

Environmental Product Declaration

Monterrey, Mexico Wall Tile



RAGNO[®]
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Program Operator	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org	
General Program instructions and Version Number	IBU Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report v1.3	
Manufacturer Name and Address	Ragno Boulevard Diaz Ordaz Km.335 San Pedro Garza García Nuevo León 66230	
Declaration Number	EPD10234	
Declared Product and Functional Unit	Wall Tile manufactured at Monterrey, Mexico 1 square meter of installed ceramic wall tile and with a building service life of 75 years	
Reference PCR and Version Number	IBU Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report v1.3 Part B: Requirements on the EPD for Ceramic Tiles and Panels (IBU, 2017)	
Product's intended Application and Use	Wall Applications	
Product RSL	75 years	
Markets of Applicability	North America	
Date of Issue	5/24/2019	
Period of Validity	5 years from date of issue	
EPD Type	Product Specific	
Range of Dataset Variability	N/A	
EPD Scope	Cradle to Grave	
Year of reported manufacturer primary data	2018	
LCA Software and Version Number	GaBi 8.7.0.18	
LCI Database and Version Number	GaBi Database Version 8.7, Service Pack 37	
LCIA Methodology and Version Number	TRACI 2.1 CML 2001-Jan 2016	

<p>This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Life Cycle Assessment Calculation Rules and Report Requirements," v3.2 (December 2018), based on CEN Norm EN 15804 (2012) and ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017)</p> <p><input type="checkbox"/> Internal <input checked="" type="checkbox"/> External</p>	<p>Jenny Oorbeck joorbeck@nsf.org</p> 
<p>This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:</p>	<p>WAP Sustainability Consulting</p>
<p>This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:</p>	<p>Jack Geibig - EcoForm jgeibig@ecoform.com</p> 
<p>Limitations: Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of Ceramic Wall Products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for Products allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.</p>	

1. PRODUCT DEFINITION AND INFORMATION

1.1 Description of Company

Always leading while learning. This simple, yet wisdom-filled phrase has been the guiding force behind Ragno USA's remarkable success in the manufacturing of elegant, refined porcelain surfaces. Fueled by the pioneering spirit of Ceramiche Ragno S.p.A, founded over 60 years ago in Fiorano, Italy, and backed by a global leader as part of the Marazzi Group, Ragno USA has distanced itself from the competition with world-class porcelain tile collections made right here in America. Ragno USA has transferred the technology and know-how from Italy to its state-of-the-art facilities in the USA, providing Italian-inspired porcelain tiles with high-quality and design-savvy styles. For more information, please visit <https://www.ragnousa.com/>.

1.2 Product Description



This Environmental Product Declaration covers all tile products manufactured at the location in the EPD's title for the duration of this document.

1.2.1 Product Identification

Dal-Tile brands of ceramic tile are a mixture of multiple mineral-based natural materials, that can include various combinations of clay, sand, feldspar, talc, nepheline, shale and/or others. The tiles are either pressed or extruded into the desired shape and generally receive a glaze or ceramic ink application to the surface prior to being fired in kilns at high temperatures. The finished product, ceramic or porcelain tile, is fire resistant, non-combustible, durable (lasts a lifetime) and extremely easy to maintain.

As wall coverings, fired tile products provide dual functions. They serve 1) an aesthetic function as a design component, and 2) a technical function as a building finishing material. As a building material, fired tile is capable of withstanding a wide range of environmental stresses.

The versatility of fired tile is further enhanced by the extensive ranges of colors, textures, and decorative motifs offered by Dal-Tile under multiple brand names. Tile products are available in a wide range of sizes from less than 1" x 1" to 24" x 48".

Ceramic tiles are classified by their shaping or production method (either dry pressed or extruded), and the level of water absorption measured as a percentage in the fired product.

