



Group of cements
CEM I 42,5
produced in **Cemex Poland**

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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 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 (see point 5.3 of the standard)

Life cycle analysis (LCA): A1-A3, in accordance with EN 15804 ("Cradle-to-Gate")

The year of validation of EPD: 2023

Product standard: EN 197-1, PN-B-19707

Service Life: according to EN 16908 no reference service life of cements is declared as they are intermediate products used in construction

PCR: ITB-PCR A (PCR based on EN 15804) and EN 16908

Declared unit: 1 ton (Mg) of Portland cement CEM I 42,5

Reasons for performing LCA: B2B

Representativeness: Polish production, year 2022



BASIC INFORMATION

Group of cements CEM I 42,5 covered by this EPD are manufactured by Cemex in Chelm, Rudniki and Gdynia manufacturing plants located in Poland.

The life-cycle assessment was carried out according to the following standards: PN-EN 15804, PN-EN 16908, PN-EN ISO 14025, PN-EN ISO 14040 and the product categorisation rules provided in document ITB PCR-A. Declared reference unit is 1 ton of cement CEM I 42,5. Reference service life according to EN 16908 is not declared as cements are intermediate products used in construction.

All LCI data was collected by Cemex Poland from three plants between January and December 2022 (12 months) and gathered data is representative for production technology used in 2022. ITB data on minor additional constituents were used based on an economic allocation. LCA assessment was carried out using internal ITB algorithms dedicated to calculate the LCA and data collected by the industry over the last 10 years. System boundary description were adopted according to EN 16908.

CEM I 42,5 is an intermediate product with large number of final uses (ready-mix concrete, precast concrete products, screeds, plasters, masonry mortars)

and it is usually impossible to provide information on the environmental impact of cement during construction, operation and at the end of life, as it largely depends on the purpose of cement and use scenarios. Calculations made for the purposes of this document cover LCA assessment stages (aggregated) of raw material production (A1), its transport to the production site (A2) and the production process (A3), i.e. "Cradle-to-Gate" according to the guidelines of EN 15804. The EPD does not include product life-cycle stages A4, A5, C1-C4 and D according to EN 15804.

EPD can be used to prepare an assessment of a specific use of cement over its entire life cycle in the building (e.g. of concretes). Cement production is subject to national and European regulations governing its environmental impact, such as the mining of natural resources, the reclamation of a mine, the energy and material recovery from waste, the emission of noise, dust and other hazardous substances (NO_x, SO₂, heavy metals etc.). Cements covered by the Type III Environmental Product Declaration comply with the harmonized European standard EN 197-1 and Polish standard PN-B-19707.



PRODUCTS DESCRIPTION

Cement is a hydraulic binder, which means, a finely ground inorganic material which, when mixed with water, forms a mass, which sets and hardens as a result of the reactions and hydration processes, maintaining strength and durability even under water after hardening.

The cement according to the EN 197-1 standard is called CEM cement, properly measured and mixed with the aggregate and water, it should form concrete or mortar that retains workability for a sufficiently long time, and after a specified time should obtain a certain level of strength, and should maintain long-term stability of the volume.

The CEM cements are made of different materials, but are statistically homogeneous in composition by quality assurance in the production and material handling processes.

One of the main components of the cement is the Portland clinker. For its production, calcareous materials (for example, limestone, chalk) and other natural or waste materials are used, correcting the proportion of the silicates and aluminates, such as: clay, sand, fly ash, iron-bearing additives or slag from the steel industry. All of these materials are crushed, homogenised and introduced into a rotary kiln where they are sintered at 1450°C.

In Cemex Poland the clinker is produced in two plants (Chełm, Rudniki). The main fuels used in the clinker firing process are alternative waste-derived fuels. Year by year, the share of the alternative fuels is gradually increasing, while the use of fossil fuels is de-

creasing. Among alternative fuels, there is the biomass for which the carbon footprint is zero.

The amount of the CO₂ calculated in accordance with the European regulations for monitoring the production of the CO₂ for the plant in Rudniki in connection with the production of the clinker is 711 kg of the CO₂/Mg of clinker, and in Chełm 718 kg of the CO₂/Mg of clinker.

Cement is produced by the joint grinding of the main constituents of the cement (for example, clinker, fly ash, blast furnace slag) with minor additional constituents, setting time adjuster and other additives.

Cemex Poland produces cement in three plants (Chełm, Gdynia, Rudniki).

