CEMEX

Cement

CEM II/A-V 52,5 R – NA

produced in **Cemex Poland**

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ECO PLATFORM EPD VERIFIED

ITB®

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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 preparing the 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-fly ash cement CEM II/A-V 52,5 R – NA

Reasons for performing LCA: B2B

Representativeness: Polish production, year 2022

BASIC INFORMATION

CEM II/A-V 52,5 R – NA product covered by this EPD is manufactured by Cemex at Chełm manufacturing plant 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 ITB PCR-A. Declared reference unit is 1 ton of CEM II/A-V 52,5 R – NA. 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 between January and December 2022 (12 months) and gathered data is representative for production technology used in 2022. ITB data on minor additional constituents and fly ash 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 II/A-V 52,5 R – NA 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 present 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 pro-duction (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, SO_2, heavy metals etc.). Cements covered by the Type III Environmental Product Declaration comply with the harmonised 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 decreasing. Among alternative fuels, there is the biomass for which the carbon footprint is zero.

The amount of the CO_2 calculated in accordance with the European regulations for monitoring the production of the CO_2 for the plant in Rudniki in connection with the production of the clinker is 711 kg of the CO_2/Mg of clinker, and in Chełm 718 kg of the CO_2/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.

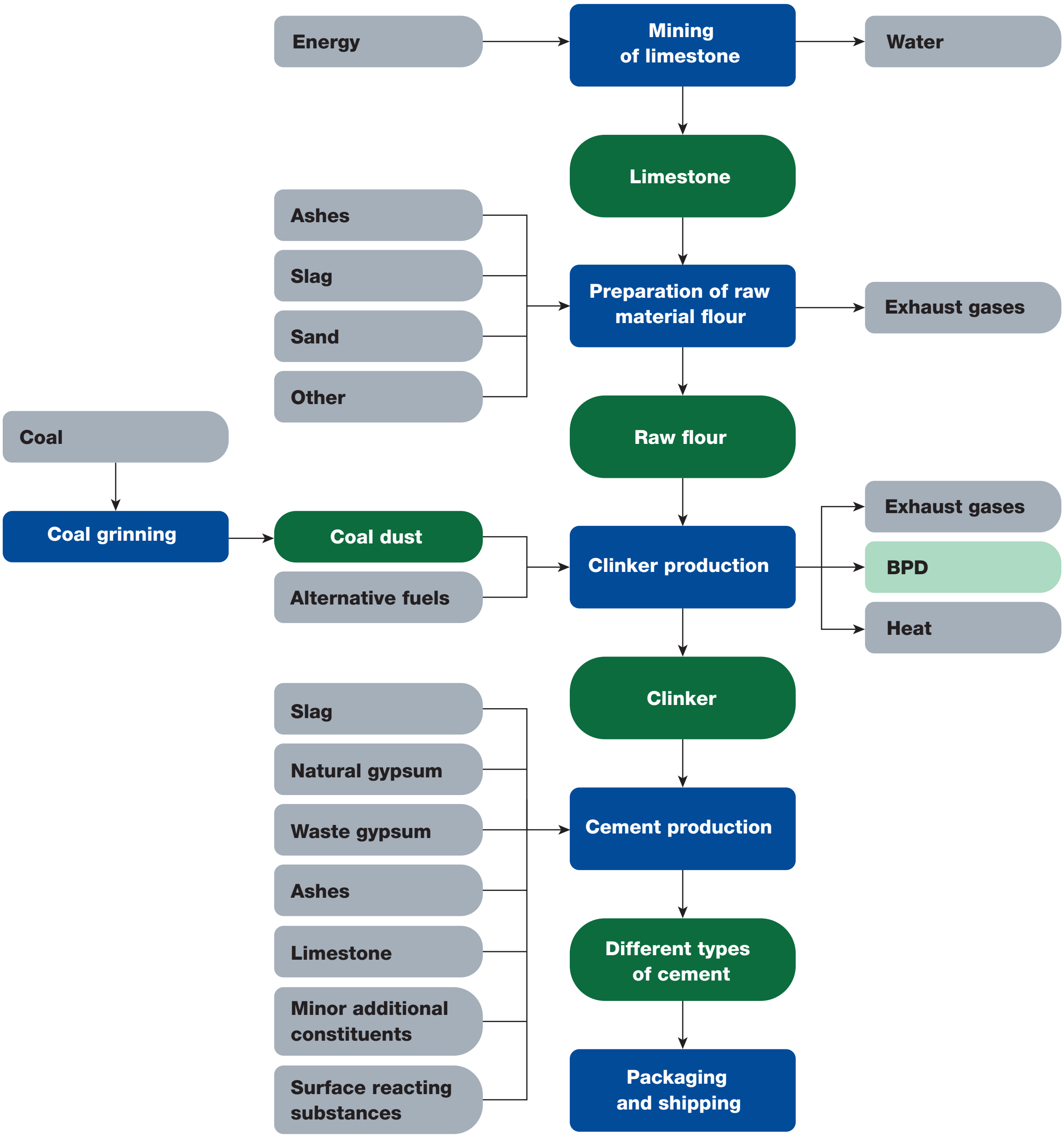
Cemex Poland produces cement in three plants (Chełm, Gdynia, Rudniki).

