Environmental Product Declaration Type III ITB No. 696/2024

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Cement CEM I 52,5R

EPD Program Operator:

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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+A2 (Cradle to Gate)

The year of preparing the EPD: 2024

Product standard: EN 197-1

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 v 1.6. (PCR based on EN 15804+A2) and EN 16908

Declared unit: 1 ton of cement CEM I 52,5R

Reasons for performing LCA: B2B

Representativeness: Polish production, year 2023

BASIC INFORMATION (about producer)

Górażdże Cement SA, the parent company and leading business line of the Górażdże Group, is the leader on the Polish cement market. The company offers a wide range of cements of very high quality and stable parameters - these are: Portland cement (CEM I), Portland composite cement (CEM II), slag cement (CEM III) and pozzolana cement (CEM IV). The high standard of production is additionally supported by a quality management system in accordance with the international ISO 9001 standard. Thanks to a well-organized distribution network, the company's products can be purchased throughout almost the entire country. The commercial offer is complemented by technological consulting services in the field of properties and application of cements and concrete. Cement is produced in two plants: Cement plant Górażdże, located in Chorula near Opole i Ekocem grinding plant in Dąbrowa Górnicza. The company's assets also include two mines: Górażdże and Folwark, where limestone and marl are mined - the basic raw materials for cement production. In both plants and mines, all production processes are carried out with respect for the environment, ensuring that the production technology and the raw material extraction process are environmentally friendly. Care for the environment and social commitment are part of the company's business strategy.
The life-cycle assessment was carried out according to the following standards: PN-EN 15804+A2, PN-EN

16908, PN-EN ISO 14025, PN-EN ISO 14040 and the product categorisation rules provided in document ITB PCR-A v1.6. Declared reference unit is 1 ton of cement. Reference service life according to EN 16908 is not declared as cements are intermediate products used in construction. All input data (LCI) was collected by manufacturer from Chorula and Ekocem plants for a period between January and December 2021 (12 months). CEM I 52,5R 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 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 excludes 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 subjected 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.

PRODUCTS DESCRIPTION

GÓRAŻDŻE CEMENT S.A. offers Portland cement of strength class 42.5 with high early strength (R) produced in the Górażdże Cement Plant and in the Ekocem Plant. The main component of CEM I 52,5R cement is Portland clinker (92-95%) and setting time regulator (up to 5%). Portland cement PN-EN 197-1 - CEM I 52,5R

meets the requirements of PN-EN 197-1 "Cement - Part 1: Composition, requirements and compliance criteria for common cements".
Portland cement CEM I 52,5 R is offered by GÓRAŻDŻE CEMENT S.A. in bulk.
The following figure 1 is a schematic representation of the cement manufacturing process stages from quarry to cement mill (production stage). The natural raw materials for cement production are mainly calcareous materials such as limestone, sand and alumina-containing materials such as clay or shale, which are widespread. Alternative raw materials, such as different type of ash, slag or other waste materials are used in the process as substitutes for natural ones. Raw resource is preheated using input gases and then fired in a rotary kiln at a temperature of approximately 1450ºC. Currently one of the main fuels used in the process is alternative fuel that is derived from waste and its share is growing. Górażdże, through the use of alternative fuels, tries to reduce environmental damage, which is one of the basic strategic assumptions of the company.
The LCA assessment encompassed the production phase and the following processes/modules: A1 – raw material production: fuel mining, raw material mining, electricity generation, alternative fuel production; A2 – transport: raw material transport; A3 – production of the product: raw meal production, consumption of fuel for firing, electricity consumption for grinding.