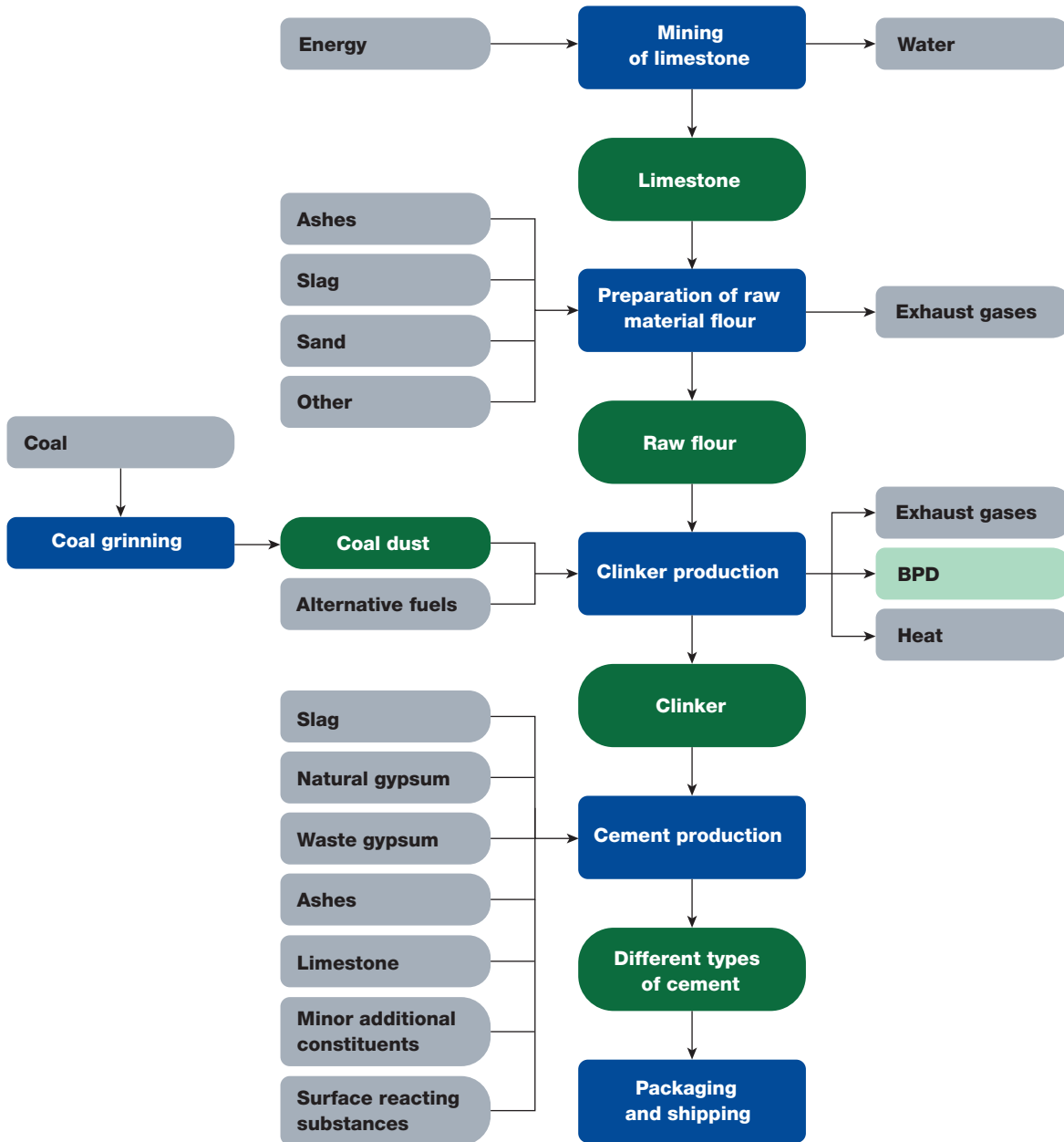
The product phase (A1-A3, see Table 3) and the following processes/modules were taken into account in the LCA analysis:

- A1 – the production of raw materials: fuel extraction, raw material extraction, electricity production, alternative fuel production,
- A2 – the transport: transport of raw materials;
- A3 – the production of a product: production of raw meal, fuel consumption for firing, consumption of the electricity for grinding.

The figure below (Figure 1) shows the cement manufacturing process from the quarry to the shipment (production phase) in a schematic way.



Figure 1. Cement production. General production diagram and included processes.



