Type III Environmental Product Declaration No. 486/2023

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Clinker bricks with complementary ceramic masonry elements

Owner of the EPD:

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ITB is the verified member of The European Platform for EPD program operators and LCA practitioner www.eco-platform.org

Basic information

This declaration is the Type III Environmental Product Declaration (EPD) based on EN 15804+A2 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment. Their aspects were verified by the independent body according to ISO 14025. Basically, a comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804+A2.

Life cycle analysis (LCA): A1-A5, C1-C4 and D modules in accordance with EN 15804 (Cradle-to-Gate with options)

The year of preparing the EPD: 2023

Product standard: PN-EN 771-1+A1:2015-10

Service Life: 50 years

PCR: ITB-PCR A v1.6. (PCR based on EN 15804+A2)

Declared unit: 1 kg of clinker bricks with complementary ceramic masonry elements

Reasons for performing LCA: B2B

Representativeness: Polish, European, production in 2022

MANUFACTURER

In a ceramic factory in Panoszów (Poland), which has been in existence for over 140 years, top-class craftsmen create a unique clinker in a traditional way. Clinker production in Patoka dates back to the end of the 19th century. To this day, the brickyard uses local deposits of high-quality clay. The heart of the plant is the Hoffman kiln from 1875. It consists of 16 interconnected chambers forming a closed circle. The fire gradually passes through these rooms, burning successive batches of hand-laid bricks, cobblestones and tiles. Part of the production is special orders, intended for work on priceless historic buildings. Employees from Patoka can recreate the unique shades and textures of materials used in the construction of architectural gems such as castles, palaces and bridges. It is in Patoka that the only clinker fittings in Poland for the construction of columns are made. Products from the Patoka brickyard are highly appreciated by foreign customers. They also have a wide circle of admirers among architects who use their beauty not only in new, prestigious projects (e.g. the building of the National Polish Radio Symphony Orchestra in Katowice, Krzysztof Kieślowski Film School at the University of Silesia), but also during the renovation of representative and historic places (Wawel Royal Castle, Jasna Góra Monastery, Malbork Castle). The Patoka Industries Ltd. brickyard produces around 6 million assortment a year. 90% are assortment with basic/standard dimensions, the remaining 10% are finishing fittings and other forms, sometimes paving clinker and ceramic tiles. Patoka assortment have good physical properties and are characterized by a wide range of colors, meet the requirements of the strictest standards, including among others the German DIN 105 and KIWA BRL 52230.

PRODUCTS DESCRIPTION AND APPLICATION

Clinker brick is a natural construction material, fired from clay and sand. They are environmentally friendly. Ceramic masonry element U are uses in unprotected masonry walls, pillars and partition walls. Ceramic masonry element P are used in protected masonry walls, pillars and partition walls. Complementary ceramic masonry element U are used in unprotected masonry walls, pillars and partition walls. Complementary ceramic masonry element P for use in protected masonry walls, pillars and partition walls. Basic brick size is: 250 x 120 x 65. Ceramic elements are manufactured in a traditional way in Hoffman kiln using the following materials: clay, sand and minor additives. The various colors are the result among others of clay firing or the glazing process. Ni-Zn powder is used as a coloring additive to the dark mass (Toba, Tytan, Alt Toba, Alt Tessin, Tessin). In the case of the production of yellow (Solaris, Alt Solaris) and orange (Alt Deco) products, manufacturer adds barium carbonate (clay from Gozdnica) to the clay.

Technical data for product can be found at website.

LIFE CYCLE ASSESSMENT (LCA) - general rules applied

Declared unit

Declared unit is 1 kg of clinker bricks with complementary ceramic masonry elements.

Allocation

The allocation rules used for this EPD are based on general ITB PCR A v 1.6. Production of the clinker bricks with complementary ceramic elements is a line process conducted in Patoka brickyard (Poland). Allocation was done on product mass basis (32%). All impacts associated with the extraction and processing of raw materials used for the production of ceramic products are allocated in module A1 of the LCA. Impacts from the global line production were inventoried and 100% were allocated to the clay bricks and elements production. Water and energy consumption, associated emissions and generated wastes are allocated to module A3. Packaging materials were takien into consideration.

