Environmental Product Declaration Type III ITB No. 424/2023

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Cement DYNAMIK

CEM II/A-M (S-LL) 52,5 R

from Małogoszcz Cement Plant

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 (Cradle to Gate)

The year of preparing the EPD: 45015

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 (PCR based on EN 15804) and EN 16908

Declared unit: 1 ton of cement: DYNAMIK; CEM II/A-M (S-LL) 52,5 R

Reasons for performing LCA: B2B

Representativeness: Polish product, year 2021

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BASIC INFORMATION

The Lafarge company has been operating in Poland since 1995 (since 2015 as Lafarge Cement S.A.). It has over 60 production plants, including: cement plants, mines, aggregate transshipments and RMX plants. The largest Lafarge plants in Poland are Małogoszcz and Kujawy Cement Plants.

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. Declared reference unit is 1 ton of cement.

All input data (LCI) was collected by manufacturer from cement production plants for a period between January and December 2021 (12 months).

Cement is an intermediate product with large number of final uses (ready-mix concrete, precast concrete products, screeds, masonry mortars and dry 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+A2. The EPD excludes product life-cycle stages A4, A5, C1-C4 and D according to EN 15804+A2.

This 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 harmonized European standard EN 197-1.

PRODUCTS DESCRIPTION

The main component of cements according to EN 197-1 is clinker. It is produced from raw materials such as limestone and clay, silica or other waste materials which are crushed, homogenized and fed into a rotary kiln. The raw materials are sintered at a temperature of 1450°C to form new compounds. Clinker consists mainly of oxides of calcium, silicon, aluminum and iron. In a second phase calcium sulfates and possibly additional cementitious or inert materials are added to the clinker. All constituents are ground leading to a fine and homogenous powder.

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 1450°C. Currently one of the main fuels used in the process is alternative fuel that is derived from waste and its share is growing. Cement production through the use of alternative fuels, tries to reduce environmental impact, which is one of the basic strategic assumptions of the company. Clinker is ground together with setting time regulator and other additives. The LCA assessment encompassed the production phase (A1-A3, see Table 3) 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.

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Unit

The declared unit is 1 ton of representative cements DYNAMIK, CEM II/A-M (S-LL) 52,5 R

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, Figure 1.