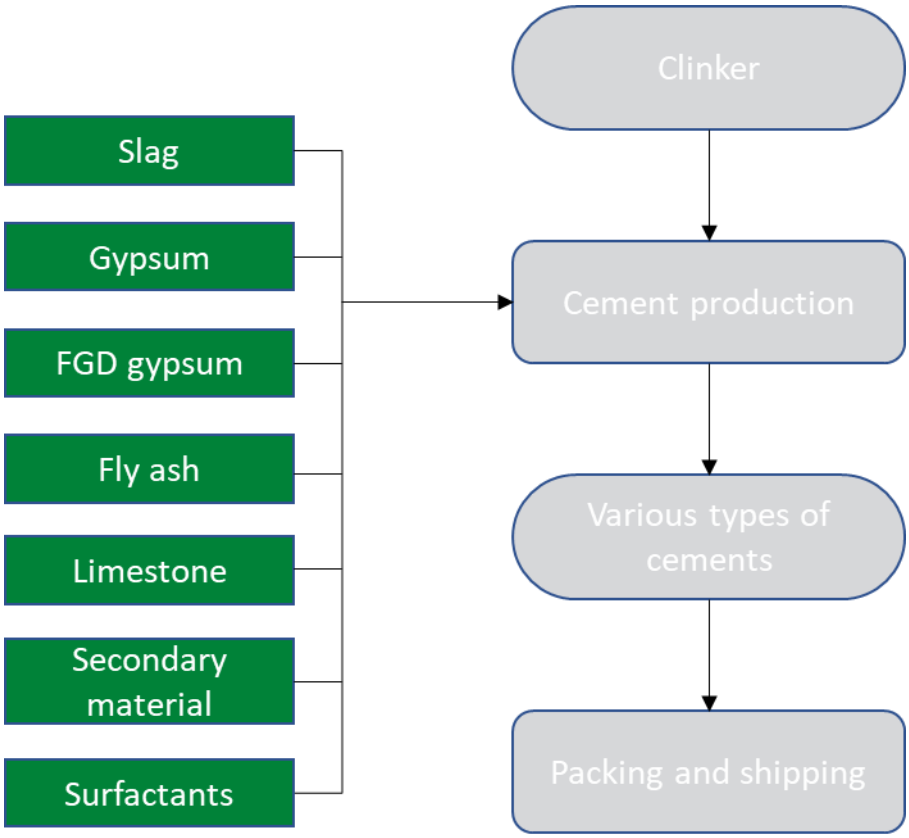

Figure 1. *Cement production general production diagram*

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Unit

The declared unit is 1 ton of representative composite group of cements CEM I 52,5R according to EN 197-1 produced by Górażdże Cement plant and Ekocem cement milling 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 16908:2017.

Allocation rules

The allocation rules used for this EPD are based on general ITB PCR A. Production of cement is a line process (see figure 1). CEM I 52,5R is not the only CEM product and the allocation in the manufacturing plant (CEM I, CEM II, CEM III) was made on the mass basis allocation for mixing impacts and clinker mass allocation in the CEM product. In the case of blast furnace slag use in cement production (other then CEM I), a co-product from steel production used as a cement constituent, economic allocation was applied. In the case of fly ash, eco-product from electricity production used as a cement constituent, economic allocation was applied. For a synthetic gypsum, allocated impacts are also economic based. Subsequent processes (e.g. granulation and grinding of blast furnace slag) were entirely allocated to the co-products. 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. Emissions allocated in clinker production are assessed using international methods for emission system declaration.

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 following processes were excluded from the LCA study: use of chromate reducing agents and 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 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.

A1 – A2 Modules: Raw materials supply and transport

Cement according to EN 197-1 is produced by grinding and mixing the constituents defined in the standard. Constituents of cement as defined in EN 197-1 are in table 1.

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

Main constituents	portland cement clinker and e.g. limestone, blast furnace slag
Calcium sulfate (gypsum/anhydrite/artificial gypsum)	added to the other constituents of cement during its manufacture to control setting
Minor additional constituents	added to improve the physical properties of the cement, such as workability or water retention
Additives	the total quantity of additives shall not exceed 1.0 % by mass of the cement (except for pigments).

The raw material resource base is the Górażdże and the Folwark mines. The "Górażdże" Limestone Mine is the largest mine owned by Górażdże Cement S.A. For the needs of the lime industry, mining began in the 19th century, and for the needs of cement production, the extraction of the raw material started in 1977, with the launch of the Górażdże Cement Plant. The exploited deposit is divided into three basic rock complexes, differentiated by mechanical and chemical properties. The Terebratul and Karchowice limestones extracted from the mine are used entirely for the production of cement at the Górażdże Cement Plant, while the Górażdże limestones are mostly used for the production of lime products. The deposit is excavated using the drilling and blasting method. In parallel with mining, successive reclamation of the pits is carried out. Over the past 25 years, about 400 hectares of land have been rehabilitated, of which more than 300 hectares have been afforested.

The Chalk Marls Mine "Folwark" is the second plant, next to the Limestone Mine "Górażdże", providing the basic raw materials for cement production at the Górażdże Cement Plant. Cretaceous marls and limestone have been mined there for more than 30 years. The "Opole-Folwark" marl deposit is one of the richest deposits of this type in the country.

