

# Environmental Product Declaration

**RAK**  
CERAMICS

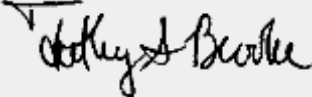


## Vitreous Ceramic and Fine Fire Clay Ceramic Sanitaryware Products



According to  
EN 15804  
ISO 21930  
ISO 14025

## 1. General Information

<b>Manufacturer Name:</b>	RAK Ceramics P.J.S.C. P.O. Box 4714 Ras Al Khaimah, UAE Sheikh Muhammad Bin Salem Rd, Al Jazirah Al Hamra, Ras Al Khaimah, UAE
<b>Program Operator:</b>	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2959, USA
<b>Declaration Number:</b>	EPD 164
<b>Reference PCR:</b>	IBU PCR Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report according to EN 15804+A2:2019– Version 1.0 IBU PCR Part B: Requirements on the EPD for Sanitary Ceramics – Version 1.0
<b>Date of Issuance:</b>	January 8, 2021
<b>End of Validity:</b>	January 8, 2026
<b>Product Name:</b>	Vitreous Ceramic and Fine Fire Clay Ceramic Sanitaryware Products
<b>EPD Owner:</b>	RAK Ceramics P.J.S.C.
<b>Product Group:</b>	Ceramic Sanitaryware Products
<b>Declared Unit:</b>	1 t of ceramic sanitaryware
<b>EPD Scope:</b>	Cradle-to-gate and End-of-Life (A1, A2, A3, C1, C2, C3, C4, D)
<b>Verification:</b>	The CEN Norm EN 15804 serves as the core PCR. Independent verification of the declaration according to ISO 14025 and ISO 21930. <input type="checkbox"/> internal <input checked="" type="checkbox"/> external
<b>LCA Reviewer and EPD Verifier:</b>	Timothy S. Brooke ASTM International 

## 2. Product

### 2.1 Product Description

The declared products are two types of ceramic sanitarywares produced by RAK Ceramics P.J.S.C: Vitreous Ceramic and Fine Fire Clay. The Vitreous Ceramic is used to produce water closets & tanks, wash basins & pedestals and urinals. The Fine Fire Clay ceramic is used for sinks. Since RAK Ceramics produces various sanitaryware products, available in various sizes and forms, this EPD represents two average products for the investigated ceramic sanitarywares.



### 2.2 Application

The ceramic sanitarywares has various applications in interior design and decoration.

### 2.3 Technical Data

Tests regarding dimension and surface quality as well as physical and chemical properties are performed prior to the product delivery. Ceramic Sanitaryware products conformity is based on standard methods, standard requirements and Rak Ceramics specifications of quality inspections. See Table 1 for technical details.

Ceramic sanitary ware are manufactured in a wide variety of dimensions. The following (structural) technical data are representative examples (details as L x W x H): Washbasins 850 x 460 x 150 mm; Bidets 530 x 360 x 400 mm; Toilets 600 x 360 x 430 mm; Urinals 650 x 300 x 350 mm; Cisterns 380 x 170 x 370 mm; Shower Trays 900 x 900 x 80 mm. RAK Ceramics conforms to the following standards and specifications. According to /SASO 1024(GS 1013)/AUSTRALIAN STANDARDS (AS 1976-1996)/BRITISH STANDARDS (BS – 3402)/American standards (ASME A112.19.2.2013/NF Standards/KIWA Standards (BRL-K621/06).

**Table 1: Product Standards**

<b>Test Description</b>	<b>Standard Test Method</b>	<b>Standard Requirements</b>	<b>RAK Ceramics Specification</b>
Water absorption	SASO 1024 (GS1013)	≤ 0.5 %	≤ 0.3 %
Crazing resistance	SASO 1024 (GS1013)	No crazing	No crazing
Chemical resistance	SASO 1024 (GS1013)	No visible effect	No visible effect
Resistance to staining and burning	SASO 1024 (GS1013)	No visible effect	No visible effect
Abrasion resistance test	SASO 1024 (GS1013)	No visible effect	No visible effect
Water absorption	AS 1976- 1992.	≤ 0.5 %	≤ 0.3 %
Crazing resistance	AS 1976- 1992.	No crazing	No crazing
Chemical resistance	AS 1976- 1992.	No visible effect	No visible effect
Water absorption	BS 3402 : 1969	≤ 0.5 %	≤ 0.3 %
Crazing resistance	BS 3402 : 1969	No crazing	No crazing
Chemical resistance	BS 3402 : 1969	No visible effect	No visible effect
Resistance to staining and burning	BS 3402 : 1969	No visible effect	No visible effect
Water absorption	ASME A 112.19.2.2018/ CSA B45.1-18	≤ 0.5 %	≤ 0.3 %
Crazing resistance	ASME A 112.19.2.2018/ CSA B45.1-18	No crazing	No crazing
Resistance to surface abrasion (NF D 14-501)	NF STANDARDS	≥600 cycles	Class - 03
Resistance to acids( NF D 14 -506)	NF STANDARDS	No visible effect	Class - AA
Resistance to hot alkaline (NF D 14 – 507)	NF STANDARDS	No visible effect	No visible effect
Resistance to chemicals and stains (NF D 14 – 508)	NF STANDARDS	No visible effect	Class - AA
Water absorption	NF STANDARDS	≤ 0.5 %	≤ 0.3 %
Test on acid resistance of glaze	KIWA BRL – K621/06	No visible effect	No visible effect
Test on alkaline resistance of glaze	KIWA BRL – K621/06	No visible effect	No visible effect
Test on resistance of glaze to various chemical agents	KIWA BRL – K621/06	No visible effect	No visible effect
Test on spot resistance of glazes	KIWA BRL – K621/06	No visible effect	No visible effect
Test on resistance of glaze to super-heated steam	KIWA BRL – K621/06	No visible effect	No visible effect
Test on resistance of glaze and body to thermal shocks	KIWA BRL – K621/06	No visible effect	No visible effect

