Environmental Product Declaration

RAK CERAMICS

1990-2020 30TH MOVING FORWARD

Vitreous Ceramic and Fine Fire Clay Ceramic Sanitaryware Products

ASTM INTERNATIONAL

According to
EN 15804
ISO 21930
ISO 14025

1. General Information

Manufacturer Name:	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
Program Operator:	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2959, USA
Declaration Number:	XXXX
Reference PCR:	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
Date of Issuance:	January 8, 2021
End of Validity:	January 8, 2026
Product Name:	Vitreous Ceramic and Fine Fire Clay Ceramic Sanitaryware Products
EPD Owner:	RAK Ceramics P.J.S.C.
Product Group:	Ceramic Sanitaryware Products
Declared Unit:	1 t of ceramic sanitaryware
EPD Scope:	Cradle-to-gate and End-of-Life (A1, A2, A3, C1, C2, C3, C4, D)
Verification:	The CEN Norm EN 15804 serves as the core PCR. Independent verification of the declaration according to ISO 14025 and ISO 21930. ☐ internal ☒ external
LCA Reviewer and EPD Verifier:	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 × 460 × 150 mm; Bidets 530 × 360 × 400 mm; Toilets 600 × 360 × 430 mm; Urinals 650 × 300 × 350 mm; Cisterns 380 × 170 × 370 mm; Shower Trays 900 × 900 × 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			
Test Description	**Standard Test Method**	**Standard Requirements**	**RAK Ceramics Specification**
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 sanitaryare.

Table 3: Product Ingredients

Products	Ingredient Name	Value	
Vitreous Ceramic	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	%
Fine Fire Clay Ceramic	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 compotent 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.

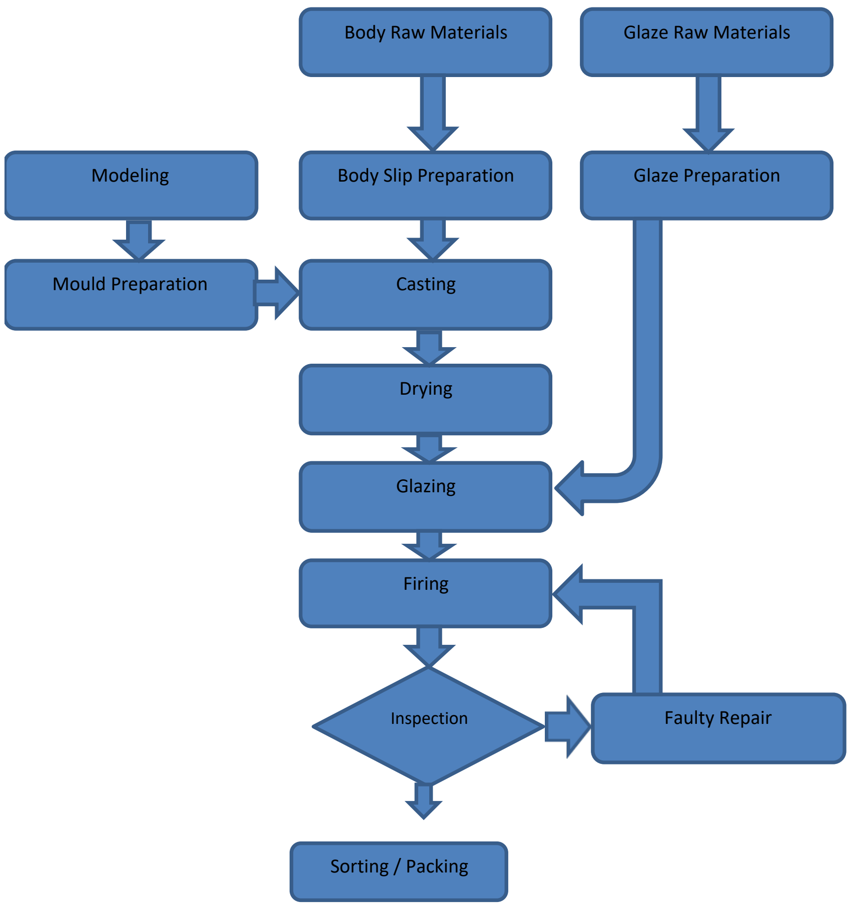

Figure 1: Ceramic Sanitaryware Flow

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, polyetlylene/ LDPE, corrugated boxes/paper cardbaord, wooden pallets, and plastic strap belts.