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

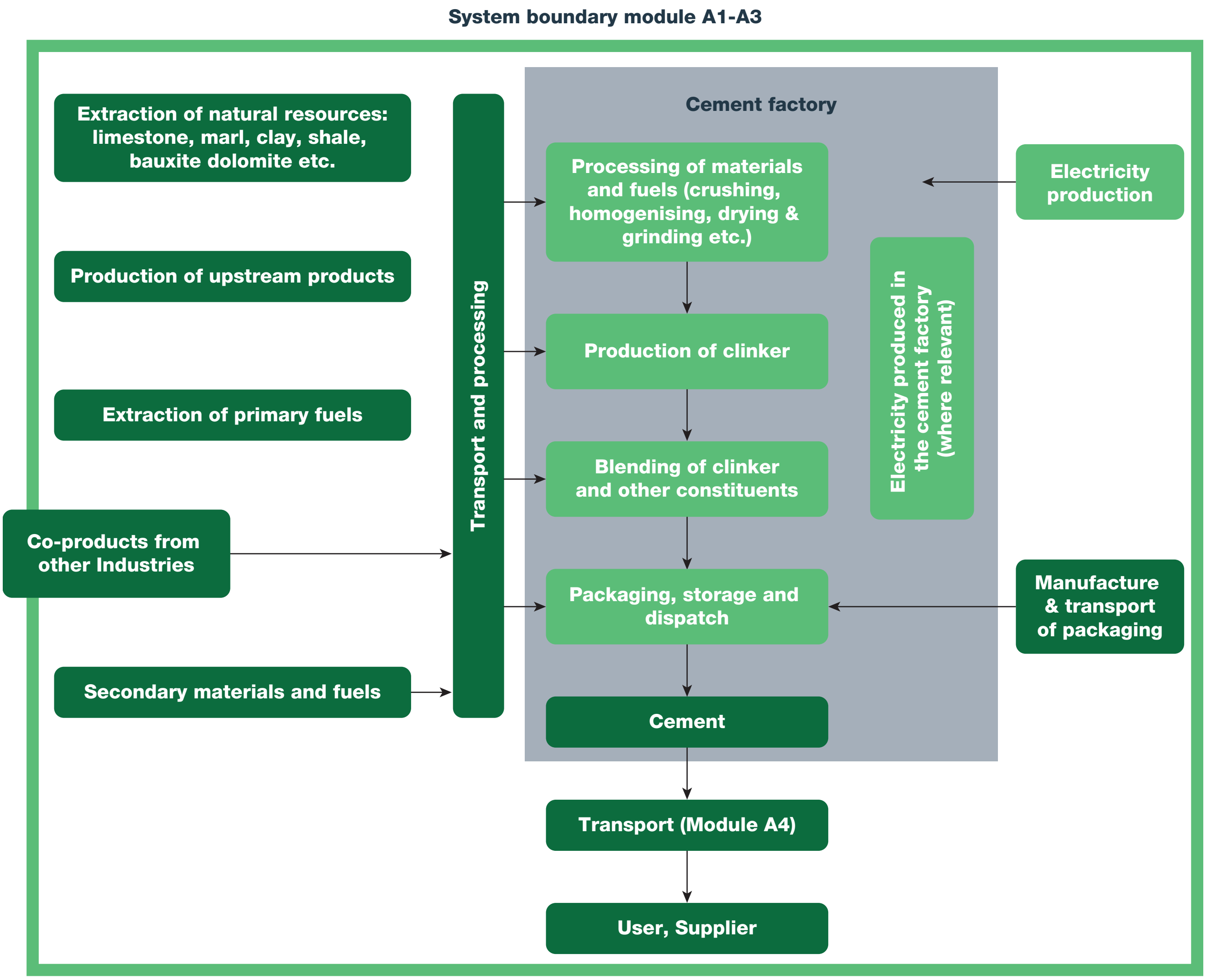
The declared unit is 1 ton of representative Portland-fly ash cement CEM II/A-V 52,5 R – NA according to EN 197-1 and PN-B-19707 produced by Cemex Poland (manufacturing plant - Chełm)