### 2.4 Delivery Status

The measurements of products can vary between different models, type, and thicknesses. Table 2 illustrates the average weight of products upon delivery, excluding packaging.

**Table 2: Average product weight on delivery, excluding packaging.**

Name	Average Weight	Unit / PC
Urinals	14	KGS
Wash Basin & Pedestal	28	KGS
Water Closet & Tank	38.5	KGS
Fine Fire Clay Sink / Ablution	32	KGS

### 2.5 Base Materials

Vitreous Ceramic and Fine Fire clay share the same production methods; whereby only the raw material composition is used in various ways during the production process. The non-linear shrinkage in the drying and firing process of Fine Fire Clay can be reduced to less than 10%. This expands the possibilities of shaping and allows for the production of larger product. Both materials, Vitreous Ceramic and Fine Fire clay, were taken into account. Table 3 provides an overview of the average composition of ceramic sanitaryware.

**Table 3: Product Ingredients**

Products	Ingredient Name	Value	
<b>Vitreous Ceramic</b>	Potash Feldspar	10-30 %	
	Water Closet & Tank	Potash	5-20 %
	Wash Basin & Pedestal	Sand	5-20 %
	Urinal	Sand Mix FC Ball Clay	5-20 %
		Hycast VC Ball Clay	5-20 %
		DS Kaolin	5-20 %
		TP Prosper Clay	5-20 %
		SPK Kaolin	5-20 %
		Ball Clay	<5 %
		Vitrous Pitchers	<5 %
	Other	<5 %	
<b>Fine Fire Clay Ceramic</b>	AGS Ball Clay	5-20 %	
	Fire Clay Sink	RS 335 Ball Clay	15-25 %
		VC Ball Clay	10-20 %
		DS Kaolin	10-20 %
		Wollastonite	<5 %
		Quartz Powder	<5 %
		Chamotee	30-50 %
		Other	<5 %

### 2.6 Manufacture

Sanitaryware products are made with white burning clays and finely-ground minerals that are mixed with water and burned at high temperatures. They are coated in all exposure surfaces with an impervious non-crazing vitreous glaze giving a white or colored finish. The raw materials supplied are dried where necessary before storing in silos. Smaller volumes of components are supplied in sacks and/or big bags.

**Slurry:** Some of the raw materials require mechanical treatment in a grinding process. This is followed by preparing the slurry by mixing the raw materials with water and passing them through a sieve.

**Glaze:** The raw material is mixed with water before being sieved and then ground. Glue is added shortly before processing.

**Mould construction:** The casting moulds required for production are made of either plaster or a porous plastic.

**Casting:** Small batches are manufactured exclusively with plaster moulds in a manual hand mould process. Another production method involves the battery casting method, also with plaster moulds. The porous plastic moulds are used for high-pressure casting. Remains and rejects are 100% recyclable and reintroduced back into the slurry preparation.

**Drying:** After casting, the ceramic products are processed through various drying methods depending on the respective complexity. Rejects are 100% recyclable and reintroduced back into the slurry preparation.

**Glazing:** The glaze is applied to the dry blank either manually or fully-automatically using robots. Surplus is collected, redirected and re-used in both methods.

**Firing:** In order to achieve a maximum kiln load, the glazed blanks are positioned manually on the firing trolley. The blanks are fired at over 1250°C in a tunnel kiln for approx. 16-24 hours.

