Environmental Product Declaration

Florence, AL
Floor Tile

Certified Environmental Product Declaration
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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	Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2
Manufacturer Name and Address	Ragno 4351 Bryson Blvd. Florence, AL 35630
Declaration Number	EPD10229
Declared Product and Functional Unit	Floor Tile manufactured at Florence, AL 1 square meter of installed flooring and with a building service life of 75 years
Reference PCR and Version Number	Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2 Part B: Flooring EPD Requirements. UL 10010-7, September 28, 2018
Product's intended Application and Use	Flooring and Wall Applications
Product RSL	75 years
Markets of Applicability	North America
Date of Issue	05/17/2019
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
The sub-category PCR review was conducted by:	Jack Geibig (Chair) Thomas Gloria, PhD Thaddeus Owen

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) ☐ Internal ☒ External	Jenny Oorbeck joorbeck@nsf.org
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig - EcoForm jgeibig@ecoform.com

Limitations:

Environmental declarations from different programs (ISO 14025) may not be comparable.

Comparison of the environmental performance of Flooring 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.

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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 floor and 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. Dal-Tile has multiple manufacturing locations producing products 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

1.3 Application

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

1.4 Technical Data

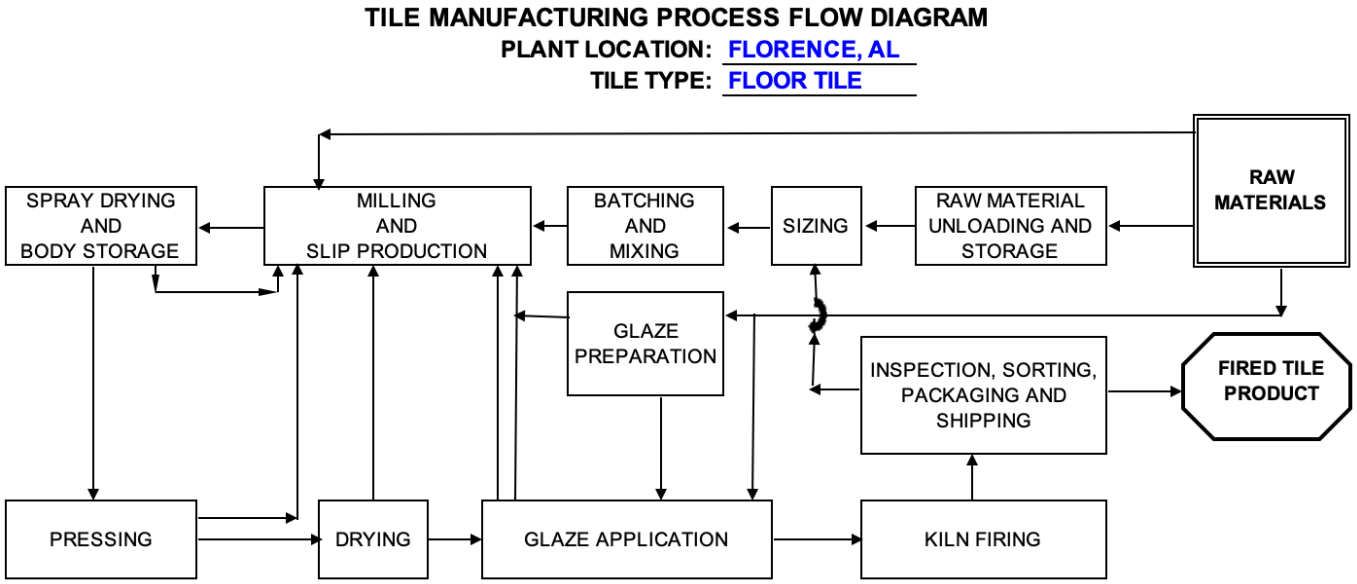
Table 1: Technical Details

Parameter	Florence, AL - Floor Tile
Nominal Area (mm^2)	92903, 139,355, 209032, 156129, 185806, 109032, 165161, 209032, 418064, 258064
Nominal Value Sizes (in)	6x24, 6x36, 9x36, 11x22, 12x24, 13x13, 16x16, 18x18, 18x36, 20x20
Average Fired Weight (g/m^2)	23,484.5
Average Fired Weight (lb/ft^2)	4.81
Thickness min value (mm)	8.992
Thickness max value (mm)	10.998
Class	P1
Tile Type	Porcelain
Grade	Standard
Dimensional Categories	Calibrated and Rectified

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 sand, Turkish feldspar, nepheline, 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.