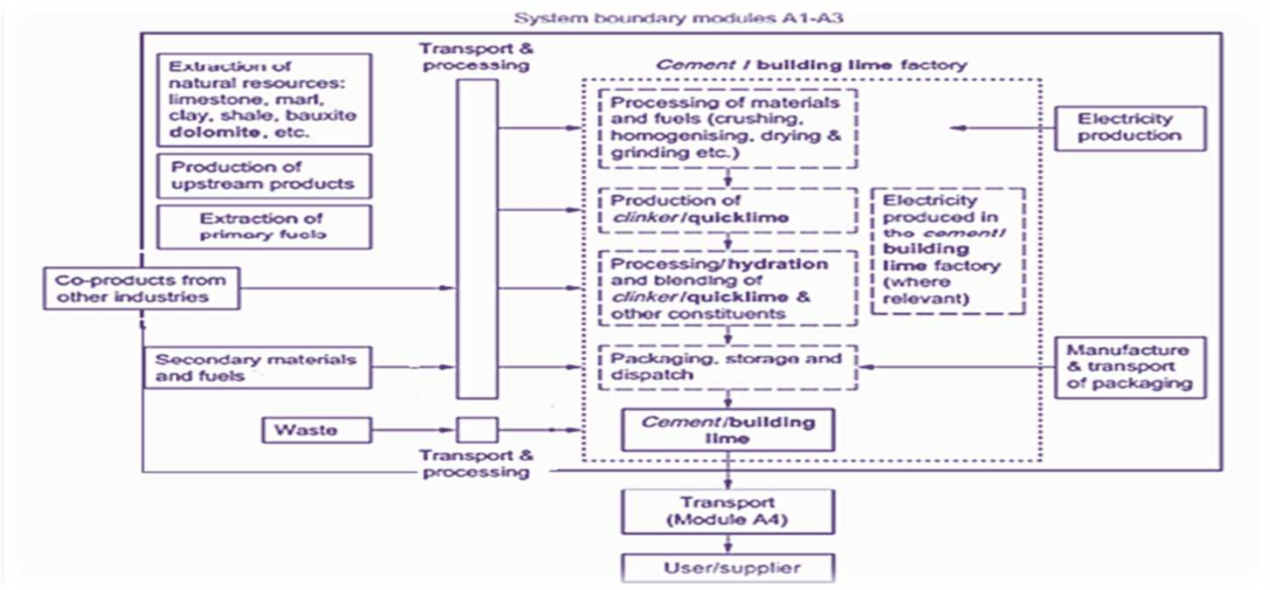

Figure 1. Inputs and processes of product system.

Allocation rules

The allocation rules used for this EPD are based on general ITB PCR A. Production of cement is a line process. Mass based allocation was used. 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 by Lafarge 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 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).

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 decarbonize (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, 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 decarbonized, 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, aluminum-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 analyzed cement 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 01.01.2021 – 31.12.2021 (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 GCCA data.

Assumptions and estimates

Electricity use per tone (A3) were assigned to different types of CEM in an equal way. Data regarding production per 1 ton of product were averaged for the analysed 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 GCCA database and specific national data. A3 and A2 modules are calculated based on the LCI questionnaire provided by the manufacturer.

Databases

The background data for the processes come from the following databases: GCCA tool (sand, ash, water, gypsum, limestone, FGD gypsum, additives, wind electricity production for Poland, transport), specific emission reporting data for clinker production by Lafarge Cement S.A.. Electricity provider guarantees a certificate of origin of renewable electricity. 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 cement produced by Lafarge 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. Environmental product characteristic (product stage) – 1 ton of cement:
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Environmental impacts: (DU) 1 ton		
Indicator	Unit	A1-A3
Global Warming Potential		
Global Warming Potential (net value)[1]	eq. kg CO_2	5.10E+02
Greenhouse potential – fossil (gross value) [2]	eq. kg CO_2	6.55E+02
Greenhouse potential - biogenic	eq. kg CO_2	2.40E-01
Global warming potential - land use and land use change	eq. kg CO_2	9.08E-02
Stratospheric ozone depletion potential	eq. kg CFC 11	3.47E-06
Soil and water acidification potential	eq. mol H^+	1.67E+00
Eutrophication potential - freshwater	eq. kg P	2.91E-02
Eutrophication potential - seawater	eq. kg N	1.93E-03
Eutrophication potential - terrestrial	eq. mol N	4.85E+00
Potential for photochemical ozone synthesis	eq. kg NMVOC	1.08E+00
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.43E-04
Abiotic depletion potential - fossil fuels	MJ	8.94E+02
Water deprivation potential	eq. m^3	2.47E+01
Environmental aspects: (DU) 1 ton		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	5.92E+02
Use of renewable primary energy resources used as raw materials	MJ	0.00E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	5.92E+02
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	8.94E+02
Use of non-renewable primary energy resources used as raw materials	MJ	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	8.94E+02
Use of secondary material	kg	1.56E+02
Use of renewable secondary fuels	MJ	1.30E+03
Use of non-renewable secondary fuels	MJ	2.22E+03
Net use of fresh water	m^3	6.20E-01
Other environmental information describing waste categories: (DU) 1 ton		
Hazardous waste disposed	kg	0.00E+00
Non-hazardous waste disposed	kg	0.00E+00
Radioactive waste disposed	kg	0.00E+00
Components for re-use	kg	4.86E+00
Materials for recycling	kg	1.44E+01
Materials for energy recover	kg	0.00E+00
Exported energy	MJ	0.00E+00

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

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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 ISO 14025 (subclause 8.1.3.) [X] 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.
- https://gccassociation.org/
- 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 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".
- KOBiZE Wskaźniki emisyjności CO_2, SO_2, NO_X, CO i pyłu całkowitego dla energii elektrycznej.

Signature Not Verified
Dokument podpisany przez Michał Piasecki; ITB
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