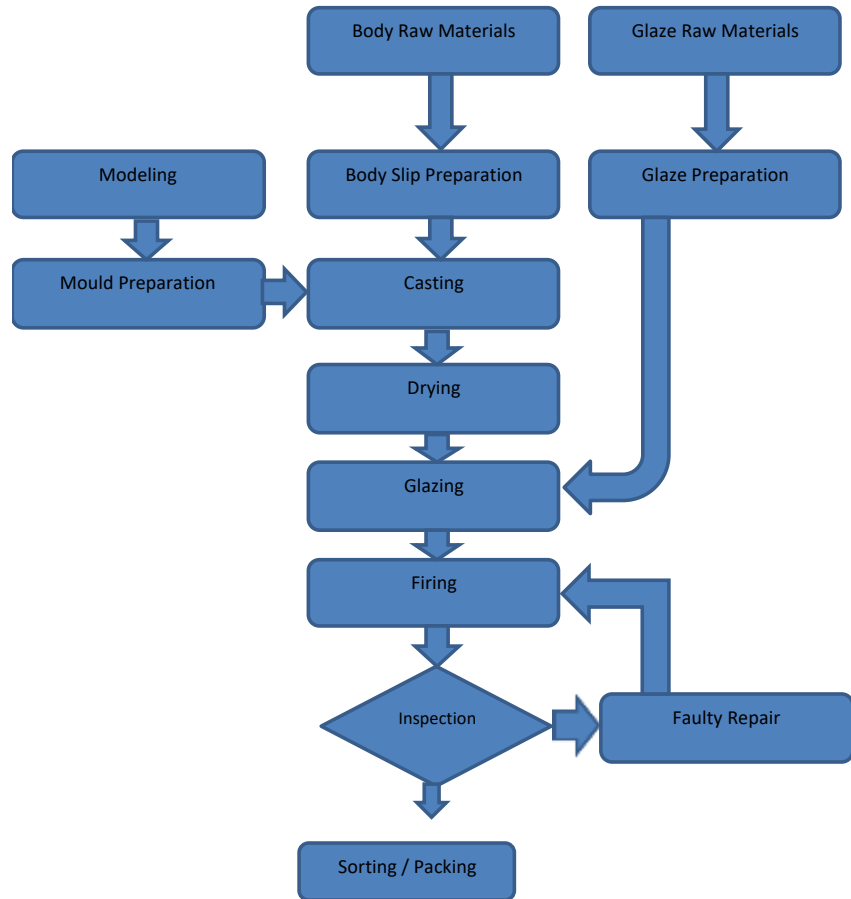
**Sorting:** After firing, each product is subject to extensive individual examination. The RAK logo either is fired on or applied by laser to perfect pieces before they are assembled, packed, stored and shipped. Products, which do not meet the quality requirements, can often be touched up and fired again in a shuttle kiln or recycled.

Depending on the particular requirements, RAK Ceramics sanitaryware meets the standards and specifications. According to /SASO 1024(GS 1013)/AUSTRALIAN STANDARDS (AS 1976-

1996)/BRITISH STANDARDS (BS – 3402)/EN 13310:2015/American standards (ASME A112.19.2.2013/NF Standards/KIWA Standards (BRL- K621/06).

The organization has the capability to design and develop new products and to respond effectively to customers' needs and passion. The organization has opted for a long-term policy which means; to produce high quality products, to mean business, to be a respectable partner and to keep clients and customers satisfied.

The production processes are strictly controlled by experienced, highly competent and professional personnel. All products pass through stringent quality control inspection and testing to ensure that only high quality tiles are delivered to customers. The tiles are continuously tested in the organization's own modern laboratories and occasionally by international and independent laboratories.



**Figure 1:** Ceramic Sanitaryware Flow



### 2.7 Environment and Health Considerations during Manufacturing

RAK Ceramics manages the activities in order to anticipate and prevent circumstances that might result in occupational injury, ill health, or adverse environmental impacts. RAK Ceramics EHS management are already in place, such as policy and risk assessment.

The significant environmental aspects were being monitored, documented, controlled, and improve the current situation as to not have adverse environmental impacts. The available guidelines and parameters obtained to which the organization subscribes shall be used as reference in environmental business planning and undertakings. All activities, products, services and new development shall operate within its bounds of parameters and restrictions.



### 2.8 Product Processing/Installation

There are no particular requirements on machines to be used. The manufacturing process complies with national, local authority, legal and other requirements. The installation tools required or the use of auxiliary materials are listed in the mounting instructions supplied with the product. Adequate PPE are required during installation.

### 2.9 Packaging

Ceramic Sanitarywares are packaged either in cardboard boxes and/or shrink-wrap or stacked on pallets and fixed by shrink-wrap. Packaging materials include, polyethylene/ LDPE, corrugated boxes/paper cardboard, wooden pallets, and plastic strap belts.

### 2.10 Conditions of Use

No particular features arise in the materials composition of the product during use. Ceramic Sanitaryware are solid and inert due to being burnt at high temperatures. The environmental



impacts generated during this phase are very low and therefore can be neglected. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

### **2.11 Environment and Health Considerations During Use**

Ceramic Sanitaryware is intrinsically inert, chemically stable, and therefore during the use stage does not emit any pollutants or substances which are harmful to the environment or human health. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

### **2.12 Reference Service Life**

Not applicable: End-of-life phase is outside the scope of the underlying LCA.

### **2.13 Extraordinary Effects**

#### **Fire**

Ceramic sanitaryware is classified as construction product A1. Non-combustible in accordance with DIN 4102-1

#### **Water**

In an event of unforeseen impact by water (e.g. flooding) on ceramic sanitaryware, no negative impacts are to be anticipated in terms of product function or the environment.