Classifications of Ceramic Tile - Wear Ratings from the Porcelain Enamel Institute

- Group I Classification - Tile that is suitable for residential bathrooms with light foot traffic.
- Group II Classification - Tile that can be used in residential areas, but not areas with high foot traffic, such as in kitchens, foyers, laundry rooms, etc.
- Group III Classification - Tile that is recommended for all residential installations with normal foot traffic.
- Group IV Classification - Tile that is suited for light to medium commercial applications, such as offices, sales rooms.
- Group V Classification - Tile used in heavy commercial traffic areas and is suited for exterior areas, shopping centers, airports, hotel lobbies, and public walkways.

1.2.2 Product Specification and Application Rules

The products considered in this EPD meet or exceed the following Technical Specifications:

- ANSI A137.1 - American National Standard Specifications for Ceramic Tile
- ISO 10545 - International Organization for Standardization Specifications for Ceramic Tile

Fire Testing:

- Classification: A, Flame Spread: 0, Smoke Developed: 0
- Interior wall: ASTM E84, NFPA 255, UL 723
- Interior floor: ASTM E 648, NFPA 253

1.2.3 Product Average

Multiple body formulations are used to manufacture tile products at this facility. To determine the average formulation for the purposes of this EPD, a production weighted average was used based on 2018 production values to create a single, representative body formulation. The range of products evaluated in the representative product are within the guidelines of the PCR.

1.3 Application

Ceramic tile products are commonly used in a variety of applications including commercial, light commercial, institutional, and residential interior and exterior applications for wall applications.

1.4 Technical Data

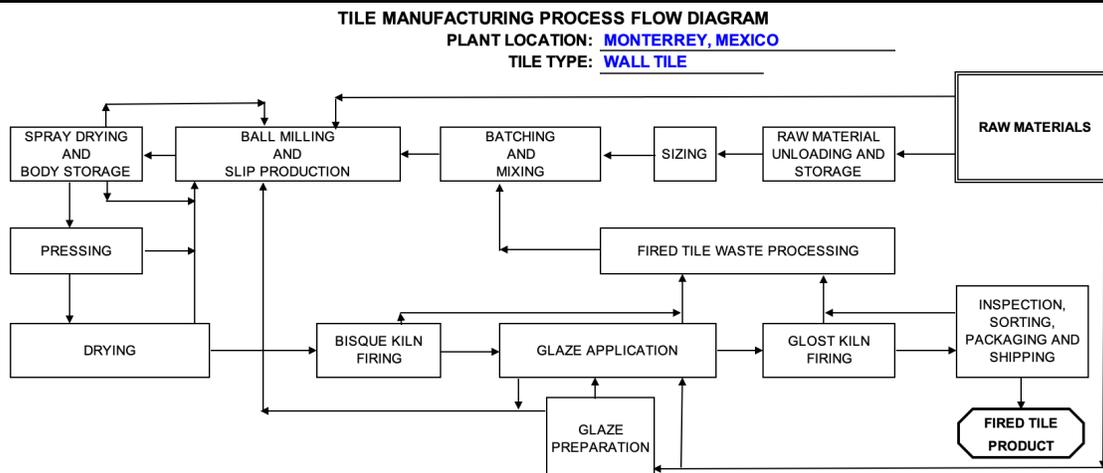
Table 1: Technical Details

Parameter	Monterrey, Mexico - Wall Tile
Nominal Area (mm ²)	92903, 90322, 185806, 109032, 209032, 258064
Nominal Value Sizes (in)	6x24, 7x20, 12x24, 13x13, 18x18, 20x20
Average Fired Weight (g/m ²)	15,379.7
Average Fired Weight (lb/ft ²)	3.15
Thickness min value (mm)	7.950
Thickness max value (mm)	7.950
Class	P2
Tile Type	Ceramic
Grade	Standard
Dimensional Categories	Calibrated

1.5 Declaration of Methodological Framework

This EPD is considered a Cradle-to-Grave study. A summary of the life cycle stages included in this EPD is presented in 2.2. The reference service life is outlined in Table 10 and is only applicable if all manufacturing guidelines are followed regarding site-selection and installation, found online. No known flows are deliberately excluded from this EPD. Third party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impacts in all impact categories required by the PCR.