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 II/A-V 52,5 R – NA is a line process in an manufacturing plants located at Chełm. CEM II/A-V 52,5 R – NA is not the only CEM product and the allocation in the manufacturing plant was made on the mass basis allocation. In the case of fly ash, a co-product from electricity production used as a cement constituent, economic allocation was applied. For a synthetic gypsum, allocated impacts are economic based but plain gypsum wase (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 product covered by this declaration. Energy supply was inventoried and allocated to the product assessed on the mass basis. The specific prices for fly ash declared by the producer were used for the economic allocation.

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: the 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 II/A-V 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 of CEM II/A-V are: clinker (80-94%), siliceous fly ash (6-20%)
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 II/A-V (0-5%)
Calcium sulphate	Calcium sulphate occurs as a natural material (e.g. gypsum and anhydrite) or a by-product of industrial processes and acts as a binding time regulator in cement
Additives	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

CEM II/A-V cement with low alkali content NA in accordance with the requirements of PN-B 19707 should contain at least 14% of fly ash in its composition.

For the LCA model, the following composition of CEM II/A-V 52,5 R – NA was adopted: clinker (80-86%), siliceous fly ash (14-20%), 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.

Chełm plants uses “green electricity” (made of wind, 100% in total electricity consumption) and Cemex Poland presented a 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 CEM II/A-V 52,5 R – NA (based on recipe). Data regarding production per 1 ton of product were averaged for the analysed production.

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 II/A-V 52,5 R – NA 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 II/A-V 52,5 R – NA

Environmental impacts: (DU) 1 ton		
Indicator	**Unit**	**A1-A3**
Global warming potential (gross value)[1]	kg eq CO_2	581
Global warming potential (net value)[2]	kg eq CO_2	449
Depletion potential of the stratospheric ozone layer	kg CFC 11	0.000030
Acidification potential of soil and water	kg SO_2	0.377
Formation potential of tropospheric ozone	kg Ethene	0.252
Eutrophication potential	kg $(PO_4)^{3-}$	0.082
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb	1.35
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ	366
Environmental aspects: (DU) 1 ton		
Indicator	**Unit**	**A1-A3**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	INA
Use of renewable primary energy resources used as raw materials	MJ	INA
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	1103
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	INA
Use of non-renewable primary energy resources used as raw materials	MJ	INA
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	383
Use of secondary material	kg	73.3
Use of renewable secondary fuels	MJ	2159
Use of non-renewable secondary fuels	MJ	1035
Net use of fresh water	m^3	7.26
Other environmental information describing waste categories: (DU) 1 ton		
Indicator	**Unit**	**A1-A3**
Hazardous waste disposed	kg	0.0072
Non-hazardous waste disposed	kg	12.7
Radioactive waste disposed	kg	0.00
Components for re-use	kg	0.00
Materials for recycling	kg	9.22
Materials for energy recover	kg	0.00
Exported energy	MJ	0.00

1) the indicated gross value includes the CO_2 emissions from alternative fuels (based on waste) excluding biomass fraction of fuels
2) the net value excludes CO_2 emissions from alternative fuels (based on waste)

RESULTS INTERPRETATION

The gross value of eq. CO_2 emissions (EN 15804/ISO 14067 based method) for CEM II/A-V 52,5 R – NA production by Cemex Poland is 581 kg of CO_2/ton of CEM II/A-V 52,5 R – NA. The net value of eq. CO_2 emissions, excluding alternative waste-based fuels, is 449 kg of CO_2/ton of cement. The fossil fules depletion potential is 366 MJ/ton, which is related to the low use of fossil fuels and significant use of alternative fuels for clinker production (over 90%) of energy total.

The result is significantly influenced by the use of green wind electricity (100% - certified) and clinker substitutes content.

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

- large content of Portland cement clinker in the product (80-94%),
- 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 № 241/2023
of TYPE III ENVIRONMENTAL DECLARATION

Products:
CEM II/A-V 52,5 R - NA Chełm

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-Skalna, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, March 2023


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