#### **Mechanical Destruction**

In the event of minor, unforeseen mechanical damage, no impacts are to be anticipated in terms of ceramic sanitaryware product function. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

### **2.14 Re-use Phase**

After demolition and deconstruction the remains of ceramic sanitaryware can be used for landfilling. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

### **2.15 Disposal**

According to the European Waste Catalogue ceramic waste belongs to the (10 12 8) with a description of waste ceramics, bricks, tiles, and construction products (after thermal processing) with entry type of absolute non-hazardous. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

### **2.16 Further Information**

Additional information is available at [www.rakceramics.com](http://www.rakceramics.com)

### 3. LCA Calculation Rules

#### 3.1 Declared Unit

The declared unit is one tonne of ceramic sanitaryware produced at RAK Ceramics Ras Al Khaimah Factory.

#### 3.2 System Boundary

The system boundary for this study includes the following life cycle stages as per the governing PCRs (see also Table 5):

- **A1 Raw material supply** (upstream processes): Extraction, handling, and processing of input materials.
- **A2 Transportation**: Transportation of all input materials from the suppliers to the gate of the manufacturing facility.
- **A3 Manufacturing** (core process): This phase also includes the operations of the manufacturing facility and all process emissions that occur at the production facility.
- **C1 Deconstruction/Demolition**: Per the Part B PCR, the environmental impacts generated during the C1 phase are very low and therefore are neglected.  
**C2 Transportation**: The transportation of the product to the treatment plant is assumed to be 50 km total including the return trip as per the Part B PCR.
- **C3 Waste Processing**: The waste processing includes the processing (crushing) for the 70% of the product that is assumed to be recycled.
- **C4 Disposal**: The disposal module includes the landfilling processing for the 30% of the product that is assumed to be deposited in landfill at end of life.
- **D Recycling Potential**: The substitution effect of the recycled material is assumed to avoid the production of crushed aggregate from conventional sources.

#### 3.3 Estimates and Assumptions

All significant foreground data was gathered from the manufacturer based on measured values (i.e. without estimation).

#### 3.4 Cut-off Criteria

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO14044:2006 and section 6 of the IBU PCR Part A:

- All inputs and outputs to a (unit) process were included in the calculation for which data is available. Data gaps were filled by conservative assumptions with average or generic data. Any assumptions for such choices were documented.
- In case of insufficient input data or data gaps for a unit process, the cut-off criteria were 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows, e.g. per module A1-A3 were a maximum

of 5% of energy usage and mass. Conservative assumptions in combination with plausibility considerations and expert judgement were used to demonstrate compliance with these criteria.

- Particular care was taken to include material and energy flows known to have the potential to cause significant emissions into air and water or soil related to the environmental indicators of this standard. Conservative assumptions in combination with plausibility considerations and expert judgement were used to demonstrate compliance with these criteria

### 3.5 Background Data and 3.6 Data Quality

Data was gathered for the primary material and energy inputs used in the production of the sanitaryware for calendar year 2019. Table 4 describes each LCI data source for raw materials (A1), transportation by mode (A2) and the core manufacture process (A3). Table 4 also includes a data quality assessment for all secondary data on the basis of the technological, temporal, and geographical representativeness as per the IBU PCR.

**Table 4: Secondary Data Sources and Data Quality Assessment**

A1: Raw Material Inputs				
Inputs	LCI Data Source	Geography	Year	Data Quality Assessment
Ball Clay	Clay {RoW}  market for clay   Cut-off, U	Global	2011	<b>Technology:</b> very good
Sand Mix FC Ball Clay				Process models average global technology
Hycast VC Ball Clay				<b>Time:</b> good
TP Prosper Clay				Data is <10 years old
Chamotee				<b>Geography:</b> very good Data is representative of global conditions.
Limestone	Limestone, crushed, washed {RoW}  market for limestone, crushed, washed   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
Potash	Feldspar {GLO}  market for   Cut-off, U	Global	2011	<b>Technology:</b> very good
Quartz Powder				Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.

<b>Wollastonite</b>	Dolomite {RoW}  market for dolomite   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Sand</b>	Sand {GLO}  market for   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Kaolin</b>	Kaolin {GLO}  market for   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Glaze</b>	Frit, for ceramic tile {GLO}  market for   Cut-off, U	Global	2014	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.

### A2: Transportation

Inputs	LCI Data Source	Geography	Year	Data Quality Assessment
<b>Truck transport</b>	Transport, freight, lorry 16-32 metric ton, EURO4 {RoW} , freight, lorry 16-32 metric ton, EURO4   Cut-off, U	Global	2014	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Ocean transport</b>	Transport, freight, sea, transoceanic tanker {GLO}  market for   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.

### A3: Manufacturing

Energy	LCI Data Source	Geography	Year	Data Quality Assessment
<b>Grid Electricity</b>	Electricity, high voltage {AE}  market for electricity, high voltage   Cut-off, U	UAE	2014	<b>Technology:</b> very good Process models average UAE technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of UAE electricity.

