario taken from "Eurostat, 2013" is used and illustrated; therefore the end of life consists in recycling, energy recovery and landfill disposal for plastics and paper, and in reuse, energy recovery and landfill disposal for wood. The loss of ceramic material considered is equal to 6.5%.

**Use (B1)**

The ceramic tiles are robust and have a hard surface that is resistant to abrasion. There is no impact on the environment during the use stage.

## Maintenance (B2)

Ceramic products can be cleaned regularly, to varying degrees depending on the type of building: residential, commercial or healthcare. The consumption of water and detergent was therefore considered. The values declared in this stage refer to a period of 1 year for residential use and described in the following table.

Residential use: 0.2 ml of detergent and 0.1 l of water are used to wash 1 m<sup>2</sup> of ceramic tiles once a week. The scenario of this stage is based on average data provided by several ceramic tile manufacturers in Europe.

Name	Value	Unit of Measure
Water consumption	0.1	l
Detergent	0.2	ml
Tile maintenance for walls and floors	52	Number/Year

## Repair, replacement and renovation (B3, B4, B5)

In general, the useful life of ceramic tiles is identical to the useful life of the building. No repair, replacement and renovation work is required for ceramic tiles.

### Use of operating energy and water (B6, B7):

These modules are not relevant to ceramic tiles.

## End of life (C1-C4)

C1: In accordance with the PCR developed by the European Federation of ceramic tile manufacturers, this module is not relevant for ceramic tiles.

C2: Ceramic tile demolition waste is transported from the building site to a container or treatment plant by truck and an average distance of 20 km is considered. The return journey will be included in the system. An average distance of 30 km from the container or treatment plant to the final destination can be considered.

C3-C4: The end-of-life scenario is described in the following table:

Name	Value	Unit of measure
Percentage of recycled material (C3)	70	%
Percentage of landfill material (C4)	30	%

## Benefits and loads that are beyond the product system limits (D):

Module D includes credits from recycling tile and packaging materials, energy credits from thermal recovery of packaging.

## EVIDENCE OF THE REQUIREMENTS

Ceramics are inert and therefore during use do not emit pollutants or substances harmful to the environment and to health. For this reason and according to the PCR, no evidence is required as it is not relevant for this product group.

## SECTION 6 - BIBLIOGRAPHY

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