Type III Environmental Product Declaration No. 562/2023

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Prefabricated products of expanded clay concrete

Owner of the EPD:

Formee Sp. z o.o.
Address: Zakaszewskiego 7
66-300 Międzyrzecz, Poland
Tel.: +48 95 740 2111
Website: https://www.formee.pl/
Contact: info@formee.pl

EPD Program Operator:

Instytut Techniki Budowlanej (ITB)
Address: Filtrowa 1,
00-611 Warsaw, Poland
Website: www.itb.pl
Contact: Michał Piasecki
m.piasecki@itb.pl
energia@itb.pl

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 and their aspects verified by the independent body according
to ISO 14025. Basically, 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-A3, A4, 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 13369, PN-EN 13225, PN-EN 14843, PN-EN 14991, PN-EN 14992

Service Life: 50 years

PCR: ITB-PCR A

Declared unit: 1 ton

Reasons for performing LCA: B2B

Representativeness: Poland, 2023

MANUFACTURER

Figure 1 The view of Formee Sp. z o.o. manufacturing plant

Formee's priority is to provide customers with comprehensive precast concrete solutions. The company located in Poland offers a wide range of precast concrete products and services, allowing customers the freedom to tailor our offerings to their individual precast concrete needs. The offer covers the full range of the process - from professional design, through the production stages, delivery, to the precise installation of precast concrete products on the construction site. The company operates in accordance with the current trends of modern and sustainable construction, which effectively translates into shorter project times using an impressive 40% of precast concrete products. Production capacity is approx. 35,000 m^3 or 200,000 m^2 of prefabricated elements per year including:

- Production line for walls, balconies and flat elements
- Production line for columns and beams
- Automated production line for stairs, automated reinforcement production line

The factory in Międzyrzecz is one of the newest prefabrication plants in Poland, equipped with a steel mesh welding line, as well as pioneering solutions for the production, distribution and recycling of concrete. Process automation combined with an advanced BIM system optimizes processes and reduces the production of post-production waste.

PRODUCTS DESCRIPTION

The declaration covers various precast light concrete products based on expanded clay including types LC12/13 D1.4, LC16/18 D1.6, LC 16/18 D1.8, LC20/22 D1.8, LC20/22 D2.0, with densities range 1400-2100 kg/m^3. Prefabricated concrete is a term that covers a wide group of ready-made building elements, joined together with other elements at the construction site. A common feature of all prefabricated elements is the ability to use them as ready-made modules from which larger structures are assembled. Prefabricated concrete elements resemble children's blocks with various shapes that allow you to build even very complex structures.

Expanded clay concrete is an innovative concrete mixture with expanded clay aggregate. Thanks to this, it is light (1400-2000 kg/m^3) and has excellent thermal and acoustic insulation. Additionally, the material is highly fire-resistant and resistant to fungi, mold, pests (rodents and insects) and moisture. It is this last feature that makes expanded clay concrete particularly recommended for people struggling with allergies or respiratory diseases. Houses built from this material provide not only durability and energy efficiency, but also a healthy and comfortable living environment.

The properties of expanded clay allow, through high thermal accumulation, to maintain optimal thermal comfort in the building regardless of the season - the house remains cool in summer and does not cool down too much in winter. Other advantages of expanded clay concrete include:

- vapor permeability,
- high compressive strength,
- low heat transfer coefficient,
- frost resistance,
- easy mechanical processing (e.g. cutting to size).

All additional technical information about the product is available on the manufacturer's website and catalogues.

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Unit

The declared unit is 1 ton of LC product (including formulations LC12/13 D1.4, LC16/18 D1.6, LC 16/18 D1.8, LC20/22 D1.8, LC20/22 D2.0, with densities 1400-2100 kg/m^3 (1870 kg /m^3 is product average density).The average recipe adopted for calculations (based on producer declaration), representing the entire spectrum of products, includes: natural aggregates (53%), expanded clay (14%), CEM I 42.5R (18%), water (10%), chemical additives 0.1%, steel reinforcement (3%), fillers (4%). Average products density is 2330 kg/m^3.