<b>Diesel Electricity</b>	Diesel, burned in diesel-electric generating set {GLO}  market for   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Natural Gas</b>	Heat, district or industrial {RoW}  market for heat, district or industrial, natural gas   Cut-off, U	Global	2015	<b>Technology:</b> very good Process models average global technology <b>Time:</b> very good Data is <5 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Water</b>	<b>LCI Data Source</b>	<b>Geography</b>	<b>Year</b>	<b>Data Quality Assessment</b>
<b>Freshwater</b>	Tap water {RoW}  market for   Alloc Rec, U	Global	2014	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Recycled water</b>	Wastewater from ceramic prod. {RoW}  treatment of, capacity 5E9l/year   Cut-off, U	Global	2010	<b>Technology:</b> very good <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Waste</b>	<b>LCI Data Source</b>	<b>Geography</b>	<b>Year</b>	<b>Data Quality Assessment</b>
<b>Tiles Scrap Waste</b>	Inert waste, for final disposal {RoW}  treatment of inert waste, inert material landfill   Cut-off, U	Global	2010	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>Industrial Waste (Plastic, Wood, Cardboard)</b>	Municipal solid waste {RoW}  treatment of, sanitary landfill   Cut-off, U	Global	2010	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.
<b>C1-C4 and D: End of Life</b>				
<b>Trucking</b>	Transport, freight, lorry 16-32 metric ton, EURO4 {RoW}  transport, freight, lorry 16-32 metric ton, EURO4   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions.

<b>Recycling process/Substituted</b>	Gravel: Gravel, crushed {RoW}  production   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions
<b>Landfill</b>	Process-specific burdens, inert material landfill {RoW}  market for process-specific burdens, inert material landfill   Cut-off, U	Global	2011	<b>Technology:</b> very good Process models average global technology <b>Time:</b> good Data is <10 years old <b>Geography:</b> very good Data is representative of global conditions

### 3.7 Period under Review

Data was gathered for the primary material and energy inputs used in the production for calendar year 2019.

### 3.8 Allocation

At RAK Ceramics' Ras Al Khaimah factory several ceramic and sanitaryware products are produced. Since the primary data for manufacturing was only available on a facility level, the environmental load among the products produced is allocated according to its mass. For waste that is recycled, the 'recycled content approach' was chosen. The recycling of waste generated by the product system is cut off.

### 3.9 Comparability

This LCA was created using industry average data for upstream materials. Data variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel types used.

## 4. LCA: Scenarios and additional technical information

### 4.1 Biogenic Carbon Content

The product does not contain any biogenic carbon. The packaging includes biogenic carbon in the form of cardboard and this packaging is less than 5% of the combined product and packaging mass, estimated to be 20-40 kg/t.



## 5. LCA: Results

Life cycle impact assessment (LCIA) is the phase in which the set of results of the inventory analysis – the inventory flow table – is further processed and interpreted in terms of environmental impacts and resource use inventory metrics. As specified in the IBU PCR, Table 5 and 6a/b below summarizes the LCA results for the product systems.

**Table 5: Description of the System Boundary (x: included in LCA; mnd: module not declared; mnr: module not relevant)**

Product			Construction Installation		Use							End-of-life				Benefits of Loads Beyond the System Boundary		
Raw Material supply	Transport	Manufacturing	Transport	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	mnd	mnd	mnd	mnd	mnr	mnr	mnr	mnd	mnd	x	x	x	x	x	x	x



