

ENVIRONMENTAL PRODUCT DECLARATION (EPD) TYPE III CEMENTS CEM I, CEM II, CEM III, CEM IV, CEM V manufactured in Poland

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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. 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

Life cycle analysis (LCA): A1-A3 in accordance with EN 15804+A2 (Cradle-to-Gate with options)

The year of preparing the EPD: 2025

Product standards: -

Service Life: depends on use in concrete

PCR: ITB-PCR A

Declared unit: 1 ton

Reasons for performing LCA: B2B

Representativeness: Poland, 2022

Basic information about the environmental product declaration

Conformity: The life-cycle assessment of cement 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 categorization rules ITB PCR-A.

Declared reference unit: 1 ton of CEM I, CEM II, CEM III, CEM IV, CEM V cement produced in Poland.

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

Time representativeness: data was collected by the Polish Cement Association (Polish abbreviation: SPC) members between January and December 2022 (12 months) and is representative for production technologies used in 2022.

Databases and LCA software used: Ecoinvent 3.11 Database, allocation at the place of origin,, specific production data provided by the Polish Cement Association, ITB data on secondary ingredients, slags and pozzolanas. ITB did not use commercial calculation software, the LCA assessment was carried out using internal ITB algorithms applied to calculate the LCA/EPD.

System boundary description adopted according to EN 16908. Cement is an intermediate product with many 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 phases 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. The Type III Environmental Product Declaration for CEM I – CEM V cements produced in Poland provides information about the process of producing cement at particular product stages according to EN 15804 for a unit of product weight (1 ton). This information 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 (NOX, SO2, heavy metals etc.) CEM I, CEM II, CEM III and CEM IV cements covered by the Type III Environmental Product Declaration comply with the harmonised European standard EN 197-1.

Data on cement production

Cement is a material universally used in construction. The environmental properties of cement are increasingly frequently declared by producers to raise consumers' environmental awareness and to foster low carbon design of buildings. This Type III Environmental Product Declaration of CEM I, CEM II, CEM III and CEM IV, CEM V produced at Polish plants was prepared based on the life-cycle assessment methodology in accordance with the guidelines of PN-EN 15804 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products and ISO 14067:2018 Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification. The carbon footprint is understood as the total emission of greenhouse gases caused directly during cement production including the following stages: mining of raw materials, their processing and the related energy consumption, the transport and the cement production process itself. The environmental impact has been expressed for the declared unit, i.e. for the reference unit of 1 ton of cement. The main stages of cement production are as follows: mining and purchase of raw materials, production of the raw meal, clinker firing, cement grinding, cement storage. Processes involved in producing cement by the wet and dry methods are presented in Figure 1.