System boundary

The life cycle analysis of the declared products covers “Product Stage” A1-A3, A4, C1-C4+D modules in accordance with EN 15804 and ITB PCR A (cradle to gate with options). Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included in the calculation. 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.

Allocation

The allocation rules used for this EPD are based on general requirements provided in ITB PCR A (2023) and EN 15804+A2. Production is a line process (see Figure 2). Allocation is mass based. For CEM I 42,5 R product (used for production) the allocation in the manufacturing plants was made on the mass and clinker mass allocation in the CEM product. Minimum 99.5% of impacts from the production lines were allocated to product covered by this declaration. Energy supply was inventoried and allocated to the product assessed on the mass basis.

System limits

99.0% materials and 100% energy consumption were inventoried in a factory and were included in calculation. In the assessment, all significant parameters from gathered production data are considered, i.e. all raw material used per formulation, utilized energy, and electric power consumption, direct production waste, and available emission measurements. The total of neglected input flows per module A1-A3 does not exceed the permitted maximum of 1 % of energy usage and product mass. Tires consumption for transport was not taken into account. The components like: dyes, foils, papers, labels, tapes with a percentage share of less than 0.1% were not included in the calculations. It is assumed that the total sum of omitted processes does not exceed 1% of all impact categories. In accordance with EN 15804 machines and facilities (capital goods) required for and during production are excluded, as is transportation of employees.

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

Raw materials such as sand, expanded clay, gravel, cement (CEM I), limestone, steel reinforcing components, additives and packaging materials come from both local and foreign suppliers. Means of transport include trains and lorries with loading capacity <10t and >16t. For calculation purposes Polish and European fuel averages were applied.

Module A3: *Production*

The product specific manufacturing process line is presented in Figure 2, the input materials (cement, natural and expanded clay aggregates, water, addings) are mixed and processed to a dedicated shape. All of the components for precast production are coming to plant by vehicles or by train . Material for production is stored in designated for it places. Each of them is described in detail, exactly what material is to be there (e.g. aggregate entanglements, cement silos or designated zones for steel types, grades or diameters). Reinforcement elements are made partially automatically.

Ready reinforcement is placed in previously individually prepared forms. Concrete is poured into the prepared forms. Ready elements are kept in the formwork until the minimum design parameters are achieved. After evacuation, each element is checked by the quality control department, and then taken to an external warehouse and then to the customer for the construction sites.