LIFE CYCLE ASSESSMENT (LCA) - GENERAL RULES APPLIED

Unit

The declared unit is 1 ton of representative Portland cements CEM I 42,5 according to EN 197-1 and PN-B-19707 produced by Cemex Poland (3 manufacturing plants: Rudniki, Chełm and Gdynia). The group of CEM I cements in the strength class 42,5 and covered by this EPD includes:

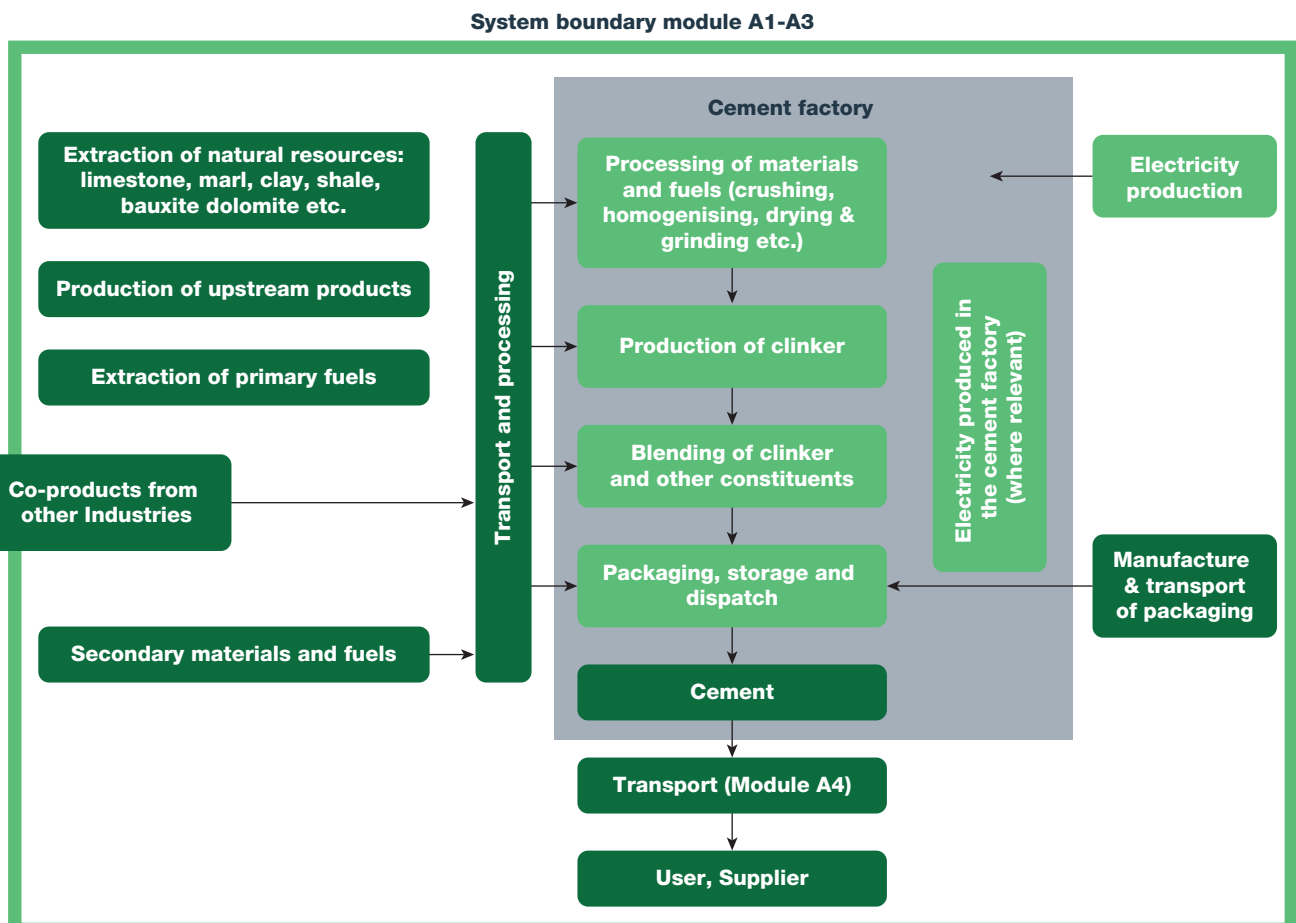
- CEM I 42,5 R – Chełm plant
- CEM I 42,5 R – NA – Gdynia plant
- CEM I 42,5 R – Rudniki plant
- CEM I 42,5 R – NA – Chełm plant
- CEM I 42,5 R – NA – Rudniki plant
- CEM I 42,5 N – SR 3/NA – Chełm plant
- CEM I 42,5 N – SR 3/NA – Gdynia plant

System boundary

The EPD covers the product stage („Cradle-to-Gate”). The selected system boundaries comprise the production of cement including raw materials’ extraction up to the finished product at the factory gate.