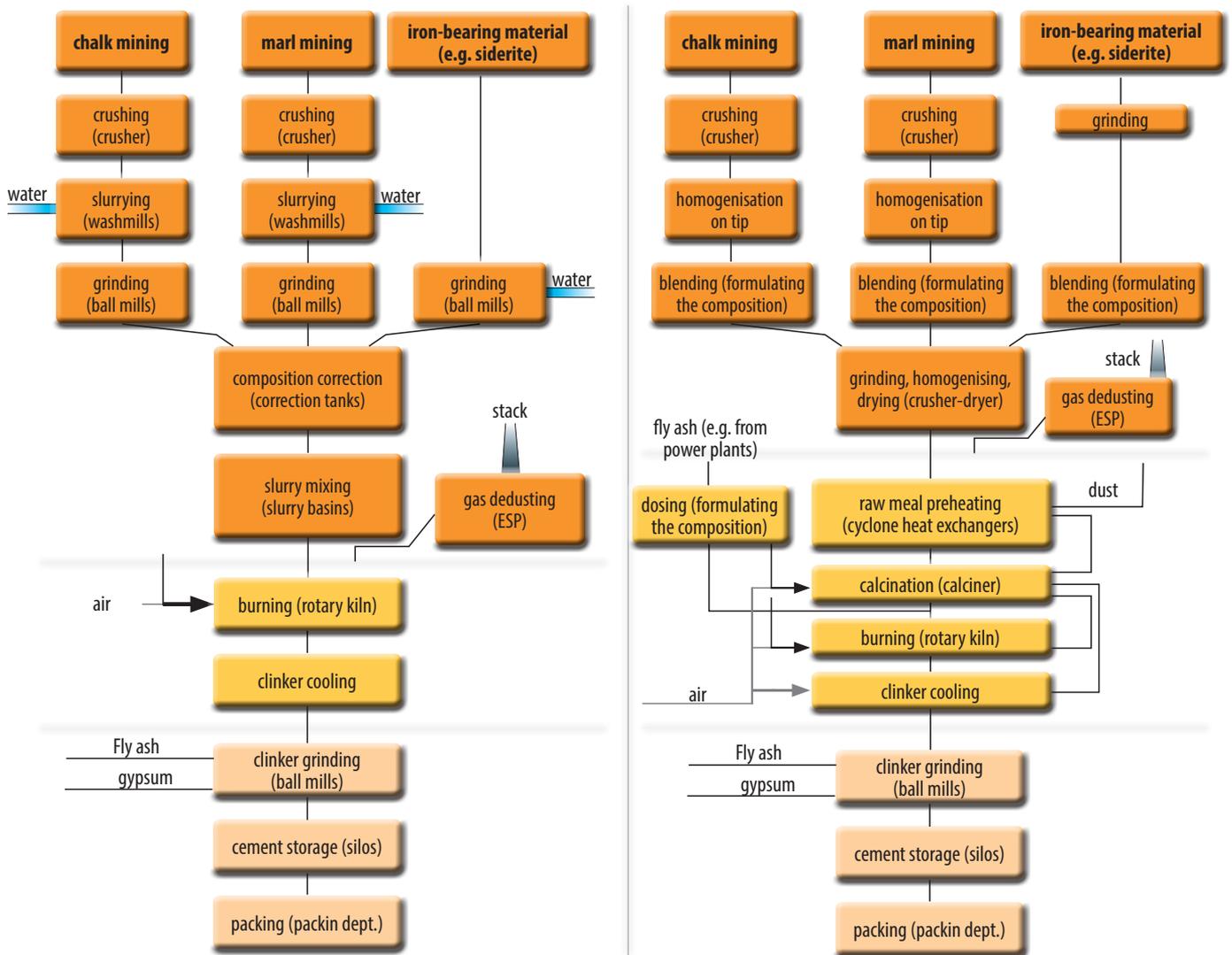


Fig. 1 Diagram of cement production by the dry and wet methods (according to ITB/SPC)

The natural raw materials for cement production are mainly calcareous materials such as limestone or marl, sand and alumina-containing materials such as clay or shale, which are widespread. Alternative raw materials, such as ash and slag, are used in the process as substitutes for natural ones. The use of clinker substitutes contributes significantly to reducing the carbon footprint of cement. The weight proportions of raw materials for producing CEM I – CEM V cements based on SPC declarations and statistics are presented in Table 1. The share of CEM I by weight in the domestic cement production amounts to approx. 29,3%, of CEM II – 56,6% , CEM III – 5,0%, and of CEM IV and CEM V about 1-2%.

Table 1. Raw materials used to produce CEM I – CEM V in Poland

Cement type	Percentage share of materials	Cement type	Percentage share of materials
CEM I – 29,3% of national production		CEM II – 56,6% of national production	
Clinker	92.0	Clinker	70.3
setting regulator	3.0	setting regulator	3.8
secondary ingredients	5.0	ash	11.7
CEM III – 5,0% of national production		slag	6.2
Clinker	43.0	limestone	5.0
setting regulator	4.0	secondary ingredients	3.0
slag	53.0		
secondary ingredients	0.0		

Cement type	Percentage share of materials	Cement type	Percentage share of materials
CEM IV – 1,7% of national production		CEM V – 1,1% of national production	
Clinker	56.9	Clinker	58.2
setting regulator	4.0	setting regulator	3.8
ash	37.4	ash	18.5
secondary ingredients	1.7	slag	19.5

In 2022, the annual production of clinker used to produce cement amounted to: 14522700 tons while the total cement production was equal to 18721400 tons.