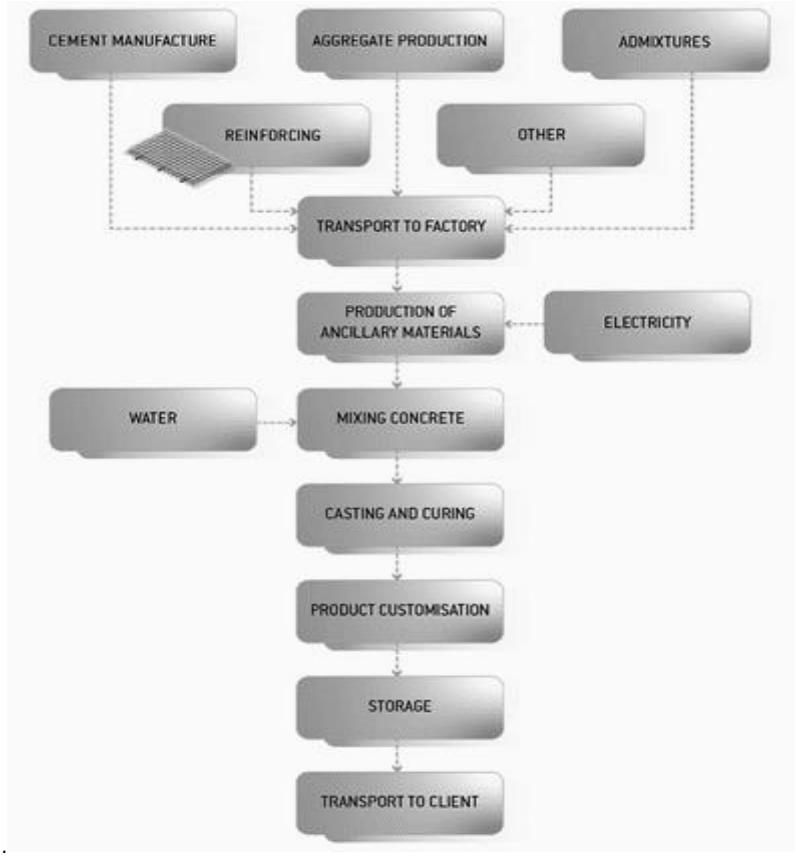

Figure 2 Manufacturing process scheme (A3)

Module A4: Transport to consumer

Vehicle transport at distance 500 km is considered (emission standard: Euro 5) with 100% load capacity.

Modules *C and D: End-of-life (EOL)*

Prefabricated reinforced elements constitutes intermediate products. Versatile application of prefabricated reinforced elements excludes the possibility of precise modeling of the impacts occurring at the de-construction stage thus the module C1 is estimated within this EPD based on approx. energy consumption. In the adapted end-of-life scenario, the de-constructed products are transported to a waste processing plant distant by 100 km on > 16t lorry EURO 5, where undergo shredding with the use of crawler gear crusher equipped with magnetic separator (115 kW, electric drive) – module C3. Recovered materials undergo re-use, recycling and landfilling according to the Polish treatment practice of industrial wastes - Table 1. The remaining materials are classified as inert wastes in the European list of waste products and are forwarded to a landfill in the form of mixed construction and demolition wastes. Environmental impacts declared in module C4 are associated with exchanges to process-specific burdens. Module D presents potential credits resulting from the use of crushed concrete wastes as aggregates for road foundation or ballast and the recycling of the steel reinforcement. Module D presents credits resulting from the recycling of the primary steel scrap, calculated in accordance with the net scrap approach developed by World Steel Association. Impacts of materials that constitute less than 1.0% of the total system flows were not taken into consideration.

Table 1 End-of-life scenario for the Prefabricated concrete products

Material	Material recovery	Recycling	Landfilling
concrete	100%	90%	10%
steel	100%	95%	5%

Electricity at end-of-life (module C) has been modelled using an average Polish electricity mix as the location where the product reaches end-of-life is unknown.

Data collection period

The data for manufacture of the declared products refer to period between 01.01.2023 – 31.12.2023 (1 year). The life cycle assessments were prepared for Poland and Europe as reference area.

Data quality

The data selected for LCA originate from ITB-LCI questionnaires completed by Formee Sp. z o.o. and verified via input 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 is judged as good. The background data for the processes come from the following resources database Ecoinvent v.3.9.1 (sand, gravel, expanded clay, dolomite, limestone, reinforcing steel, steel, calcium nitrate, timber, ABS, HDPE). Specific EPD was used for CEM I 42.5 input data. Specific (LCI) data quality analysis was a part of the input data verification. Where no background data was available, data gaps were complemented by manufacturer information and literature research.

Assumptions and estimates

The impacts of the representative products were aggregated using weighted average.

Calculation rules

LCA was performed using ITB-LCA tool developed in accordance with EN 15804+A2. Emission of greenhouse gases was calculated using the IPCC 2013 GWP method with a 100-year horizon. Emission of acidifying substances, Emission of substances to water contributing to oxygen depletion, Emission of gases that contribute to the creation of ground-level ozone, Abiotic depletion, and ozone depletion emissions where all calculated with the CML-IA baseline method

Additional information

Polish electricity (Ecoinvent v.3.9.1 supplemented by actual national KOBiZE data) emission factor used is 0.702 kg CO_2/kWh. As a general rule, no particular environmental or health protection measures other than those specified by law are necessary.