System limits

Type of the EPD is: cradle to gate - with options. The following life cycle stages were considered. Production stage including: A1 - Raw material extraction and processing, A2 - Transport to the manufacturer and A3 - Manufacturing, A4 - Transport to Site, A5- Installation, End-of-life stage: C1- Deconstruction, C2 - Transport to waste processing, C3 - Waste processing, C4 - Disposal (landfill). This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues. EPD includes D module - declaration of all benefits and loads beyond product system. Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804+A2, machines and facilities (capital goods) required for the production as well as transportation of employees were not included in LCA. 99.8% materials submitted for the formulations and production data were taken into consideration. In the assessment, all available data from production have been considered, i.e. all raw materials/elements used as per formulation process, utilized thermal energy for heating, and electric power consumption. Thus, material and energy flows contributing less than 1 % of mass or energy have been considered. It can be assumed that the total sum of neglected processes does not exceed 0.5 % of energy use and mass per modules.

Modules A1 and A2: *Raw materials supply and transport*

The modules A1 and A2 represent the extraction and processing of raw materials and components and transport to the production sites. Clays, sand, additives and packaging materials are sourced from domestic and foreign suppliers. Means of transport include trucks (inventoried). Polish and European standards for average combustion were used for calculations. Data on mode of transport and distances, as reported by suppliers were used for those materials and parts contributing more than 0.1 % of total product mass.

Module A3: *Production*

The production of clay bricks with complementary elements is carried out in brickyard Patoka in Panoszów (Poland). Only two main ingredients are used for the production of ceramics: sand and pure clay, free of harmful substances. The brickyard uses clay deposit. Its decks are located on the area of 27 hectares. It is mined by opencast method. It is a homogeneous clay of high quality,

perfectly suitable for the production of clinker bricks, pavers and tiles. In addition, it is also used by companies producing clay bricks and elements and manufacturers of roof tiles. It is estimated that at the current level of exploitation, the Patoka deposits will be sufficient for 50-70 years. The clay brought from the mine goes to the deposit within the brickyard. From here it is collected for preliminary mechanical treatment. Two types of clay: top and red are mixed with a slimming additive, i.e. sand (25% of the mixture). The clay structure is broken down in the crusher, then the mix passes through a set of two roller crushers. The last roller passes the mixture through a gap of approx. 1 mm. The processed raw material is aged for 2-3 weeks, after which it is sent to the production hall with a forming set consisting of a feeder, a stirrer and a forming system. Mass is ground here and brought to the form of a plastic homogeneous mass. This mass (vented and compressed at the tip of the molding set) passes through a replaceable tip called the "mouthpiece".

The formed band goes to the cutting set, from where the cut elements, having obtained their final shape (i.e. the shape of the future brick), are loaded onto trolleys and transported to the drying room. Ceramic products leave the drying room after obtaining a sufficiently low humidity. Their transport in the area of the brickyard takes place as it has been for decades - on trolleys, pushed by hand along narrow tracks. On such carts, the dried products reach the inside of the kiln. Here, they are manually stacked, and after firing, they are also manually loaded onto trolleys and transported to the sorting plant. Then they are sorting and placed on pallets, and after wrapping, they are transported to the storage yard. Here they are waiting to be loaded and transported to points of sale.

The heart of the brickyard is a traditional Hoffman coal-fired ring kiln. The history of the ring kiln dates back to 1858, when Friedrich Hofmann built a ring kiln. The design of this kiln, improved over the years, led to the creation of the ring kiln. Contemporary kilns consist of two parallel, multi-chamber channels, connected at the ends by semi-circular chambers. Each chamber has its own gate, through which the charge is loaded and unloaded, in the vault there are chimneys that discharge fumes to the chimney through a smoke channel. The fuel is charged through openings in the vault of the furnace. The ring kiln masonry, 1.5 - 2.8 m thick, consists of a refractory inner wall (chamotte brick with refractory mortar) and an outer wall (brick with cement mortar). Firing in a ring kiln is similar to firing in a multi-chamber kiln. The following zones are distinguished here: drying (spraying), heating, burning (fire) and cooling (fire). In addition, some of the chambers are reserved for loading and unloading the batch, as well as for ongoing conservation work. Four stokers working in shifts watch over the proper course of brick burning. The firing process lasts 8 days and takes place at a temperature around of 1100°C. It is obtained by appropriate dosing (manual and mechanical) of fine coal. A scheme of the clay bricks and elements production process by Patoka is presented in Fig. 1.