2.10 Conditions of Use

No particular features arise in the materials composotion 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 negected. Not applicable: End-of-life phase is outside the scope of the underlying LCA.

2.11 Environment and Health Considerations During Use

Ceramic Sanitryware is intrinstically inert, chemically stable, and therefore during the use stage does not emit any pollutants or substances which are harmful to the environement 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

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 is limited to a cradle-to-gate focus. The following three life cycle stages as per the governing PCRs are included in the study scope (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): The preparation processes of ceramic sanitaryware at RAK Ceramics' Ras Al Khaimah Factory. This phase also includes the operations of the manufacturing facility and all process emissions that occur at the production facility.

C1-C4 and D End of Life

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 **Sand Mix FC Ball Clay** **Hycast VC Ball Clay** **TP Prosper Clay** **Chamotee**	Clay {RoW}| market for clay | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Limestone	Limestone, crushed, washed {RoW}| market for limestone, crushed, washed | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Potash **Quartz Powder**	Feldspar {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Wollastonite	Dolomite {RoW}| market for dolomite | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.

Sand	Sand {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Kaolin	Kaolin {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Glaze	Frit, for ceramic tile {GLO}| market for | Cut-off, U	Global	2014	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
A2: Transportation				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Truck transport	Transport, freight, lorry 16-32 metric ton, EURO4 {RoW}| transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, U	Global	2014	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Ocean transport	Transport, freight, sea, transoceanic tanker {GLO}| market for | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
A3: Manufacturing				
Energy	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Grid Electricity	Electricity, high voltage {AE}| market for electricity, high voltage | Cut-off, U	UAE	2014	**Technology**: very good Process models average UAE technology **Time:** good Data is <10 years old **Geography**: very good Data is representative of UAE electricity.

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

	freight, lorry 16-32 metric ton, EURO4 | Cut-off, U			Data is <10 years old **Geography:** very good Data is representative of global conditions.
Recycling process/Substituted	Gravel: Gravel, crushed {RoW}| production | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Landfill	Process-specific burdens, inert material landfill {RoW}| market for process-specific burdens, inert material landfill | Cut-off, U	Global	2011	**Technology:** very good Process models average global technology **Time:** good Data is <10 years old **Geography:** 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 biogenic carbon content in less than 5% of the product and packaging. The cardboard packaging is 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 summmarizes the LCA results for the cradle-to-gate (A1-A3) 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	mnd	mnd	mnd	mnd	mnd	mnd	mnd