The selected system boundaries are in accordance with the system boundaries given in EN 16908 (Figure 2).

Figure 2. Inputs and processes of product system





Allocation rules

The allocation rules used for this EPD are based on general ITB PCR A. Production of CEM I 42,5 is a line process in an manufacturing plants located in Rudniki, Chełm and Gdynia. CEM I from the three locations was calculated as the weighted average volume (mass based) of CEM I 42,5 production by Cemex in Poland. CEM I 42,5 is not the only CEM product and the allocation in the manufacturing plants was made on the mass basis allocation. For a synthetic gypsum, allocated impacts are economic based but plain gypsum waste (a value=0) are neglected in the cement LCA due to its very low impact. Minimum 99.5% of impacts from the production lines were allocated to the product covered by this declaration. Energy supply (gas and electricity) was inventoried and allocated to the product assessed on the mass basis.

System limits

99.5% of the consumed materials and 100% energy consumption was inventoried in 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 following processes were excluded from the LCA study: use of chromate reducing agents (total mass < 0.2% of cements), use of grinding balls. The total of neglected input flows per module A1-A3 does not exceed the permitted maximum of 1% of energy usage and mass.

Tires consumption for transport was not taken into account. Pre components, 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.

A1 – A2 Modules: Raw materials supply and transport

Constituents of cement as defined in EN 197-1 are in Table 1.

Table 1. Constituents of CEM I cement described in the EN 197-1 standard

Main constituents	The main constituent of cement is the constituent whose share in relation to the sum of all cement constituents exceeds 5% The main constituents for CEM I are: clinker (95-100%)
Minor additional constituents	Minor additional constituents of cement are constituents whose share in relation to the sum of all cement constituents does not exceed 5% Minor additional constituents for CEM I (0-5%)
Calcium sulphate	Calcium sulphate occurs as a natural material (e.g. gypsum, anhydrite) or a by-product of industrial processes and acts as a binding time regulator in cement
Additives	Cement additives are components added to improve the production or properties of cement and their total amount may not exceed 1.0% of the cement mass

For the LCA model, the following composition of CEM I 42,5 was adopted: clinker (95-100%), minor additional constituents (0-5%), calcium sulphate.

A3 Module Production

Cement is produced by grinding and mixing constituents according to EN 197-1 standard.

Production data was inventoried and verified. Data on transport of the different input products to the manufacturing plants were inventoried in detail and modelled. For transport calculation purposes European fuel averages are applied.

All manufacturing plants use “green electricity” (made of wind, 100% in total consumption) and have presented the certificate issued by the energy supplier confirming this fact. The percentage of alternative fuels in clinker production at the cement plants in Cemex Poland in 2022 was above 90%.

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 done for Poland as reference area.

Data quality - production

The values determined to calculate A3 originate from verified Cemex Poland LCI inventory data. A1 values (raw materials) were prepared considering specific national EPDs, Ecoinvent data and economic allocation (for a steel and energy products - gypsum, slag and ash).

Assumptions and estimates

All production processes (A3) were assigned to different types of cements in an equal way (based on recipe). The impacts of the representative products were aggregated for Poland using weighted average. Data regarding production per 1 ton of product were averaged for the analyzed production of each product group.

Calculation rules

LCA was done in accordance with ITB PCR A document. Characterization factors are CML ver. 4.2 based.

ITB-LCA software were used for impact calculations. A1 was calculated based on data from the database and specific EPDs. Modules A2 and A3 are calculated based on the LCI questionnaire provided by the manufacturer.

Databases

The background data for the processes come from the following databases: Ecoinvent v.3.9 (sand, water, wind electricity production for Poland, transport), specific emission reporting data for clinker production by Cemex Poland, specific EPDs for a raw material (sand, gypsum, limestone, FGD Gypsum, additives), allocated impacts for ash and slag production calculated by ITB, KOBiZE (combustion factors for selected fuels). Electricity provider PGE guarantees a certificate of origin of 100% renewable electricity used by Cemex Poland plants. Specific (LCI) data quality analysis was a part of audit. The time related quality of the data used is valid (5 years).

LIFE CYCLE ASSESSMENT (LCA) – RESULTS

System boundaries

System boundaries in environmental assessment are presented in Table 2.