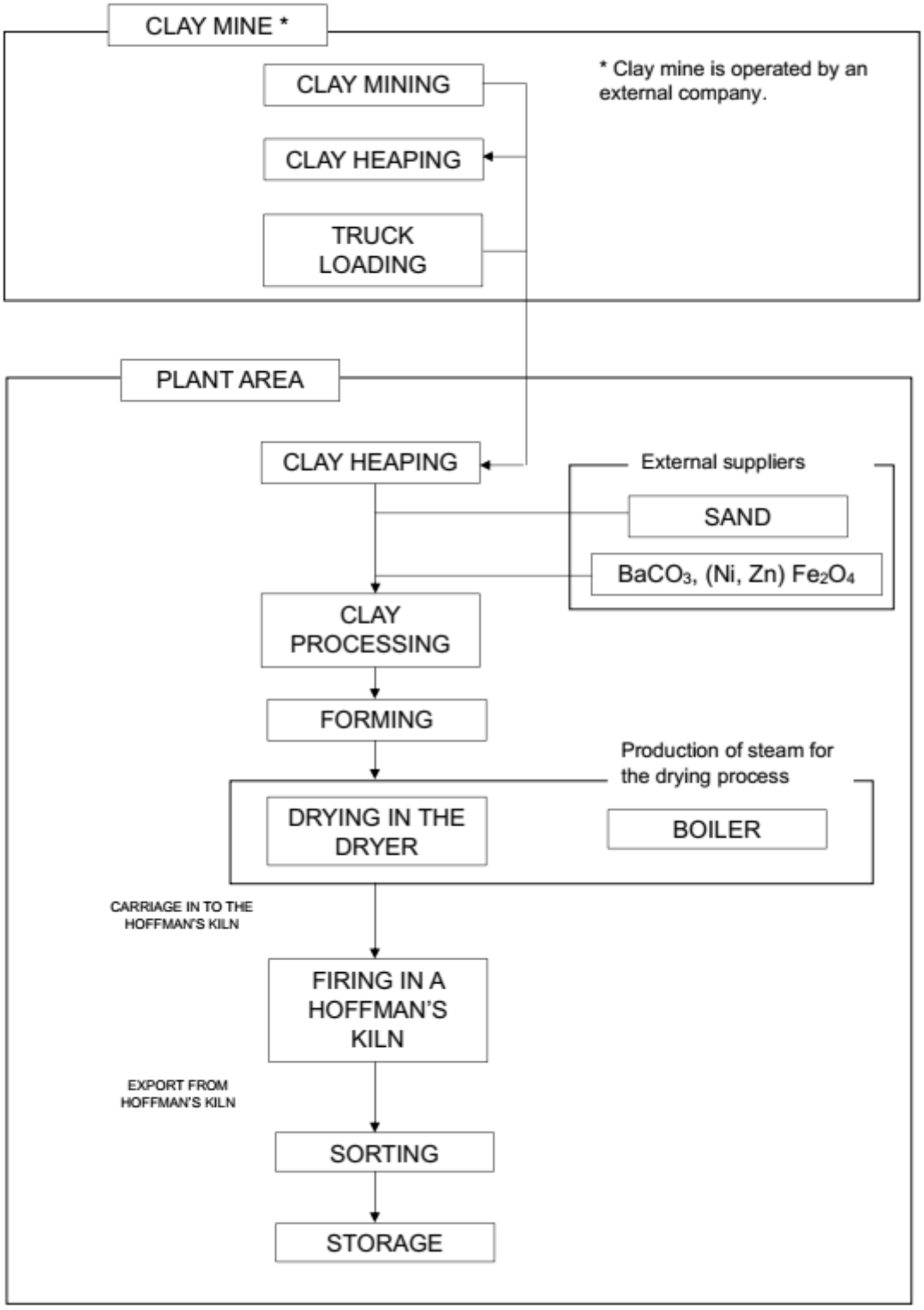

Fig. 1. The scheme of the clay bricks and elements production process by Patoka.