Table 6a. Life Cycle Impact Assessment Results for 1 ton vitreous ceramic product											
Environmental Indicator	**Abbrev.**	**Units**	**Total**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Impact Categories											
Global warming potential	**GWP - total**	kg CO2-eq	5.16E+02	5.98E+01	1.53E+02	2.94E+02	0	8.61E+00	6.09E+00	8.06E-01	-6.09E+00
Global warming potential - fossil fuels	**GWP - fossil**	kg CO2-eq	4.99E+02	5.94E+01	1.52E+02	2.78E+02	0	8.61E+00	6.00E+00	8.03E-01	-6.00E+00
Global warming potential - biogenic	**GWP - biogenic**	kg CO2-eq	1.66E+01	3.45E-01	9.61E-02	1.62E+01	0	3.34E-03	7.80E-02	2.18E-03	-7.80E-02
GWP land use & land use change	**GWP - luluc**	kg CO2-eq	1.36E-01	6.09E-02	5.82E-02	1.35E-02	0	3.12E-03	7.94E-03	6.82E-05	-7.94E-03
Depletion potential of the stratospheric ozone layer	**ODP**	kg CFC-11-eq	6.41E-05	7.11E-06	2.65E-05	2.84E-05	0	1.88E-06	5.44E-07	1.62E-07	-5.44E-07
Acidification potential of land and water	**AP**	kg SO2-eq	1.83E+00	3.08E-01	1.12E+00	3.60E-01	0	3.35E-02	3.04E-02	5.80E-03	-3.04E-02
Acidification potential, accumulated exceedance	**AP**	mol H+-eq	2.27E+00	3.57E-01	1.38E+00	4.78E-01	0	4.41E-02	3.91E-02	8.06E-03	-3.91E-02
Eutrophication potential	**EP**	kg PO4-eq	4.05E-01	1.04E-01	1.78E-01	1.13E-01	0	7.96E-03	1.50E-02	1.36E-03	-1.50E-02
Eutrophication, fraction of nutrients reaching freshwater end compartment	**EP-Freshwater**	kg PO4-eq	4.02E-02	2.09E-02	1.41E-02	4.47E-03	0	7.29E-04	3.68E-03	4.55E-05	-3.68E-03
Eutrophication, fraction of nutrients reaching marine end compartment	**EP- Marine**	kg N-eq	5.58E-01	7.38E-02	2.86E-01	1.80E-01	ND	1.48E-02	8.86E-03	3.45E-03	-8.86E-03
Eutrophication, accumulated exceedance	**EP- Terrestrial**	mol N-eq	5.77E+00	7.98E-01	3.15E+00	1.62E+00	ND	1.62E-01	1.07E-01	3.78E-02	-1.07E-01
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg ethene-eq	8.99E-02	1.37E-02	4.44E-02	3.04E-02	0	1.16E-03	1.99E-03	2.36E-04	-1.99E-03
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg NMVOC-eq	1.70E+00	2.22E-01	9.05E-01	5.13E-01	ND	4.61E-02	2.71E-02	1.06E-02	-2.71E-02
Abiotic Depletion Potential for Non-Fossil Resources	**ADPE**	kg Sb eq	8.66E-04	2.31E-04	3.66E-04	3.97E-05	0	2.28E-04	6.41E-04	1.17E-06	-6.41E-04
Abiotic Depletion Potential for Fossil Resources	**ADPF**	MJ Surplus	7.75E+03	7.73E+02	2.21E+03	4.63E+03	0	1.26E+02	6.72E+01	1.06E+01	-6.72E+01
Water user deprivation potential, deprivation weighted water consumption	**WDP**	m^3 world- Eq deprived	3.35E+01	5.39E+01	7.10E+00	5.52E+00	0	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01