1.8 Material Composition

Table 2: Material Composition

Component	Material	Recycled	Florence, AL - Floor Tile (Mass %)
Body	Sand	No	4.0%
	Turkish Feldspar	No	24.7%
	Nepheline	Yes	27.7%
	Fired Scrap	Yes	2.9%
	Unfired Scrap	Yes	3.8%
	Clay	No	36.3%
Surface	Glaze	No	0.7%

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%)	0.211	kg/m^2

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 instructions and materials are referenced from guidelines published by the Tile Council of North America (TCNA). Cement mortar acts as the adhesive that binds the tile to the floor or wall surface. It is recommended that 4.07 kg of mortar on average is required to install 1 m^2 of tile. 4.5% of the total material is lost as waste which is then sent to the landfill. Cement grout acts as the filler for the spaces in between the tiles. It was determined that 0.212 kg of grout on average is required to fill an area of 1 m^2 of ceramic tiles. Along with cement and mortar, installation solution made up of acrylate and 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	4.07	kg/m^2	0.83	lb/ft^2
Grout	0.212	kg/m^2	0.043	lb/ft^2
Water	0.37	kg/m^2	0.075	lb/ft^2
Acrylate	0.043	kg/m^2	0.008	lb/ft^2
Waste for mortar	4.5	%	4.5	%
Waste for grout	4.5	%	4.5	%

1.11 Use Conditions

The floors are cleaned using a dust mop every day and using a damp mop 4 times a year for residential and 36 times a year for commercial applications as recommended by the Tile Council of North America (TCNA). Commercial use case scenario has been applied as a conservative estimate.

Table 5: Use Phase Parameters

Use	Cleaning Process	Cleaning Frequency	Consumption of energy and resources
Commercial	Dust mop	365 times/ year	-
	Damp mop	36 times/ year (Commercial)	Tap water

Table 6: Use Phase Inputs

Input	Amount	Unit
Tap water	0.783	l/m2/yr

1.12 Product Reference Service Life and Building Estimated Service Life

According to Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL Environment, V3.2, 2018, the Estimated Service Life (ESL) of the building is assumed to be 75 years. Since ceramic tiles are expected to last as long as the building itself, the Reference Service Life (RSL) of ceramic tiles is taken to be 75 years.

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 m^2 of finished flooring.

Table 7: Functional Unit

	Floor Tile – Florence, AL
Functional Unit [m^2]	1
Average Weight [kg]	23.48

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 Florence, AL. 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 Flooring 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 flooring 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
Fuel type	Diesel	-
Liters of fuel	39.0625	l/100km
Vehicle type	Heavy duty diesel truck/ 50,000 lb payload	-
Transport distance	800	km
Capacity utilization	65	%
Weight of products transported	23.94	kg
Capacity utilization volume factor	1	-

Table 10: Reference Service Life

Name	Value	Unit
RSL	75	years
Declared product properties (at the gate) and finishes, etc.	See Table 1	-
Design application	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, e.g. frequency of use, mechanical exposure	Normal building operating conditions	-

Table 11: Installation into the building (A5)

Name	Value	Unit
Mortar	4.07	kg
Grout	0.212	kg
Acrylate	0.043	kg
Net freshwater consumption specified by water source and fate	0.0004 m^3 tap water, installation solution	m^3
Product loss per functional unit	0.46	kg

Waste materials at the construction site before waste processing, generated by product installation	0.87	kg
Packaging waste, cardboard	0.211	kg
Biogenic carbon contained in packaging	0.749	kg CO_2

Table 12: Maintenance (B2)

Name	Value	Unit
Maintenance process information	Use phase parameters as recommended by TCNA guidelines	
Dust mop	27,375	Cycles/ RSL and Cycles/ ESL
Damp mop (Commercial)	2,700	Cycles/ RSL and Cycles/ ESL
Damp mop (Residential)	300	Cycles/ RSL and Cycles/ ESL
Net freshwater consumption specified by water source and fate	0.05 m^3 tap water, evaporated	m^3
Further assumptions for scenario development	Floor cleaned with dust mop daily and with damp mop 36 times/year for commercial applications and 4 times/year for residential applications	

Table 13: End of life (C1-C4)

Name		Value	Unit
Assumptions for scenario development		Product is either disposed of with the underlying floor or manually removed via scraping	
Collection process	Collected separately	0	kg
	Collected with mixed construction waste	28.2	kg
Recovery	Reuse	0	kg
	Recycling	0	kg
	Landfill	28.2	kg
	Incineration	0	kg
	Incineration with energy recovery	0	kg
	Energy conversion efficiency rate	84-94	%
Disposal	Product or material for final deposition	28.2	kg
Removals of biogenic carbon (excluding packaging)		0.159	kg CO_2