Module A4: *Transport to a construction site*

The clay bricks and elements produced are delivered to Polish as well as foreign customers. In the adapted scenario an average distance of 500 km from the factory gate to a recipient is

assumed. Means of transport include 16 - 32 t lorry (EURO 5) with fuel consumption of 35 l per 100 km.

Module A5: *Installation process*

In the adapted scenario the installation process requires ancillary materials recommended by the producer. Only consumable materials have been included in the calculation.

Modules C1, C2, *C3, C4 and D: End-of-life (EoL)*

In the adapted scenario, dismantling of clay bricks and elements (C1) is performed as part of building renovation or demolition processes, where environmental impacts from declared products can be considered as minor (<1%). There are no specific deconstruction methods, applied in Poland, in regards with the clay bricks and elements so the electric tools impact was assumed. During the demolition process the major amount of the products contribute to the construction and demolition wastes which can be processed on site or in a waste processing plant. It is assumed that 100% of clay bricks and elements are recovered at the EoL cycle. Recovered material is transported to either to landfill or construction site distant by 100 km, on 16 - 32t lorry (EURO 5) with fuel consumption of 35 l per 100 km. In the adapted scenario 70% of the clay bricks and elements is recycled and further used as aggregate for road foundation or ballast (credits presented in module D) while remaining 30% is forwarded to landfill in the form of mixed construction and demolition wastes. Environmental burdens declared in module C4 are associated with waste-specific emissions to air, soil and groundwater. Regarding the recycling material of metals, the metal parts in the EoL are declared as end-of-waste status. Electricity at end-of-life (module C) has been modelled. Electricity at end-of-life (module D) has been modelled using an average EU-27 electricity mix as the location where the product reaches end-of-life is unknown.

Data quality

The data selected for LCA originate from ITB-LCI questionnaires (1 manufacturing plant) completed by producer and verified via data audit. No data collected is older than five years and no generic datasets used are older than ten years. The representativeness, completeness, reliability, and consistency are judged as good. The background data for the processes come from the following resources database Ecoinvent v.3.9 (minerals, additives, energy carriers, waste treatment, and packaging). The background data for energy is national based on KOBiZE/GUS reports (Polish electricity mix and combustion factors for fuels). Specific (LCI) data quality analysis was a part of the input data verification. Where no background data was available, data gaps were complemented by literature research.

Data collection period

The data for manufacture of the declared products refer to period between 01.01.2022 - 31.12.2022 (1 year). The life cycle assessments were prepared for Poland.

Assumptions and estimates

Environmental impacts associated with clinker bricks witch complementary ceramic elements production were aggregated using weighted averages.

Calculation rules

LCA was done in accordance with ITB PCR A 1.6. document.

Databases

The data for the processes comes from the following databases: Ecoinvent v.3.9.1.

Additional information

Polish electricity mix used (production) is 0.702 kg CO_2/kWh (KOBiZE 2022). European electricity mix used is 0.430 kg CO_2/kWh for the end of life (Ecoinvent v3.9.1, RER).

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to declared unit (DU) - 1 kg of clinker bricks with complementary ceramic masonry elements produced by Patoka.

Table 3. System boundaries for the environmental characteristic of clay bricks and elements

Environmental assessment information (MD – Module Declared, MND – Module Not Declared, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse-recovery-recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
MD	MD	MD	MD	MD	MND	MND	MND	MND	MND	MND	MND	MD	MD	MD	MD	MD