1.6 Flow Diagram



1.7 Manufacturing

The manufacturing process begins with the mining of raw materials, which is a mixture composed mostly of clay, feldspar, sand, talc, and other minerals. The raw materials are mixed and ground together with water in a mill to form a wet slurry called body slip. This slurry is then pumped into a large spray dryer to make the mixture uniform as well as reduce its moisture content. Next, the spray dried powder is pressed to form tiles of the desired shape and size. After that, the tiles are dried to remove most of their moisture. Depending on the product, pigments or stains can be mixed into the body powder and/or the glazes. Glazes and/or ceramic inks may be applied to the surface of the tile. Finally, the tiles are fired in a kiln at extremely high temperature. Any unfired and/ or fired scrap generated during the manufacturing process is recovered, crushed and returned to the mixing process. This virtually eliminates the generation of waste. Different sites produce a small amount of waste (between 0.01 and 1.769 kg of waste per m² of tile) which is sent offsite to a landfill. Once the tiles are manufactured, they are packaged in cardboard boxes and palletized. Manufacturing of these tiles requires no additional measure beyond the typical OHSAS practices to protect human health.

1.8 Material Composition

Table 2: Material Composition

Component	Material	Recycled	Monterrey, Mexico - Wall Tile (Mass %)
Body	Clay	No	36.5%
	Feldspar	50.0% recycled	16.4%
	Sand	Yes	6.6%
	Fired Scrap	Yes	13.1%
	Unfired Scrap	Yes	4.0%
	Volcanic Ash	No	3.1%
	Talc	No	10.2%
	Calcium Carbonate	No	7.0%
Surface	Glaze	No	3.0%

This product contains no regulated substances.

1.9 Packaging

Table 3: Packaging Inputs

Input (per m ²)	Disposal Mechanism	Value	Unit
Cardboard	Recycled (75%), Landfilled (20%), Incinerated (5%)	0.230	kg/m ²

Cardboard is used to pack the product for shipment. Packaging waste disposal has been modeled as per guidelines in section 2.8.5 of Part A: Life Cycle Assessment Calculation Rules and Report Requirements.

1.10 Product Installation

Installation materials are referenced from guidelines published by the IBU PCR for Ceramic Tiles and Panels. Cement mortar acts as the adhesive that binds the tile to the wall surface. It is recommended that 3.3 kg of mortar on average is required to install 1 m² of tile. 4.5% of the total material is lost as waste which is then sent to the landfill. Along with mortar, water is also used in the installation process. These are detailed in the table below.

Table 4: Installation Materials

Material	Amount	Unit	Amount	Unit
Mortar	3.3	kg/m ²	1.4	lb/ft ²
Water	0.8	kg/m ²	0.3	lb/ft ²
Waste for mortar	4.5	%	4.5	%
Waste for grout	4.5	%	4.5	%

1.11 Use Conditions

It has been determined that the walls are cleaned using detergent and water once every three months as recommended by the IBU PCR for Ceramic Tiles and Panels.

Table 5: Use Phase Parameters

Use	Cleaning Inputs	Cleaning Frequency
Commercial	Detergent	4 times/ year
	Water	4 times/ year

Table 6: Use Phase Inputs

Input	Amount	Unit
Tap water	0.4	l/m ² /yr
Detergent	0.00081	kg/m ² /yr

1.12 Product Reference Service Life and Building Estimated Service Life

As per the IBU Part B PCR, a service life of 75 years was chosen with no replacements during the estimated service life of the building. The service life chosen is in accordance with the BBSR table and not an RSL according to ISO 15686.

1.13 Disposal

All waste has been classified according to regional-specific legislation as laid out in Section 2.8.6 in Part A: Life Cycle Assessment Calculation Rules and Report Requirements from UL Environment. Since ceramic is a non-metal, all of it is landfilled at end-of-life as per the aforementioned PCR.