Declared unit

The declaration refers to the unit (DU) – 1 ton of CEM I 42,5 produced by Cemex Poland (Table 3).

Table 2. System boundaries (life stage modules included) in a product environmental assessment

Environmental assessment information																
(MA – Module assessed, MNA – Module not assessed, 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
MA	MA	MA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA

Table 3. Environmental product characteristic – 1 ton of CEM I 42,5 products
(produced in Gdynia, Chełm and Rudniki)

Indicator	Unit	CEM I 42,5 R Chełm	CEM I 42,5 R – NA Gdynia
Global warming potential (gross value) ¹	kg eq CO ₂	665	685
Global warming potential (net value) ²	kg eq CO ₂	512	531
Depletion potential of the stratospheric ozone layer	kg CFC 11	0.000034	0.000035
Acidification potential of soil and water	kg SO ₂	0.421	0.433
Formation potential of tropospheric ozone	kg Ethene	0.285	0.290
Eutrophication potential	kg (PO ₄) ³⁻	0.093	0.097
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb	1.55	1.59
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ	386	396
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	INA	INA
Use of renewable primary energy resources used as raw materials	MJ	INA	INA
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	1050	1115
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	INA	INA
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	400	409
Use of secondary material	kg	76.5	74.4
Use of renewable secondary fuels	MJ	2504	2581
Use of non-renewable secondary fuels	MJ	1201	1238
Net use of fresh water	m ³	8.43	8.68
Hazardous waste disposed	kg	0.0067	0.0068
Non-hazardous waste disposed	kg	13.5	14.5
Radioactive waste disposed	kg	0.00	0.00
Components for re-use	kg	0.00	0.00
Materials for recycling	kg	9.19	9.44
Materials for energy recover	kg	0.00	0.00
Exported energy	MJ	0.00	0.00

1) the indicated gross value includes the CO₂ emissions from alternative fuels (based on waste) excluding biomass fraction of fuels

2) the net value excludes CO₂ emissions from alternative fuels (based on waste)

CEM I 42,5 R – NA Chelm	CEM I 42,5 R CEM I 42,5 R – NA Rudniki	CEM I 42,5 N – SR 3/NA Chelm	CEM I 42,5 N – SR 3/NA Gdynia	weighted average for CEM I 42,5
673	643	661	694	664
518	481	509	534	508
0.000035	0.000032	0.000034	0.000036	0.000034
0.425	0.430	0.417	0.439	0.426
0.288	0.263	0.279	0.294	0.280
0.095	0.095	0.093	0.098	0.095
1.57	1.43	1.53	1.61	1.53
389	437	378	399	402
INA	INA	INA	INA	INA
INA	INA	INA	INA	INA
1052	1072	1128	1111	1073
INA	INA	INA	INA	INA
INA	INA	INA	INA	INA
402	444	389	411	413
76.6	66.0	70.2	74.7	72.9
2537	1924	2491	2621	2367
1216	710	1195	1257	1077
8.53	7.77	8.38	8.81	8.31
0.0066	0.0063	0.0058	0.0067	0.0066
13.6	14.3	13.4	14.6	13.9
0.00	0.00011	0.00	0.00	0.00003
0.00	0.00	0.00	0.00	0.00
9.22	8.48	9.05	9.52	9.04
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00

RESULTS INTERPRETATION

The gross value of eq. CO₂ emissions (EN 15804/ISO 14067 based method) for average CEM I 42,5 production by Cemex Poland is 664 kg of CO₂/ton of CEM I 42,5. The net value of eq. CO₂ emissions, excluding alternative waste-based fuels, is 508 kg of CO₂/ton of CEM I 42,5. The fossil fuels depletion potential is 402 MJ/ton, which is related to the low use of fossil fuels (coal, oil) and significant use of alternative fuels (over 90%) of energy total.

The result is significantly influenced by the use of wind electricity (100% - certified).

The LCA of cement is mainly influenced by the following factors:

- large content of Portland cement clinker in the product (95-100%),
- fuel mix and highshare of alternative fuels to fossil fuels in clinker production,
- specific process emission of clinker production,
- electricity (wind) used in the respective cement plant.