4. LIFE CYCLE ASSESSMENT RESULTS

All results are given per functional unit, which is 1 m^2 of installed flooring 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			CONSTRUCT-ION 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	Florence, AL – Floor Tile	Unit
BCRP	Biogenic Carbon Removal from Product	0.179	kg CO_2
BCEP	Biogenic Carbon Emission from Product	0.147	kg CO_2
BCRK	Biogenic Carbon Removal from Packaging	0.865	kg CO_2
BCEK	Biogenic Carbon Emission from Packaging	0.398	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
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		

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4.1 Florence, AL – Floor 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]	1.35E-05	2.88E-07	5.52E-06	0.00E+00	2.90E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.44E-08	0.00E+00	5.12E-07	MND
ADP-fossil fuel [MJ]	3.01E+02	2.13E+01	2.21E+01	0.00E+00	1.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E+00	0.00E+00	1.93E+01	MND
AP [kg SO_2 eq]	3.52E-02	5.12E-03	4.95E-03	0.00E+00	2.33E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.97E-04	0.00E+00	5.22E-03	MND
EP [kg Phosphate eq]	4.44E-03	1.44E-03	6.82E-04	0.00E+00	8.54E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.27E-04	0.00E+00	6.86E-04	MND
GWP [kg CO_2 eq]	2.01E+01	1.54E+00	2.91E+00	0.00E+00	2.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.38E-01	0.00E+00	1.24E+00	MND
ODP [kg CFC 11 eq]	3.90E-10	1.43E-16	2.85E-10	0.00E+00	3.22E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.20E-17	0.00E+00	4.52E-15	MND
POCP [kg Ethene eq]	2.77E-03	-7.31E-04	7.61E-04	0.00E+00	1.96E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.71E-04	0.00E+00	4.42E-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]	3.76E-02	6.95E-03	5.43E-03	0.00E+00	2.91E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-03	0.00E+00	5.68E-03	MND
EP [kg N eq]	2.42E-03	5.81E-04	4.72E-04	0.00E+00	1.23E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.87E-05	0.00E+00	2.90E-04	MND
GWP [kg CO_2 eq]	1.99E+01	1.54E+00	2.90E+00	0.00E+00	2.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E-01	0.00E+00	1.24E+00	MND
ODP [kg CFC 11 eq]	4.13E-10	-8.13E-15	3.63E-10	0.00E+00	-3.55E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.82E-15	0.00E+00	-6.50E-14	MND
Resources [MJ]	3.75E+01	2.85E+00	2.47E+00	0.00E+00	1.50E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.38E-01	0.00E+00	2.48E+00	MND
POCP [kg O_3 eq]	6.56E-01	1.63E-01	9.03E-02	0.00E+00	5.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-02	0.00E+00	1.14E-01	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]	1.34E+01	6.63E-01	2.68E+00	0.00E+00	7.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-01	0.00E+00	1.51E+00	MND
RPR_M [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
$NRPR_E$ [MJ]	3.26E+02	2.14E+01	2.35E+01	0.00E+00	1.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.80E+00	0.00E+00	1.98E+01	MND
$NRPR_M$ [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
SM [kg]	1.56E+00	0.00E+00	3.12E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
FW [m^3]	5.75E-02	2.57E-03	7.79E-03	0.00E+00	5.89E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.75E-04	0.00E+00	2.35E-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]	1.81E-07	1.74E-07	7.79E-08	0.00E+00	2.37E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.89E-08	0.00E+00	6.92E-08	MND
NHWD [kg]	8.63E-01	8.08E-04	9.12E-01	0.00E+00	7.76E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-04	0.00E+00	2.83E+01	MND
HLRW [kg]	1.18E-05	5.73E-08	7.07E-07	0.00E+00	3.47E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-08	0.00E+00	2.40E-07	MND
ILLRW [kg]	9.84E-03	4.75E-05	5.63E-04	0.00E+00	2.34E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-05	0.00E+00	1.91E-04	MND
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
MR [kg]	0.00E+00	0.00E+00	1.59E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
MER [kg]	0.00E+00	0.00E+00	1.06E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND
EE [MJ]	0.00E+00	0.00E+00	1.83E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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 clay (16%), and feldspar (8%). Within manufacturing, electricity contributes to 19% of overall GWP impacts while thermal energy from natural gas contributes to 34%.

Shipping to customer contributes around 5% of total GWP impacts, while, mortar used during installation contributes around 8% of GWP impacts. Finally, disposal of the product to landfill contributes 6% 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 Florence, AL has the following certifications:

- OHSAS 18001
- ISO 9001
- PTCA – Certified Porcelain

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. Product Category Rule (PCR) for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL 10010. Version 3.2, December 12, 2018.
3. Part B: Flooring EPD Requirements. UL Environment. Version 2.0, September 2018.
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)