Table 4. Life cycle assessment (LCA) results of the clay bricks and elements manufactured by Patoka - environmental impacts (DU: 1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO2	1.08E-02	3.34E-03	1.42E-01	1.56E-01	8.34E-02	3.13E-03	6.98E-03	1.67E-02	1.17E-02	3.19E-03	-6.65E-03
Greenhouse gas potential - fossil	eq. kg CO2	1.10E-02	3.32E-03	1.38E-01	1.52E-01	8.31E-02	3.04E-03	6.85E-03	1.66E-02	1.16E-02	3.16E-03	-6.65E-03
Greenhouse gas potential - biogenic	eq. kg CO2	-2.30E-04	1.14E-05	4.62E-03	4.40E-03	2.84E-04	8.80E-05	2.00E-04	5.68E-05	3.98E-05	3.19E-05	-3.99E-07
Global warming potential - land use and land use change	eq. kg CO2	1.36E-05	1.30E-06	5.83E-05	7.32E-05	3.26E-05	1.46E-06	2.40E-06	6.52E-06	4.57E-06	3.20E-06	-3.05E-05
Stratospheric ozone depletion potential	eq. kg CFC 11	1.86E-10	7.69E-10	4.82E-09	5.77E-09	1.92E-08	1.15E-10	1.40E-10	3.85E-09	2.69E-09	9.61E-10	-1.25E-09
Soil and water acidification potential	eq. mol H+	9.29E-05	1.35E-05	1.20E-03	1.31E-03	3.37E-04	2.61E-05	7.60E-05	6.75E-05	4.72E-05	2.66E-05	-2.79E-04
Eutrophication potential - freshwater	eq. kg P	4.10E-06	2.23E-07	1.21E-04	1.25E-04	5.59E-06	2.50E-06	1.30E-05	1.12E-06	7.82E-07	9.17E-07	-1.01E-05
Eutrophication potential - seawater	eq. kg N	2.44E-05	4.07E-06	5.37E-04	5.65E-04	1.02E-04	1.13E-05	1.10E-05	2.04E-05	1.43E-05	9.19E-06	-2.48E-05
Eutrophication potential - terrestrial	eq. mol N	2.91E-04	4.44E-05	1.52E-03	1.86E-03	1.11E-03	3.72E-05	9.30E-05	2.22E-04	1.56E-04	1.00E-04	-3.33E-04
Potential for photochemical ozone synthesis	eq. kg NMVOC	8.25E-05	1.36E-05	7.53E-04	8.49E-04	3.40E-04	1.70E-05	2.60E-05	6.80E-05	4.76E-05	2.89E-05	-8.00E-05
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	2.62E-07	1.18E-08	3.15E-07	5.89E-07	2.95E-07	1.18E-08	3.34E-08	5.89E-08	4.12E-08	1.07E-08	-1.98E-06
Abiotic depletion potential - fossil fuels	MJ	5.32E-02	4.93E-02	1.66E+00	1.76E+00	1.23E+00	3.53E-02	1.16E-01	2.47E-01	1.73E-01	7.29E-02	-2.34E-01
Water deprivation potential	eq. m^3	6.68E-03	2.28E-04	1.07E-01	1.14E-01	5.70E-03	2.27E-03	2.40E-03	1.14E-03	7.99E-04	4.24E-04	-1.73E-02

Table 5. Life cycle assessment (LCA) results of the clay bricks and elements manufactured by Patoka - environmental information describing waste categories (DU: 1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste neutralized	kg	9.83E-04	5.54E-05	9.16E-03	1.02E-02	1.38E-03	1.15E-04	1.20E-06	2.77E-04	1.94E-04	1.15E-07	-1.63E-03
Non-hazardous waste neutralised	kg	1.55E-02	9.83E-04	3.91E-01	4.07E-01	2.46E-02	4.04E-03	6.24E-05	4.92E-03	3.44E-03	3.01E-01	-4.55E-02
Radioactive waste	kg	1.14E-07	3.68E-09	5.72E-07	6.90E-07	9.21E-08	7.91E-09	8.70E-08	1.84E-08	1.29E-08	4.44E-07	-6.16E-07
Components for re-use	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
Materials for recycling	kg	4.82E-06	1.53E-07	2.10E-01	2.10E-01	3.82E-06	2.10E-03	1.20E-07	7.64E-07	5.35E-07	0.00E+00	-3.16E-06
Materials for energy recovery	kg	3.27E-08	1.24E-09	5.37E-08	8.76E-08	3.09E-08	8.74E-10	1.05E-09	6.18E-09	4.32E-09	0.00E+00	-2.94E-07