VERIFICATION

The process of verification of this EPD was 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 EN 15804 I ITB PCR A

external internal

External verification of EPD: Ph.D. Eng. Halina Prejzner

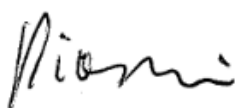
LCA \ LCI audit and input data verification: Ph.D. D.Sc. Eng. Michał Piasecki, m.piasecki@itb.pl

The purpose of this EPD is to provide the basis for assessing buildings and other construction works. A comparison of EPD data is only meaningful if all the data sets compared were developed according to EN 15804 and the product-specific performance characteristics and its impacts on the construction works are taken into account.

Normative references

- ITB PCR A General Product Category Rules for Construction Products
- EN 197-1:2011: Cement - part 1: Composition, specifications and conformity criteria for common cements
- PN-B-19707:2013-10 Cement – Special cement: composition, specifications and conformity criteria
- PN-EN ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations. Principles and procedures
- PN-EN 15804+A2:2020-03 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- PN-EN 16908:2017-02 Cement and building lime. Environmental product declarations. Product category rules complementary to EN 15804
- PN-EN ISO 14040:2009 Environmental management – Life cycle assessment – Principles and frame-work
- ECRA (European Cement Research Academy) – Background report “TR-ECRA 0181/2014 Environmental Product Declarations for representative European cements“

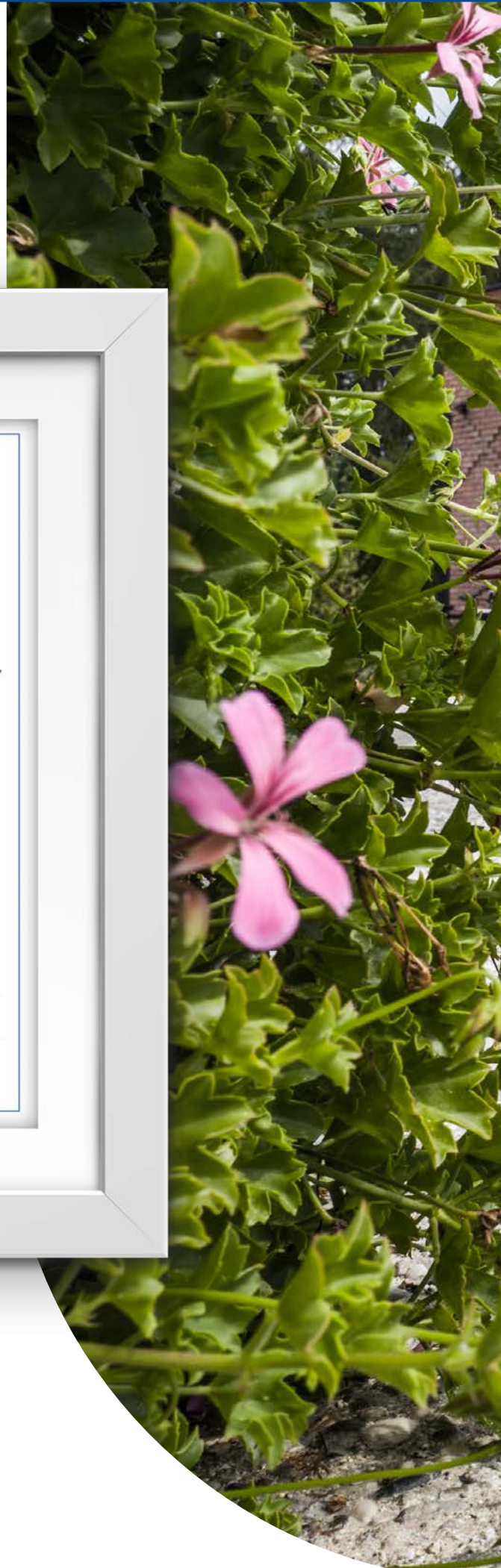
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CERTIFICATE № 236/2023
of TYPE III ENVIRONMENTAL DECLARATION

Products:
Group of cements CEM I 42,5: CEM I 42,5 R Chełm, CEM I 42,5 R - NA Gdynia,
CEM I 42,5 R Rudniki, CEM I 42,5 R - NA Chełm, CEM I 42,5 R - NA Rudniki,
CEM I 42,5 N - SR 3/NA Chełm, CEM I 42,5 N - SR 3/NA Gdynia

Manufacturer:
Cemex Polska Sp. z o.o.
ul.Krakowiaków 46, 02-255 Warszawa, 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

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

This certificate, issued on 10th March 2023 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics
and Environment Department

Agnieszka Winkler-Skałna, PhD



Deputy Director
for Research and Innovation

Krzysztof Kuźczyński, PhD

Warsaw, March 2023





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