**Table 6a. Life Cycle Impact Assessment Results for 1 m<sup>2</sup> ceramic tile product**

Environmental Indicator											
Impact Categories	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Global warming potential	<b>GWP - total</b>	kg CO <sub>2</sub> -eq	5.61E+00	1.76E+00	1.95E-01	3.46E+00	0.00	1.72E-01	1.22E-01	1.61E-02	-1.22E-01
Global warming potential - fossil fuels	<b>GWP - fossil</b>	kg CO <sub>2</sub> -eq	5.28E+00	1.76E+00	1.95E-01	3.14E+00	0.00	1.72E-01	1.20E-01	1.61E-02	-1.20E-01
Global warming potential - biogenic	<b>GWP - biogenic</b>	kg CO <sub>2</sub> -eq	3.27E-01	2.50E-03	7.54E-05	3.24E-01	0.00	6.67E-05	1.56E-03	4.35E-05	-1.56E-03
GWP land use & land use change	<b>GWP - luluc</b>	kg CO <sub>2</sub> -eq	2.22E-03	1.80E-03	7.05E-05	2.87E-04	0.00	6.23E-05	1.59E-04	1.36E-06	-1.59E-04
Depletion potential of the stratospheric ozone layer	<b>ODP</b>	kg CFC-11-eq	1.09E-06	4.49E-07	3.43E-08	5.69E-07	0.00	3.76E-08	1.09E-08	3.23E-09	-1.09E-08
Acidification potential of land and water	<b>AP</b>	kg SO <sub>2</sub> -eq	2.27E-02	1.40E-02	7.00E-04	7.20E-03	0.00	6.70E-04	6.07E-04	1.16E-04	-6.07E-04
Acidification potential, accumulated exceedance	<b>AP</b>	mol H <sup>+</sup> -eq	2.70E-02	1.49E-02	9.97E-04	1.01E-02	0.00	8.81E-04	7.81E-04	1.61E-04	-7.81E-04
Eutrophication potential	<b>EP</b>	kg PO <sub>4</sub> -eq	7.99E-03	5.30E-03	2.00E-04	2.30E-03	0.00	1.59E-04	3.00E-04	2.72E-05	-3.00E-04
Eutrophication, fraction of nutrients reaching freshwater end compartment	<b>EP-Freshwater</b>	kg PO <sub>4</sub> -eq	6.73E-05	4.66E-05	8.24E-07	4.37E-06	0.00	1.46E-05	7.35E-05	9.10E-07	-7.35E-05
Eutrophication, fraction of nutrients reaching marine end compartment	<b>EP- Marine</b>	kg N-eq	6.58E-04	1.37E-04	1.68E-05	1.39E-04	0.00	2.96E-04	1.77E-04	6.91E-05	-1.77E-04
Eutrophication, accumulated exceedance	<b>EP- Terrestrial</b>	mol N-eq	6.83E-03	1.50E-03	1.83E-04	1.15E-03	0.00	3.24E-03	2.14E-03	7.57E-04	-2.14E-03
Formation potential of tropospheric ozone photochemical oxidants	<b>POCP</b>	kg ethene-eq	1.23E-03	6.00E-04	0.00E+00	6.00E-04	0.00	2.33E-05	3.97E-05	4.72E-06	-3.97E-05
Formation potential of tropospheric ozone photochemical oxidants	<b>POCP</b>	kg NMVOC-eq	1.97E-02	8.15E-03	1.04E-03	9.35E-03	0.00	9.23E-04	5.41E-04	2.12E-04	-5.41E-04
Abiotic Depletion Potential for Non-Fossil Resources	<b>ADPE</b>	kg Sb eq	2.96E-04	2.90E-04	5.58E-07	7.94E-07	0.00	4.56E-06	1.28E-05	2.35E-08	-1.28E-05
Abiotic Depletion Potential for Fossil Resources	<b>ADPF</b>	MJ Surplus	1.21E+02	2.32E+01	2.83E+00	9.27E+01	0.00	2.52E+00	1.34E+00	2.12E-01	-1.34E+00
Water user deprivation potential, deprivation weighted water consumption	<b>WDP</b>	m <sup>3</sup> world- Eq deprived	-6.09E-01	4.98E-02	4.68E-04	8.45E-04	0.00	8.28E-03	-4.64E-01	3.09E-04	-2.05E-01

Inventory Metrics - Resources	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Use of renewable primary energy as energy	PERE	MJ	2.39E+00	2.12E+00	2.83E-02	2.07E-01	0.00	2.86E-02	1.56E-01	1.65E-03	-1.56E-01
Use of renewable primary energy as a material	PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy	PERT	MJ	2.39E+00	2.12E+00	2.83E-02	2.07E-01	0.00	2.86E-02	1.56E-01	1.65E-03	-1.56E-01
Use of non-renewable primary energy as energy	PENRE	MJ	3.32E+01	2.72E+01	3.05E+00	0 102.9642	0.00	2.71E+00	1.86E+00	2.27E-01	-1.86E+00
Use of non-renewable primary energy as a material	PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy	PENRT	MJ	3.32E+01	2.72E+01	3.05E+00	0.00E+00	0.00	2.71E+00	1.86E+00	2.27E-01	-1.86E+00
Use of secondary materials	SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of freshwater resources	FW	m3	-5.91E-01	4.09E-02	5.00E-04	2.73E-02	0.00	8.28E-03	-4.64E-01	3.09E-04	-2.05E-01
Inventory Metrics – Waste and Outputs	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Disposed of Hazardous Waste	HWD	kg	1.48E+00	0.00E+00	0.00E+00	1.48E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Non-Hazardous Waste	NHWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Radioactive Waste	RWD	m3	6.14E-08	3.50E-08	7.68E-09	1.87E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Reuse	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Recycling	MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Energy Recovery	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Electrical Energy (Waste to Energy)	EEE	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Thermal Energy (Waste to Energy)	ETE	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

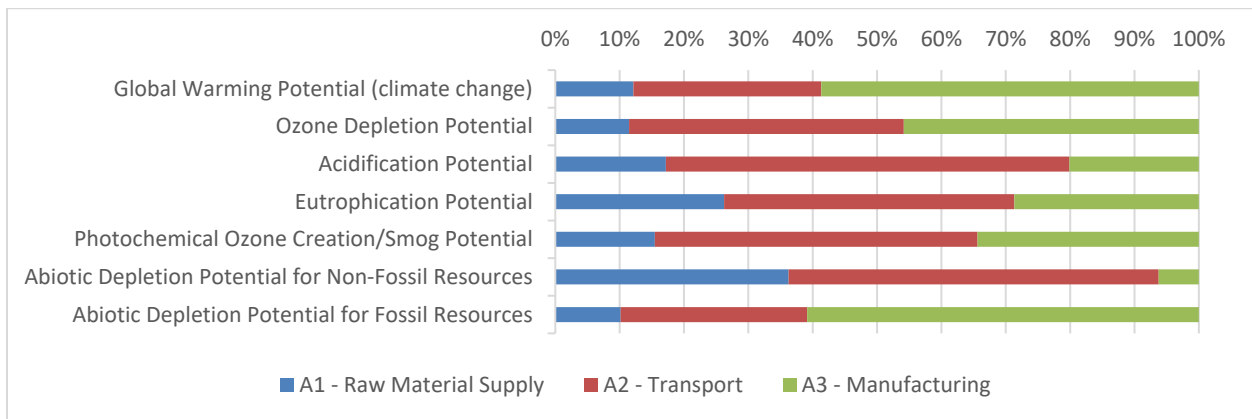
**Table 6b. Life Cycle Impact Assessment Results for 1 m<sup>2</sup> poreclain tile product**