Table 6. Life cycle assessment (LCA) results of the clay bricks and elements manufactured by Patoka - environmental aspects related to resource use (DU: 1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.80E-02	7.08E-04	2.17E-01	2.36E-01	1.77E-02	4.72E-03	8.60E-03	3.54E-03	2.48E-03	0.00E+00	-2.69E-02
Consumption of renewable primary energy resources used as raw materials	MJ	3.19E-03	0.00E+00	0.00E+00	3.19E-03	0.00E+00	6.38E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total consumption of renewable primary energy resources	MJ	2.12E-02	7.08E-04	2.17E-01	2.39E-01	1.77E-02	4.79E-03	8.60E-03	3.54E-03	2.48E-03	1.28E-03	-2.69E-02
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.29E-01	4.93E-02	1.66E+00	1.84E+00	1.23E+00	3.67E-02	1.16E-01	2.47E-01	1.73E-01	0.00E+00	-2.34E-01
Consumption of non-renewable primary energy resources used as raw materials	MJ	1.68E-03	0.00E+00	0.00E+00	1.68E-03	0.00E+00	3.37E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total consumption of non-renewable primary energy resources	MJ	1.30E-01	4.93E-02	1.67E+00	1.85E+00	1.23E+00	3.69E-02	1.16E-01	2.47E-01	1.73E-01	7.89E-02	-2.34E-01
Consumption of secondary materials	kg	6.13E-04	1.65E-05	5.39E-04	1.17E-03	4.14E-04	2.34E-05	1.06E-05	8.27E-05	5.79E-05	0.00E+00	7.41E-01
Consumption of renewable secondary fuels	MJ	5.96E-05	1.82E-07	3.44E-06	6.32E-05	4.56E-06	1.26E-06	5.91E-08	9.11E-07	6.38E-07	0.00E+00	-8.59E-06
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	4.12E-04	4.12E-04	0.00E+00	8.24E-06	9.39E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater resources	m^3	1.71E-04	6.21E-06	2.03E-02	2.04E-02	1.55E-04	4.09E-04	3.15E-05	3.10E-05	2.17E-05	1.14E-05	-4.24E-04

Table 7. Life cycle assessment (LCA) results of the clay bricks and elements manufactured by Patoka. – additional impacts indicators (DU: 1 kg)

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Particulate matter	disease incidence	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential human exposure efficiency relative to U235	eg. kBq U235	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for ecosystems	CTUe	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for humans (cancer effects)	CTUh	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential comparative toxic unit for humans (non-cancer effects)	CTUh	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Potential soil quality index	dimensionless	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA

Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification, this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

The basis for LCA analysis was EN 15804+A2:2020-03 and ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3.) ☒ external ☐ internal
External verification: Halina Prejzner, PhD. eng. LCA, LCI audit and input data verification: Michał Piasecki, PhD., D.Sc., eng.

Note 1: The declaration owner has the sole ownership, liability, and responsibility for the for the information provided and contained I EPD. Declarations of construction products may not be comparable if they do not comply with EN 15804+A2. For further information about comparability, see EN 15804+A2 and ISO 14025.

Note 2: Note: ITB is a public Research Organization and Notified Body (EC Reg. no 1488) to the European Commission and to other Member States of the European Union designated for the tasks concerning the assessment of building products' performance. ITB acts as the independent, third-party verification organization (17065/17029 certified). ITB-EPD program is recognized and registered member of The European Platform - Association of EPD program operators and ITB-EPD declarations are registered and stored in the international ECO-PORTAL.

Normative references

- ITB PCR A, V1.6 General Product Category Rules for Construction Products (2023)
- ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- PN-EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- EN 771-1:2011+A1:2015 Specification for masonry units Clay masonry units
- KOBiZE Wskaźniki emisyjności CO_2, SO_2, NO_x, CO i pyłu całkowitego dla energii elektrycznej, grudzień 2021

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Thermal Physics, Acoustics and Environment Department
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CERTIFICATE № 486/2023
of TYPE III ENVIRONMENTAL DECLARATION

Products:

Clinker bricks with complementary ceramic masonry elements

Manufacturer:

Patoka Industries Ltd. Sp. z o.o.

Panoszów, ul. Ceramiczna 23, 42-793 Ciasna, Poland

confirms the correctness of the data included in the development of
Type III Environmental Declaration and accordance with the requirements of the standard

EN 15804+A2

Sustainability of construction works.
Environmental product declarations.
Core rules for the product category of construction products.

This certificate, issued on 21st July 2023 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics and Environment Department
Agnieszka Winkler-Skalna, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director
for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, July 2023