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Inventory Metrics - Resources											
Use of renewable primary energy as energy	**PERE**	MJ	1.00E+02	6.03E+01	2.81E+01	1.04E+01	0	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of renewable primary energy as a material	**PERM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy	**PERT**	MJ	1.00E+02	6.03E+01	2.81E+01	1.04E+01	0	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of non-renewable primary energy as energy	**PENRE**	MJ	8.62E+03	9.37E+02	2.39E+03	5.15E+03	0	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of non-renewable primary energy as a material	**PENRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy	**PENRT**	MJ	8.62E+03	9.37E+02	2.39E+03	5.15E+03	0	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of secondary materials	**SM**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	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	ND	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of freshwater resources	**FW**	m3	-2.88E+01	2.45E+00	4.03E-01	1.37E+00	0	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01
Inventory Metrics – Waste and Outputs											
Disposed of Hazardous Waste	**HWD**	kg	7.42E+01	0.00E+00	0.00E+00	7.42E+01	0	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Radioactive Waste	**RWD**	m3	8.07E-06	1.17E-06	5.97E-06	9.34E-07	0	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	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	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	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 6b. Life Cycle Impact Assessment Results for 1 ton fine fire clay product											
Environmental Indicator	**Abbrev.**	**Units**	**Total**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Impact Categories											
Global warming potential	**GWP - total**	kg CO2-eq	4.38E+02	3.60E+01	9.87E+01	2.94E+02	0	8.61E+00	6.09E+00	8.06E-01	-6.09E+00
Global warming potential - fossil fuels	**GWP - fossil**	kg CO2-eq	4.22E+02	3.58E+01	9.86E+01	2.78E+02	0	8.61E+00	6.00E+00	8.03E-01	-6.00E+00
Global warming potential - biogenic	**GWP - biogenic**	kg CO2-eq	1.65E+01	1.62E-01	9.06E-02	1.62E+01	0	3.34E-03	7.80E-02	2.18E-03	-7.80E-02
GWP land use & land use change	**GWP - luluc**	kg CO2-eq	9.64E-02	3.96E-02	4.00E-02	1.35E-02	0	3.12E-03	7.94E-03	6.82E-05	-7.94E-03
Depletion potential of the stratospheric ozone layer	**ODP**	kg CFC-11-eq	5.14E-05	4.04E-06	1.69E-05	2.84E-05	0	1.88E-06	5.44E-07	1.62E-07	-5.44E-07
Acidification potential of land and water	**AP**	kg SO2-eq	1.75E+00	1.97E-01	1.15E+00	3.60E-01	0	3.35E-02	3.04E-02	5.80E-03	-3.04E-02
Acidification potential, accumulated exceedance	**AP**	mol H+-eq	2.12E+00	2.39E-01	1.36E+00	4.78E-01	0	4.41E-02	3.91E-02	8.06E-03	-3.91E-02
Eutrophication potential	**EP**	kg PO4-eq	3.44E-01	7.16E-02	1.50E-01	1.13E-01	0	7.96E-03	1.50E-02	1.36E-03	-1.50E-02
Eutrophication, fraction of nutrients reaching freshwater end compartment	**EP-Freshwater**	kg PO4-eq	2.97E-02	1.44E-02	1.01E-02	4.47E-03	0	7.29E-04	3.68E-03	4.55E-05	-3.68E-03
Eutrophication, fraction of nutrients reaching marine end compartment	**EP- Marine**	kg N-eq	4.50E-01	4.89E-02	2.03E-01	1.80E-01	0	1.48E-02	8.86E-03	3.45E-03	-8.86E-03
Eutrophication, accumulated exceedance	**EP- Terrestrial**	mol N-eq	4.63E+00	5.52E-01	2.26E+00	1.62E+00	0	1.62E-01	1.07E-01	3.78E-02	-1.07E-01
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg ethene-eq	8.48E-02	8.70E-03	4.43E-02	3.04E-02	0	1.16E-03	1.99E-03	2.36E-04	-1.99E-03
Formation potential of tropospheric ozone photochemical oxidants	**POCP**	kg NMVOC-eq	1.37E+00	1.48E-01	6.53E-01	5.13E-01	0	4.61E-02	2.71E-02	1.06E-02	-2.71E-02
Abiotic Depletion Potential for Non-Fossil Resources	**ADPE**	kg Sb eq	7.10E-04	2.58E-04	1.83E-04	3.97E-05	0	2.28E-04	6.41E-04	1.17E-06	-6.41E-04
Abiotic Depletion Potential for Fossil Resources	**ADPF**	MJ Surplus	6.63E+03	4.40E+02	1.42E+03	4.63E+03	0	1.26E+02	6.72E+01	1.06E+01	-6.72E+01
Water user deprivation potential, deprivation weighted water consumption	**WDP**	m^3 world- Eq deprived	-6.33E+00	1.67E+01	4.42E+00	5.52E+00	0	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01

Inventory Metrics - Resources												
Use of renewable primary energy as energy	**PERE**	MJ	7.25E+01	3.78E+01	2.28E+01	1.04E+01	0	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of renewable primary energy as a material	**PERM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy	**PERT**	MJ	7.25E+01	3.78E+01	2.28E+01	1.04E+01	0	1.43E+00	7.82E+00	8.24E-02	-7.82E+00
Use of non-renewable primary energy as energy	**PENRE**	MJ	7.38E+03	5.33E+02	1.55E+03	5.15E+03	0	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of non-renewable primary energy as a material	**PENRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy	**PENRT**	MJ	7.38E+03	5.33E+02	1.55E+03	5.15E+03	0	1.36E+02	9.29E+01	1.13E+01	-9.29E+01
Use of secondary materials	**SM**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of freshwater resources	**FW**	m3	-3.03E+01	1.04E+00	2.48E-01	1.37E+00	0	4.14E-01	-2.32E+01	1.54E-02	-1.02E+01
Inventory Metrics – Waste and Outputs												
Disposed of Hazardous Waste	**HWD**	kg	7.42E+01	0.00E+00	0.00E+00	7.42E+01	0	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of Radioactive Waste	**RWD**	m3	5.45E-06	6.84E-07	3.83E-06	9.34E-07	0	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	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	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	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	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	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 of the cradle-to-gate life cycle. 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.