The deposit is excavated here using two methods: drilling and blasting works and mechanical ripping. The raw material is then loaded by excavators or loaders onto process trucks, which transport it to crushers. After crushing, the raw material is transported by conveyor belts with a total length of about 9 km to the Górażdże Cement Plant.

A3 Module: Production

The raw meal that is collected from the homogenization tanks is transported to the buffer tank in the dosing system. Between the first and second stages of the cyclone exchanger, material is introduced and then distributed in the gas stream. From there it goes to the next stage and then to the decarboniser (calciner). The material then enters the process stage, where the raw meal is separated from the gases and directed to the rotary kiln. Due to precipitation in the cyclones, the material moves down the exchanger, against the direction of the gases. The material, passing through the successive stages of the cyclone, exchanges heat with hot gases. The rotary kiln is fired with coal dust, the preparation of which takes place in rotary dryers and grinding mills. About 40% of the fuel is fed to the furnace burner. The rotary movement of the furnace, combined with the angle of its inclination (approx. 3.5%), enables the transport of material from which cement will be produced in next stage of production. The material temperature in the firing zone reaches approximately 1450° C. The clinker formation process begins already in the decarboniser, but the proper reactions take place only in the furnace. The clinker obtained in the firing process, after cooling in the grate cooler, is transported through a system of conveyors to the clinker hall or to the clinker silo. Clinker consists mainly of calcium, silica, aluminium-and iron-oxides. In a second phase calcium sulphates and possibly additional cementitious or inert materials are added to the clinker. All constituents are ground leading to a fine and homogenous powder. In the cement production process, and more specifically - for the burning of clinker, alternative fuel is used in addition to coal dust. The process of feeding alternative fuels is divided into four stages: unloading from means of transport (cars with self-unloading trailers or with the so-called "moving floor"), storage in silos, transport and dosing to the furnace line. The main component of CEM I 52,5R according to EN 197-1 is clinker. The final product, i.e. cement, is obtained by grinding gypsum, clinker and additives together. Additives are added to the cement to improve its properties. Material with a strictly defined percentage composition is fed to the cement mills. Clinker with limestone, gypsum and ash are transported from the landfill by belt conveyors to separate buffer tanks, from which they are precisely dosed to the mills. Cement segregation is carried out in two stages. From the open system, the finished product goes directly from the mill to the cement silos. In a closed system, some of the cement goes to the silos, and too thick particles, separated by a separator, return to the mill. The entire installation includes: transport of clinker and additives to the pre-mill tanks, transport of the finished mixture to the mill, grinding, collection of the finished product (cement) and transport of cement to storage silos. The material is heated and dried in the mill by hot gases taken from the furnace cooler after dedusting them or by hot gases produced by an auxiliary furnace fired with fuel oil.
Production data was inventoried by producer and verified. Data on transport of the different input products to the manufacturing plants were inventoried in detail. For transport calculation purposes European fuel averages are applied.

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 done for Poland as reference area.

Data quality - production
The values determined to calculate A3 originate from verified manufacturer inventory data. A1 values (raw materials) were prepared considering national specific data, Ecoinvent data and economic allocation (for a steel and energy coproducts - gypsum, slag and ash).

Assumptions and estimates

Electricity use per tone (A3) were assigned to different types of CEM in technological allocation way. Data regarding production per 1 ton of product were averaged for the analyzed production for each product group. Due to the difficulty of separating the clinker and cement production processes, the data were aggregated as A1-A3.

Calculation rules

LCA was done in accordance with ITB PCR A document. Characterization factors are CML ver. 4.2 based. ITB-LCA algorithms were used for impact calculations. A1 was calculated based on data from the Ecoinvent v3.10 database and specific national data. A3 and A2 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.3.10 (sand, water, electricity production for Poland, transport), specific emission reporting data for clinker production by producer, specific data a raw material (gypsum, limestone, FGD Gypsum, additives), allocated impacts for ash and slag production calculated by ITB using KOBiZE report (combustion factors for selected fuels). 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

Declared unit

The declaration refers to the unit DU – 1 ton of CEM I 52,5R produced by Górażdże Cement S.A.