2. LIFE CYCLE ASSESSMENT BACKGROUND INFORMATION

2.1 Functional Unit

The functional unit according to the PCR is 1 m² of finished ceramic tiles.

Table 7: Functional Unit

	Wall Tile – Monterrey, Mexico
Functional Unit [m ²]	1
Average Weight [kg]	15.38

2.2 System Boundary

This EPD is considered a Cradle-to-Grave study. A summary of the life cycle modules included in this EPD is presented in Table 8. Infrastructure flows have been excluded.

Table 8: Summary of Included Life Cycle Modules

Module Name	Description	Analysis Period	Summary of Included Elements
A1	Product Stage: Raw Material Supply	2018	Raw Material sourcing and processing as defined by secondary data.
A2	Product Stage: Transport	2018	Shipping from supplier to manufacturing site. Fuel use requirements estimated based on product weights and measured and calculated distance.
A3	Product Stage: Manufacturing	2018	Energy, water and material inputs required for manufacturing products from raw materials. Packaging materials and manufacturing waste are included as well.
A4	Construction Process Stage: Transport	2018	Shipping from manufacturing site to project site. Fuel use requirements estimated based on assumed distance recommended by the PCR (Part B).
A5	Construction Process Stage: Installation	2019	Installation materials, installation waste and packaging material waste.
B1	Use Stage: Use	2019	Use of the product.
B2	Use Stage: Maintenance	2019	Cleaning water.
B3	Use Stage: Repair	2019	Ceramic tile typically does not need to be repaired.
B4	Use Stage: Replacement	2019	No inputs required for replacement manufacturing. Ceramic tile does not need to be replaced for over 75 years.
B5	Use Stage: Refurbishment	2019	Ceramic tile is typically not refurbished.
B6	Operational Energy Use	2019	Operational Energy Use of Building Integrated System During Product Use
B7	Operational Water Use	2019	Operational Water Use of Building Integrated System During Product Use
C1	EOL: Deconstruction	2019	No inputs required for deconstruction.
C2	EOL: Transport	2019	Shipping from project site to landfill. Fuel use requirements estimated based on product weight and assumed distance recommended by the PCR (Part B).

C3	EOL: Waste Processing	2019	Waste processing not required. All waste can be processed as is.
C4	EOL: Disposal	2019	Assumes all products are sent to landfill. Landfill impacts modeled based on secondary data.
D	Benefits beyond system	MND	Credits from energy or material capture.

2.3 Estimates and Assumptions

All estimates and assumptions are within the requirements of ISO 14040/44. The majority of the estimations are within the primary data. The primary data was collected as annual totals including all utility usage and production information. For the LCA, the usage information was divided by the production to create an energy and water use per square meter. Another assumption is that the installation tools are used enough times that the per square meter impacts are negligible.

2.4 Cut-off Rules

Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit. No known flows are deliberately excluded from this EPD.

2.5 Data Sources

Primary data was collected by Ragno associates for onsite energy, water and waste during the course of manufacturing. Whenever available, supplier data was used for raw materials used in the production process. When primary data did not exist, secondary data for raw material production was used from GaBi Database Version 8.7, Service Pack 37. All calculation procedures adhere to ISO14044.

2.6 Data Quality

The geographical scope of the manufacturing portion of the life cycle is Monterrey, Mexico. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent. Primary data were provided by the manufacturer and represent all information for calendar year 2018. Primary data provided by the manufacturer is specific to the technology that the company uses in manufacturing their product. It is site-specific and considered of good quality. Data used to allocate energy and water on a per unit of product produced includes overhead energy such as lighting, heating and sanitary use of water. Sub-metering was not available to extract process only energy and water use from the total energy use. Sub-metering would improve the technological coverage of data quality.

2.7 Period under Review

The period under review is calendar year 2018.