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to declared unit (DU) – 1 ton of Prefabricated concrete products produced in Europe. The following life cycle modules (Table 2) were included in the analysis. The following tables 3-6 show the environmental impacts of the life cycle of selected modules (A1-A5+C1-C4+D).

Table 2 System boundaries for the environmental characteristic of the product.

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**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MD**	**MD**	**MD**	**MD**	**MD**

Table 3 Life cycle assessment (LCA) results for specific product – environmental impacts of (DU: 1 ton)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Global Warming Potential	eq. kg CO_2	2.30E+02	2.21E+01	4.23E+01	2.95E+02	8.34E+01	3.49E+00	1.67E+01	1.67E+01	1.02E+00	-3.09E+01
Greenhouse potential - fossil	eq. kg CO_2	2.27E+02	2.20E+01	4.16E+01	2.91E+02	8.31E+01	3.42E+00	1.66E+01	1.66E+01	1.01E+00	-3.09E+01
Greenhouse potential - biogenic	eq. kg CO_2	2.87E+00	9.30E-02	9.17E-01	3.88E+00	2.84E-01	1.00E-01	5.68E-02	5.68E-02	1.02E-02	-8.61E-02
Global warming potential - land use and land use change	eq. kg CO_2	2.21E-01	9.36E-03	1.10E-02	2.42E-01	3.26E-02	1.20E-03	6.52E-03	6.52E-03	1.02E-03	-4.30E-02
Stratospheric ozone depletion potential	eq. kg CFC 11	2.47E-06	5.03E-06	1.20E-06	8.70E-06	1.92E-05	7.00E-08	3.85E-06	3.85E-06	3.08E-07	-2.48E-06
Soil and water acidification potential	eq. mol H+	7.95E-01	9.19E-02	3.47E-01	1.23E+00	3.37E-01	3.80E-02	6.75E-02	6.75E-02	8.54E-03	-4.70E-01
Eutrophication potential - freshwater	eq. kg P	5.89E-02	1.70E-03	5.83E-02	1.19E-01	5.59E-03	6.50E-03	1.12E-03	1.12E-03	2.93E-04	-2.32E-02
Eutrophication potential - seawater	eq. kg N	2.39E+01	2.80E-02	5.21E-02	2.40E+01	1.02E-01	5.50E-03	2.04E-02	2.04E-02	2.94E-03	-5.30E-02
Eutrophication potential - terrestrial	eq. mol N	1.37E+00	3.05E-01	4.29E-01	2.10E+00	1.11E+00	4.65E-02	2.22E-01	2.22E-01	3.20E-02	-6.64E-01
Potential for photochemical ozone synthesis	eq. kg NMVOC	4.35E-01	9.29E-02	1.22E-01	6.50E-01	3.40E-01	1.30E-02	6.80E-02	6.80E-02	9.27E-03	-2.19E-01
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	8.83E-04	7.89E-05	1.54E-04	1.12E-03	2.95E-04	1.67E-05	5.89E-05	5.89E-05	3.42E-06	-3.14E-03
Abiotic depletion potential - fossil fuels	MJ	1.25E+03	3.27E+02	5.99E+02	2.18E+03	1.23E+03	5.80E+01	2.47E+02	2.47E+02	2.34E+01	-4.99E+02
Water deprivation potential	eq. m^3	4.35E+01	1.65E+00	1.12E+01	5.64E+01	5.70E+00	1.20E+00	1.14E+00	1.14E+00	1.36E-01	-2.65E+01

Table 4 Life cycle assessment (LCA) results for specific product – additional impacts indicators (DU: 1 ton)