***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**. Life cycle assessment (LCA) results for CEM I 52,5R– the environmental impacts (DU: 1 ton)*

Indicator	Unit	A1-A3 Chorula Plant	A1-A3 Ekocem plant
Global Warming Potential net total	eq. kg CO_2	5,21E+02	5,63E+02
Global Warming Potential gross total	eq. kg CO_2	7,00E+02	7,40E+02
Greenhouse gas potential - fossil	eq. kg CO_2	7,00E+02	7,40E+02
Greenhouse gas potential - biogenic	eq. kg CO_2	2,12E-01	5,20E-01
Global warming potential - land use and land use change	eq. kg CO_2	1,35E-02	2,29E-02
Stratospheric ozone depletion potential	eq. kg CFC 11	1,76E-06	1,92E-06
Soil and water acidification potential	eq. mol H+	1,75E+00	1,86E+00
Eutrophication potential - freshwater	eq. kg P	9,71E-02	1,06E-01
Eutrophication potential - seawater	eq. kg N	2,00E-02	3,03E-02
Eutrophication potential - terrestrial	eq. mol N	5,01E+00	5,33E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	1,12E+00	1,20E+00
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1,92E-03	2,26E-03
Abiotic depletion potential - fossil fuels	MJ	8,70E+02	1,00E+03
Water deprivation potential	eq. m^3	1,43E+01	1,60E+01

Note: The gross value includes the CO_2 emissions from waste incineration (excluding biomass fraction of fuels, net-value excludes alternative waste-based fuels

***Table 4.** Life cycle assessment (LCA) for CEM I 52,5R – the environmental impacts (DU: 1 ton)*

Indicator	Unit	A1-A3 Chorula Plant	A1-A3 Ekocem plant
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	8,86E+01	1,11E+02
Consumption of renewable primary energy resources used as raw materials	MJ	0,00E+00	0,00E+00
Total consumption of renewable primary energy resources	MJ	8,86E+01	1,11E+02
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	8,65E+02	9,98E+02
Consumption of non-renewable primary energy resources used as raw materials	MJ	0,00E+00	0,00E+00
Total consumption of non-renewable primary energy resources	MJ	8,71E+02	1,00E+03
Consumption of secondary materials	kg	4,77E+01	4,99E+01
Consumption of renewable secondary fuels	MJ	1,18E-03	1,61E-03
Consumption of non-renewable secondary fuels	MJ	0,00E+00	0,00E+00
Net consumption of freshwater resources	m^3	4,10E-01	4,43E-01

Table 5. *Life cycle assessment (LCA) results for CEM I 52,5R - environmental information describing waste categories (DU: 1 ton)*

Indicator	Unit	A1-A3 Chorula Plant	A1-A3 Ekocem plant
Hazardous waste, neutralized	kg	1,51E+00	2,07E+00
Non-hazardous waste, neutralised	kg	3,04E+01	5,58E+01
Radioactive waste	kg	1,43E-04	3,59E-04
Components for re-use	kg	0,00E+00	0,00E+00
Materials for recycling	kg	1,86E-02	1,52E-02
Materials for energy recovery	kg	7,45E-06	1,36E-05

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 and ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3) ☒ external ☐ internal
External verification of EPD: Halina Prejzner, PhD Eng LCI audit and verification: Filip Poznański, M.Sc. Eng. LCA, LCI audit and input data verification: Michał Piasecki, prof. ITB

Note 1: The declaration owner has the sole ownership, liability and responsibility for the for the information provided and contained in EPD. Declarations within the same product category but from different programmes may not be comparable. 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. Depending on the application, a corresponding conversion factor such as the specific weight per surface area must be taken into consideration.
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. 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
- EN 197-1:2011: Cement - part 1: Composition, specifications and conformity criteria for common cements
- PN-EN ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations. Principles and procedures.
- PN-EN 15804 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 cate-gory rules complementary to EN 158044.
- 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 "
- KOBiZE Wskaźniki emisyjności CO_2, SO_2, NO_x, CO i pyłu całkowitego dla energii elektrycznej, 2023

LCA,LCI, input data verification
Michał Piasecki, PhD. D.Sc.

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CERTIFICATE № 696/2024
of TYPE III ENVIRONMENTAL DECLARATION

Products:

Cement CEM I 52,5R

Manufacturer:

Górażdże Cement S.A.

Cementowa 1, 47-316 Chorula, 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 15th November 2024 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, November 2024