2.8 Allocation

General principles of allocation were based on ISO 14040/44. There are no products other than ceramic tiles that are produced as part of the manufacturing processes studied in the LCA. Since there are no co-products, no allocation based on co-products is required. To derive a per unit value for manufacturing inputs such as electricity, natural gas and water, allocation based on total production in square meters was adopted. Discussions with Ragno staff divulged this was a more representative way than via mass to allocate the manufacturing inputs based on the manufacturing processes used and the types of products created. As a default, secondary GaBi datasets use a physical mass basis for allocation. Throughout the study recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of a raw material from recycled stock are excluded from the system boundary. Additionally, impacts and benefits associated with secondary functions of materials at end of life are also excluded (i.e. production into a third life or energy generation from the incineration plant). The study does include the impacts associated with reprocessing and preparation of recycled materials that are part of the bill of materials of the products under study.

2.9 Comparability and Benchmarking

The user of the EPD should take care when comparing EPDs from different companies. Assumptions, data sources, and assessment tools may all impact the variability of the final results and make comparisons misleading. Without understanding the specific variability, the user is therefore, not encouraged to compare EPDs. Even for similar products, differences in use and end-of-life stage assumptions, and data quality may produce incomparable results. Comparison of the environmental performance of ceramic wall products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for ceramic wall products allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

3. LIFE CYCLE ASSESSMENT SCENARIOS

Table 9: Transport to building site (A4)

Name	Truck	Unit
Liters of fuel	39.0625	l/100km
Transport distance	800	km
Capacity utilization	65	%
Weight of products transported	15.68	kg
Capacity utilization volume factor	1	-

Table 10: Reference Service Life

Name	Value	Unit
Life Span (According to BSSR)	75	years
Declared product properties (at the gate) and finishes, etc.	See Table 1	-
Design application parameters	Installation per recommendation by manufacturer	-
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Accepted industry standard	-
Indoor environment (if relevant for indoor applications)	Normal building operating conditions	-
Use conditions	Normal building operating conditions	-
Maintenance	See Table 12	

Table 11: Installation into the building (A5)

Name	Value	Unit
Mortar	3.3	kg
Water consumption	0.8 kg tap water	m ³
Product loss per functional unit	0.30	kg
Waste materials at the construction site before waste processing, generated by product installation	0.739	kg
Dust emissions	N/A	kg
VOC emissions	N/A	kg

Table 12: Maintenance (B2)

Name	Value	Unit
Maintenance process information	Use phase parameters as recommended by Ceramic Tiles and Panels PCR (IBU)	
Cleaning with water and detergent	300	Cycles/ RSL and Cycles/ ESL
Net freshwater consumption specified by water source and fate	0.0004 m ³ tap water, evaporated	m ³
Detergent	0.00081	kg/m ² wall tile /yr

Table 13: End of life (C1-C4)

Name	Value	Unit
Collected separately	0	kg
Collected with mixed construction waste	20.1	kg
Reuse	0	kg
Recycling	0	kg
Landfill	20.1	kg
Incineration	0	kg
Incineration with energy recovery	0	kg
Energy conversion efficiency rate	84-94	%

4. LIFE CYCLE ASSESSMENT RESULTS

All results are given per functional unit, which is 1 m² of installed ceramic wall tile over an estimated building life of 75 years. Environmental Impacts were calculated using the GaBi software platform. Impact results have been calculated using both TRACI 2.1 and CML 2001-Jan 2016 characterization factors. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Table 14: Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE						END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY	
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
Cradle to Grave	X			X	X	X	X	X	X	X	X	X	X	X	X	X	MND

Table 15: Biogenic Carbon Uptake and Emissions

Parameter	Parameter	Monterrey, Mexico – Wall Tile	Unit
BCRP	Biogenic Carbon Removal from Product	0.163	kg CO ₂
BCEP	Biogenic Carbon Emission from Product	0.144	kg CO ₂
BCRK	Biogenic Carbon Removal from Packaging	0.818	kg CO ₂
BCEK	Biogenic Carbon Emission from Packaging	0.376	kg CO ₂

See Impact Category Key below for definition of acronyms.