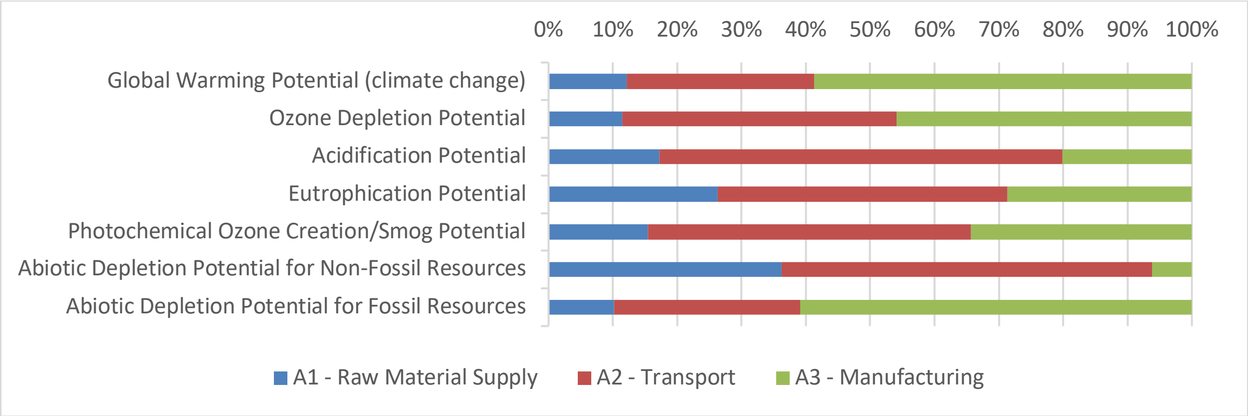

Figure 2a. Contribution analysis for Vitreous Ceramics

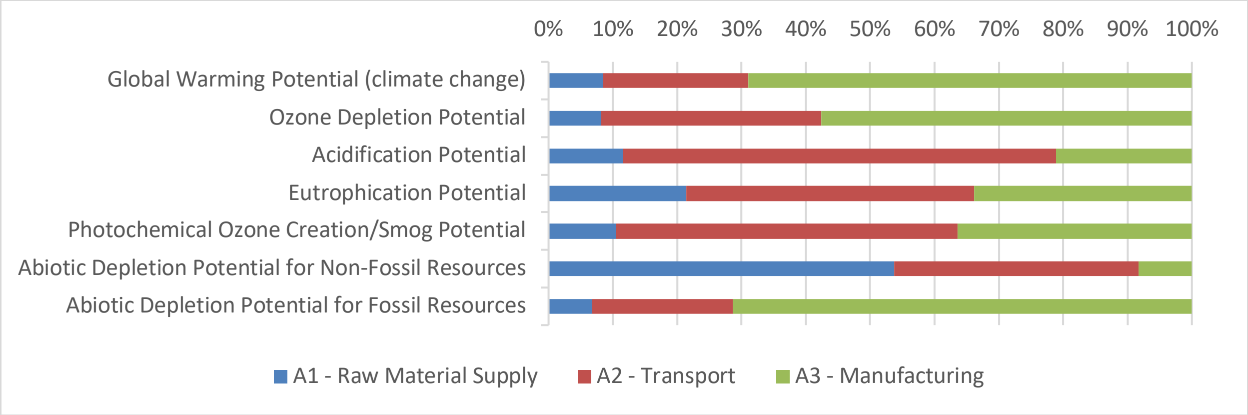

Figure 2b. Contribution analysis for Fine Fire Clay Ceramics

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 Cradle-to-Gate 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.