Raw meal is produced in both the wet and dry method process (Fig. 1). In the wet method, the raw meal is turned into slurry before burning. The slurry is homogenised and pumped into the kiln. In the dry method, the mix is usually produced in a single-step grinding process. The heat of process gases is used for drying. The quantity of cement produced by the wet method is decreasing with every passing year. Raw meal is preheated using input gases and then fired in a rotary kiln at a temperature of approximately 1450°C. The main fossil fuel used in the process is hard coal (20.1%). Alternative fuel that is used is derived from waste and its share is growing with every passing year. A large proportion of alternative fuels contains biomass with a low carbon footprint coefficient. The use of alternative fuel significantly reduces the carbon footprint of cement. The degree to which alternative fuels are used varies significantly within the territory of Poland. As measured by the amount of heat obtained from fuel during cement production, alternative fuel accounts for 76.5% of total energy.

In 2022, the amount of CO₂ emitted by cement industry in Poland was 11265856,4 tons. Calculated per clinker production, this represents 0.775 Mg CO₂/ton of clinker. The process emission factor amounted to 0.47 Mg CO₂/ton of clinker. Clinker is ground together with additives. The statistical average consumption of energy for clinker production is 56.1 kWh/ton of clinker and for cement grinding is equal to 48.1 kWh/ton. The total electricity consumption in cement production amounts to 104.2 kWh/ton. The emission ratio of electricity generation in Poland is 0.951 kg/kWh (Ecoinvent 3.11) but declared by SPC percentage of renewable electricity purchase for cement plants is 55%. The LCA assessment took into account the production phase (A1-A3) 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.

Specific conditions of conducting the life-cycle assessment

Cut-off (exclusion) criteria: mass and energy streams which were excluded from the analysis as it is difficult to assign them to a specific reference stream are as follows: office lighting, office heating, sanitary facilities and building cleaning, employee transport and meal preparation, production and maintenance of tools and production infrastructure, streams from research and development, administration, management and marketing, vehicle fleet maintenance. The proportion of elements excluded from calculations does not exceed 1% of the consumption of renewable energy and non-renewable primary energy or the 1% weight cut-off rule permitted by the standard. The sum total of excluded input streams of modules A1-A3 is equal to no more than 1% of the energy and mass consumption.

Elements considered in the analysis: cement products are produced in three subsequent production stages of "raw material preparation": production of clinker from raw materials (limestone, clay, sand...); "clinker firing": the raw materials are fired to produce clinker and dust; "cement grinding and storage": other ingredients (anhydrite, limestone, fly ash...) are added to clinker to produce cement. In Poland, various substitutes of fossil fuels are used to produce cement products, e.g. fuel produced from municipal waste, including, cardboard, wood, textiles and plastics, and this significantly reduces the environmental

footprint of cements. Recycled materials: cement products contain, among others, the following recycled materials: blast furnace slag and fly ash. CEM I – CEM V cements were calculated without packaging, as delivered in bulk. Factors characterizing environmental impacts were assumed according to the EF 3.1 models and methodology. Table 2 presents LCA assessment results for CEM I – CEM V.

Table 2. Environmental assessment results of cements CEM I – CEM V at product stages from cradle to gate (A1-A3, according to EN 15804+A2), expressed in the declared unit of 1 ton