Table 16: Acronym Key

Acronym	Text	Acronym	Text
ADP-elements	Abiotic depletion potential for non-fossil resources	GWP	Global warming potential
ADP-fossil	Abiotic depletion potential for fossil resources	OPD	Depletion of stratospheric ozone layer
AP	Acidification potential of soil and water	POCP	Photochemical ozone creation potential
EP	Eutrophication potential	Resources	Depletion of non-renewable fossil fuels
RPR _E	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	SM	Use of secondary materials
RPR _M	Use of renewable primary energy resources used as raw materials	RSF	Use of renewable secondary fuels
NRPR _E	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	NRSF	Use of non-renewable secondary fuels
NRPR _M	Use of non-renewable primary energy resources used as raw materials	FW	Net use of fresh water
RPR _T	Total use of renewable primary energy resources	NRPR _T	Total use of non-renewable primary energy resources
HWD	Disposed-of-hazardous waste	MR	Materials for recycling
NHWD	Disposed-of non-hazardous waste	MER	Materials for energy recovery
HLRW	High-level radioactive waste, conditioned, to final repository	EE	Exported energy
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	CRU	Components for reuse
RE	Recovered energy		

4.1 Monterrey, Mexico – Wall Tile

4.1.1 CML Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
ADP-elements [kg Sb eq]	8.16E-06	1.90E-07	4.08E-06	0.00E+00	4.35E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.42E-08	0.00E+00	3.51E-07	MND
ADP-fossil fuel [MJ]	2.66E+02	1.40E+01	1.51E+01	0.00E+00	8.21E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.27E+00	0.00E+00	1.32E+01	MND
AP [kg SO ₂ eq]	2.02E-02	3.38E-03	2.90E-03	0.00E+00	1.48E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.47E-04	0.00E+00	3.58E-03	MND
EP [kg Phosphate eq]	3.48E-03	9.51E-04	4.89E-04	0.00E+00	5.54E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-04	0.00E+00	4.71E-04	MND
GWP [kg CO ₂ eq]	1.67E+01	1.01E+00	2.11E+00	0.00E+00	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-01	0.00E+00	8.53E-01	MND
ODP [kg CFC 11 eq]	4.15E-11	9.44E-17	8.44E-13	0.00E+00	4.66E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.20E-17	0.00E+00	3.10E-15	MND
POCP [kg Ethene eq]	1.96E-03	-4.82E-04	5.43E-04	0.00E+00	1.27E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.86E-04	0.00E+00	3.04E-04	MND

4.1.2 TRACI Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
AP [kg SO ₂ eq]	2.33E-02	4.58E-03	3.27E-03	0.00E+00	1.82E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.32E-04	0.00E+00	3.90E-03	MND
EP [kg N eq]	1.88E-03	3.83E-04	3.51E-04	0.00E+00	8.09E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.77E-05	0.00E+00	1.99E-04	MND
GWP [kg CO ₂ eq]	1.65E+01	1.01E+00	2.10E+00	0.00E+00	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-01	0.00E+00	8.48E-01	MND
ODP [kg CFC 11 eq]	4.23E-11	-5.35E-15	8.22E-13	0.00E+00	4.66E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.25E-15	0.00E+00	-4.46E-14	MND
Resources [MJ]	3.53E+01	1.88E+00	1.73E+00	0.00E+00	9.31E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.38E-01	0.00E+00	1.70E+00	MND
POCP [kg O ₃ eq]	5.32E-01	1.07E-01	6.24E-02	0.00E+00	3.34E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-02	0.00E+00	7.80E-02	MND