Environmental Indicator											
Impact Categories	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Global warming potential	<b>GWP - total</b>	kg CO2-eq	8.30E+00	2.07E+00	1.82E+00	4.19E+00	0.00E+00	1.89E-01	1.34E-01	1.77E-02	-1.34E-01
Global warming potential - fossil fuels	<b>GWP - fossil</b>	kg CO2-eq	7.90E+00	2.07E+00	1.82E+00	3.80E+00	0.00E+00	1.89E-01	1.32E-01	1.77E-02	-1.32E-01
Global warming potential - biogenic	<b>GWP - biogenic</b>	kg CO2-eq	3.97E-01	2.33E-03	1.67E-03	3.92E-01	0.00E+00	7.34E-05	1.72E-03	4.79E-05	-1.72E-03
GWP land use & land use change	<b>GWP - luluc</b>	kg CO2-eq	3.18E-03	2.03E-03	7.39E-04	3.47E-04	0.00E+00	6.86E-05	1.75E-04	1.50E-06	-1.75E-04
Depletion potential of the stratospheric ozone layer	<b>ODP</b>	kg CFC-11-eq	1.49E-06	5.11E-07	3.12E-07	6.26E-07	0.00E+00	4.14E-08	1.20E-08	3.55E-09	-1.20E-08
Acidification potential of land and water	<b>AP</b>	kg SO2-eq	4.55E-02	1.55E-02	2.12E-02	7.90E-03	0.00E+00	7.37E-04	6.68E-04	1.28E-04	-6.68E-04
Acidification potential, accumulated exceedance	<b>AP</b>	mol H+-eq	5.46E-02	1.63E-02	2.50E-02	1.22E-02	0.00E+00	9.70E-04	8.59E-04	1.77E-04	-8.59E-04
Eutrophication potential	<b>EP</b>	kg PO4-eq	1.12E-02	5.70E-03	2.80E-03	2.50E-03	0.00E+00	1.75E-04	3.30E-04	2.99E-05	-3.30E-04
Eutrophication, fraction of nutrients reaching freshwater end compartment	<b>EP-Freshwater</b>	kg PO4-eq	7.56E-05	4.53E-05	8.47E-06	4.81E-06	0.00E+00	1.60E-05	8.09E-05	1.00E-06	-8.09E-05
Eutrophication, fraction of nutrients reaching marine end compartment	<b>EP- Marine</b>	kg N-eq	8.68E-04	1.43E-04	1.70E-04	1.53E-04	0.00E+00	3.26E-04	1.95E-04	7.60E-05	-1.95E-04
Eutrophication, accumulated exceedance	<b>EP- Terrestrial</b>	mol N-eq	9.11E-03	1.55E-03	1.89E-03	1.27E-03	0.00E+00	3.56E-03	2.36E-03	8.32E-04	-2.36E-03
Formation potential of tropospheric ozone photochemical oxidants	<b>POCP</b>	kg ethene-eq	2.23E-03	7.00E-04	8.00E-04	7.00E-04	0.00E+00	2.56E-05	4.37E-05	5.19E-06	-4.37E-05
Formation potential of tropospheric ozone photochemical oxidants	<b>POCP</b>	kg NMVOC-eq	3.40E-02	9.42E-03	1.20E-02	1.13E-02	0.00E+00	1.01E-03	5.96E-04	2.33E-04	-5.96E-04
Abiotic Depletion Potential for Non-Fossil Resources	<b>ADPE</b>	kg Sb eq	3.12E-04	3.03E-04	3.39E-06	8.73E-07	0.00E+00	5.02E-06	1.41E-05	2.58E-08	-1.41E-05
Abiotic Depletion Potential for Fossil Resources	<b>ADPF</b>	MJ Surplus	5.80E+01	2.87E+01	2.62E+01	0 101.9305	0.00E+00	2.78E+00	1.48E+00	2.33E-01	-1.48E+00
Water user deprivation potential, deprivation weighted water consumption	<b>WDP</b>	m <sup>3</sup> world- deprived Eq	-6.43E-01	7.87E-02	3.71E-03	9.29E-04	0.00E+00	9.10E-03	-5.10E-01	3.40E-04	-2.25E-01