Environmental impacts	Unit	CEM I	CEM II	CEM III	CEM IV	CEM V
Global Warming Potential Net ¹	eq. kg CO ₂	5.84E+02	4.73E+02	3.98E+02	3.97E+02	4.30E+02
Global Warming Potential Gross ²	eq. kg CO ₂	7.66E+02	6.13E+02	4.83E+02	5.10E+02	5.46E+02
Greenhouse potential - fossil	eq. kg CO ₂	7.66E+02	6.13E+02	4.83E+02	5.10E+02	5.45E+02
Greenhouse potential - biogenic	eq. kg CO ₂	2.11E-01	5.79E-01	7.76E-01	1.43E+00	8.51E-01
Global warming potential - land use and land use change	eq. kg CO ₂	6.56E-02	8.79E-02	1.65E-01	1.16E-01	1.23E-01
Stratospheric ozone depletion potential	eq. kg CFC 11	1.12E-06	1.42E-06	2.12E-06	1.81E-06	1.83E-06
Soil and water acidification potential	eq. mol H+	1.90E+00	1.71E+00	1.60E+00	1.73E+00	1.71E+00
Eutrophication potential - freshwater	eq. kg P	1.19E-01	1.15E-01	9.04E-02	1.37E-01	1.16E-01
Eutrophication potential - seawater	eq. kg N	4.57E-01	4.11E-01	3.47E-01	4.38E-01	4.03E-01
Eutrophication potential - terrestrial	eq. mol N	4.97E+00	4.47E+00	3.73E+00	4.77E+00	4.37E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	1.34E+00	1.24E+00	1.14E+00	1.35E+00	1.26E+00
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	2.26E-03	7.55E-04	2.13E-03	2.38E-03	2.14E-03
Abiotic depletion potential - fossil fuels	MJ	1.96E+03	2.07E+03	2.44E+03	2.41E+03	2.36E+03
Water deprivation potential	eq. m ³	3.21E+01	3.04E+01	3.02E+01	3.19E+01	3.11E+01
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	3.38E+02	3.09E+02	3.05E+02	3.01E+02	3.04E+02
Use 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
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	3.38E+02	3.09E+02	3.05E+02	3.01E+02	3.04E+02
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	1.96E+03	2.07E+03	2.44E+03	2.42E+03	2.36E+03
Use of non-renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	1.96E+03	2.07E+03	2.44E+03	2.42E+03	2.36E+03
Use of secondary material	kg	6.95E+01	2.32E+02	5.63E+02	4.17E+02	4.24E+02
Use of renewable secondary fuels	MJ	1.72E+03	1.31E+03	8.03E+02	1.06E+03	1.09E+03
Use of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water	m ³	1.83E+00	1.72E+00	1.56E+00	1.79E+00	1.71E+00
Hazardous waste disposed	kg	1.26E+02	3.33E+02	6.53E+01	8.31E+02	4.54E+02
Non-hazardous waste disposed	kg	5.73E+02	5.12E+02	5.16E+02	4.92E+02	5.06E+02
Radioactive waste disposed	kg	1.79E-03	1.64E-03	2.11E-03	1.66E-03	1.71E-03
Materials for reuse	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	1.24E-01	1.03E-01	8.63E-02	9.34E-02	9.52E-02
Materials for energy recovery	kg	9.21E-05	1.82E-04	6.64E-04	1.84E-04	3.45E-04
Exported energy	MJ	2.34E+00	2.22E+00	3.30E+00	2.15E+00	2.44E+00

1 Net global warming – without fossil part of alternative fuels

2 Gross global warming – without emissions from biogenic part of fuels

Carbon footprint of Polish cements

The net average carbon footprint of cement produced in Poland in 2022, determined using the LCA method and according to ISO 14067 – Carbon Footprint of Products amounts to:

The carbon footprint of CEM I cement – Carbon Footprint of Product – amounts to **0.584 ton CO₂/ton CEM I**.

The carbon footprint of CEM II cement – Carbon Footprint of Product – amounts to **0.473 ton CO₂/ton CEM II**.

The carbon footprint of CEM III cement – Carbon Footprint of Product – amounts to **0.398 ton CO₂/ton CEM III**.

The carbon footprint of CEM IV cement – Carbon Footprint of Product – amounts to **0.397 ton CO₂/ton CEM IV**.

The carbon footprint of CEM V cement – Carbon Footprint of Product – amounts to **0.430 ton CO₂/ton CEM V**.

In comparison, the gross carbon footprint of CEM I declared by the European Cement Association CEMBUREAU is 0.803 ton CO₂/ton CEM I.

Verification

This EPD verification process complies with EN ISO 14025 and ISO 21930. After verification, this EPD is valid for 5 years. The process of verification of this EPD is in accordance with EN ISO 14025, clause 8 and ISO 21930, clause 9.

The LCA analysis was carried out according to the guidelines of EN 15804 and ITB PCR A

Independent verification compliant with ISO 14025 & 8.1.3.

external

internal

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References to standards

- EN 197-1:2011: Cement – part 1: Composition, specifications and conformity criteria for common cements
- ISO 14025:2011: Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- EN 15804:2012+A2:2019: Sustainability of construction works – Environmental Product Declarations – Core rules for the product category of construction products
- EN 16908:2017: Cement and building lime – Environmental product declarations – Product Category Rules complementary to EN 15804
- ECRA (European Cement Research Academy) – Background report “TR-ECRA A2019/1838 Environmental Product Declarations for representative European cements”, Jan 2020

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 (see 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.

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