4.1.3 Resource Use Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
RPR _E [MJ]	1.35E+01	4.37E-01	1.95E+00	0.00E+00	9.48E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-01	0.00E+00	1.03E+00	MND
RPR _M [MJ]	0.00E+00	MND													
RPR _T [MJ]	1.35E+01	4.37E-01	1.95E+00	0.00E+00	9.48E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-01	0.00E+00	1.03E+00	MND
NRPR _E [MJ]	2.85E+02	1.41E+01	1.61E+01	0.00E+00	8.66E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E+00	0.00E+00	1.36E+01	MND
NRPR _M [MJ]	0.00E+00	MND													
NRPR _T [MJ]	2.85E+02	1.41E+01	1.61E+01	0.00E+00	8.66E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E+00	0.00E+00	1.36E+01	MND
SM [kg]	4.91E+00	0.00E+00	9.82E-02	0.00E+00	MND										
RSF [MJ]	0.00E+00	MND													
NRSF [MJ]	0.00E+00	MND													
RE [MJ]	0.00E+00	MND													
FW [m ³]	4.32E-02	1.69E-03	6.00E-03	0.00E+00	3.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.95E-04	0.00E+00	1.61E-03	MND

4.1.4 Output Flows and Waste Results

Impact Category	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD [kg]	2.35E-07	1.15E-07	6.08E-08	0.00E+00	2.30E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.67E-08	0.00E+00	4.75E-08	MND
NHWD [kg]	6.25E-01	5.33E-04	6.55E-01	0.00E+00	3.98E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-04	0.00E+00	1.94E+01	MND
HLRW [kg]	9.94E-06	3.78E-08	4.94E-07	0.00E+00	2.54E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.80E-09	0.00E+00	1.65E-07	MND
ILLRW [kg]	7.52E-03	3.13E-05	3.79E-04	0.00E+00	1.80E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.28E-06	0.00E+00	1.31E-04	MND
CRU [kg]	0.00E+00	MND													
MR [kg]	0.00E+00	0.00E+00	1.73E-01	0.00E+00	MND										
MER [kg]	0.00E+00	0.00E+00	1.15E-02	0.00E+00	MND										
EE [MJ]	0.00E+00	0.00E+00	2.00E-02	0.00E+00	MND										

5. LIFE CYCLE ASSESSMENT INTERPRETATION

Overall for Ragno's ceramic tile products, Global Warming (GWP) and Abiotic Depletion of fossil fuels are the impact categories of most significance. Within these impact categories, the vast majority of impacts are aggregated in the A1-A3 phase of the life cycle of the product. A1-A3 includes raw material sourcing, transportation and manufacturing. The second largest life cycle stage is A5 in terms of global warming impacts which is transport of product to customer.

For ceramic tiles, in the sourcing and extraction stage, the largest contributors to the impacts in terms of raw materials are kaolin (9.6%), talc (2.2%), and feldspar (1%). Within manufacturing, electricity contributes to 14.5% of overall GWP impacts while thermal energy from natural gas contributes to 49%.

Shipping to customer contributes around 4.1% of total GWP impacts, while, mortar used during installation contributes around 10% of GWP impacts. Finally, disposal of the product to landfill contributes 5.2% to total GWP impacts over the life cycle of the product.

6. ADDITIONAL ENVIRONMENTAL INFORMATION

6.1 Extraordinary Effects

Fire

Fire testing and performance results are mentioned in 1.2.2.

Water

Any excess water from flooding must be removed and tile should be dried as soon as possible.

Mechanical Destruction

Any damaged or broken tiles must be removed and replaced only by a qualified contractor.

6.2 Environmental Activities and Certifications

Ragno's facility at Monterrey, Mexico has the following certifications:

- ISO 9001
- ISO 14001
- OHSAS 18001
- SA 8000

Additional information about products can be found here:

<https://www.ragnousa.com/professional>

7. REFERENCES

1. Life Cycle Assessment, LCA Report for Dal-Tile. WAP Sustainability Consulting. March 2019.
2. IBU Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report v1.3.
3. Part B: Requirements on the EPD for Ceramic Tiles and Panels (IBU, 2017).
4. ISO 14044: 2006 Environmental Management – Life cycle assessment – Requirements and Guidelines.
5. ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
6. ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
7. European Standard DIN EN 15804: 2012.04+A1 2013. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products (includes Amendment A1:2013)