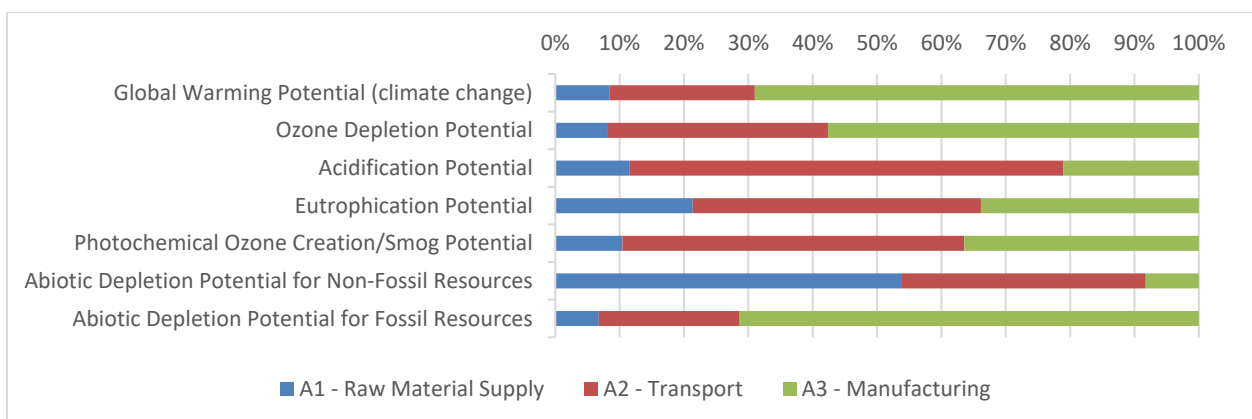
Inventory Metrics - Resources	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Use of renewable primary energy as energy	PERE	MJ	2.99E+00	2.31E+00	4.20E-01	2.28E-01	0.00E+00	3.14E-02	1.72E-01	1.81E-03	-1.72E-01
Use of renewable primary energy as a material	PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy	PERT	MJ	2.99E+00	2.31E+00	4.20E-01	2.28E-01	0.00E+00	3.14E-02	1.72E-01	1.81E-03	-1.72E-01
Use of non-renewable primary energy as energy	PENRE	MJ	6.55E+01	3.36E+01	2.86E+01	0 113.2606	0.00E+00	2.99E+00	2.04E+00	2.49E-01	-2.04E+00
Use of non-renewable primary energy as a material	PENRM	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
Total use of non-renewable primary energy	PENRT	MJ	6.55E+01	3.36E+01	2.86E+01	0 113.2606	0.00E+00	2.99E+00	2.04E+00	2.49E-01	-2.04E+00
Use of secondary materials	SM	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
Use of renewable secondary fuels	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
Use of non-renewable secondary fuels	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
Use of freshwater resources	FW	m3	-6.32E-01	5.89E-02	4.60E-03	3.01E-02	0.00E+00	9.10E-03	-5.10E-01	3.40E-04	-2.25E-01
Inventory Metrics – Waste and Outputs	Abbrev.	Units	Total	A1	A2	A3	C1	C2	C3	C4	D
Disposed of Hazardous Waste	HWD	kg	1.63E+00	0.00E+00	0.00E+00	1.63E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Non-Hazardous Waste	NHWD	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
Disposed of Radioactive Waste	RWD	m3	1.35E-07	4.35E-08	7.08E-08	2.05E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Reuse	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
Materials for Recycling	MFR	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
Materials for Energy Recovery	MER	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
Exported Electrical Energy (Waste to Energy)	EEE	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
Exported Thermal Energy (Waste to Energy)	ETE	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

## 6. Interpretation

Figure 2a and 2b shows the relative contribution to the cumulative impacts of the A1 through A3 phases. The C1 through C4 phases and Module D are all relatively insignificant in terms of the overall results and are thus excluded from this contribution analysis. In the cradle-to-gate portion, the manufacturing (A3) and transportation (A2) are the major contributor to the overall impact. Major A3 impacts came from the combustion of natural gas for heat during the drying process. The transportation impacts are related to the long distances of the raw material procurement.



**Figure 2a.** Contribution analysis for Vitreous Ceramics



**Figure 2b.** Contribution analysis for Fine Fire Clay Ceramics



## 7. Requisite Evidence

No environmental claims beyond the LCA results are made in this EPD and thus no additional evidence is required.



## 8. References

1. A Life Cycle Assessment of Ceramic Tiles and Sanitary Ceramics Manufactured by RAK Ceramics
2. EN 15804 +A1:2013 Sustainability of construction works – Environmental product declarations –Core rules for the product category of construction products.
3. EN 15804 + A2:2019 Sustainability of construction works- Environmental product declarations- Core rules for the product category of construction products.
4. IBU PCR Part A: Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report according to EN 15804 + A2:2019– Version 1.0
5. IBU PCR Part B: Requirements on the EPD for sanitary ceramics, Version 1.0
6. ISO 21930: 2017 Building construction – Sustainability in building construction – Environmental declaration of building products.
7. ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
8. ISO 14044: 2006 Environmental management - Life cycle assessment - Requirements and guidelines.
9. ISO 14040: 2006 Environmental management - Life cycle assessment - Principles and framework.