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

Table 5 Life cycle assessment (LCA) results for specific product - the resource use (DU: 1 ton)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.47E+02	5.51E+00	3.85E+01	1.91E+02	1.77E+01	4.30E+00	3.54E+00	3.54E+00	4.10E-01	-5.18E+01
Consumption of renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total consumption of renewable primary energy resources	MJ	1.47E+02	5.51E+00	3.87E+01	1.91E+02	1.77E+01	4.30E+00	3.54E+00	3.54E+00	4.10E-01	-5.18E+01
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.09E+03	3.27E+02	5.21E+02	1.93E+03	1.23E+03	5.82E+01	2.47E+02	2.47E+02	2.53E+01	-4.91E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	1.94E+02	0.00E+00	8.91E+01	2.83E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total consumption of non-renewable primary energy resources	MJ	1.28E+03	3.27E+02	6.10E+02	2.22E+03	1.23E+03	5.82E+01	2.47E+02	2.47E+02	2.53E+01	-4.91E+02
Consumption of secondary materials	kg	1.19E+01	1.19E-01	5.54E-02	1.21E+01	4.14E-01	5.30E-03	8.27E-02	8.27E-02	6.07E-06	-3.10E+00
Consumption of renew. secondary fuels	MJ	5.28E-02	1.21E-03	2.83E-04	5.42E-02	4.56E-03	2.95E-05	9.11E-04	9.11E-04	1.59E-07	-1.57E-02
Consumption of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	4.20E-01	4.20E-01	0.00E+00	4.70E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net consumption of freshwater	m^3	1.05E+00	4.49E-02	2.32E-01	1.33E+00	1.55E-01	1.58E-02	3.10E-02	3.10E-02	3.67E-03	-7.38E-01

Table 6 Life cycle assessment (LCA) results for specific product – waste categories (DU: 1 ton)

Indicator	Unit	A1	A2	A3	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste	kg	8.13E+00	4.04E-01	1.17E-02	8.55E+00	1.38E+00	6.00E-04	2.77E-01	2.77E-01	6.74E-05	2.24E+00
Non-hazardous waste	kg	1.12E+02	7.48E+00	8.61E+00	1.29E+02	2.46E+01	3.12E-02	4.92E+00	4.92E+00	9.62E+01	5.89E+01
Radioactive waste	kg	1.51E-03	2.99E-05	4.06E-04	1.94E-03	9.21E-05	4.35E-05	1.84E-05	1.84E-05	1.42E-04	4.57E-04
Components for re-use	kg	2.09E-02	0.00E+00	0.00E+00	2.09E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	9.58E-02	1.02E-03	9.54E-01	1.05E+00	3.82E-03	6.00E-05	7.64E-04	7.64E-04	5.78E-08	4.34E-03
Materials for energy recovery	kg	2.92E-03	8.43E-06	5.35E-06	2.94E-03	3.09E-05	5.25E-07	6.18E-06	6.18E-06	6.85E-10	4.03E-04
Exported Energy	MJ	6.02E+00	0.00E+00	1.61E+00	7.63E+00	0.00E+00	1.73E-01	0.00E+00	0.00E+00	0.00E+00	8.71E-01

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 and ITB PCR A
Independent verification corresponding to ISO 14025 (sub clause 8.1.3.) ☒ external ☐ internal
External verification of EPD: Halina Prejzner, PhD. Eng. LCI audit and verification: Michał Chwedaczuk, M.Sc. 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 information provided and contained in 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: 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 (ISO 17025/17065/17029). 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 General Product Category Rules for Construction Products (2023, v1.6)
- PN-EN 14992+A1:2012 - Prefabrykaty z betonu -- Elementy ścian
- 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
- ISO 14067:2018 Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification
- PN-EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- ISO 20915:2018 Life cycle inventory calculation methodology for steel products
- KOBiZE Wskaźniki emisyjności CO_2, SO_2, NO_x, CO i pyłu całkowitego dla energii elektrycznej. December 2022

Instytut Techniki Budowlanej

Instytut Techniki Budowlanej

00-611 Warsaw, Filtrowa 1

Thermal Physics, Acoustics and Environment Department

02-656 Warsaw, Ksawerów 21

CERTIFICATE № 562/2023
of TYPE III ENVIRONMENTAL DECLARATION

Products:

Prefabricated products of expanded concrete

Manufacturer:

Formee Sp. z o.o.

ul. Zakaszewskiego 7, 66-300 Międzyrzecz, 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 1st December 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, December 2023