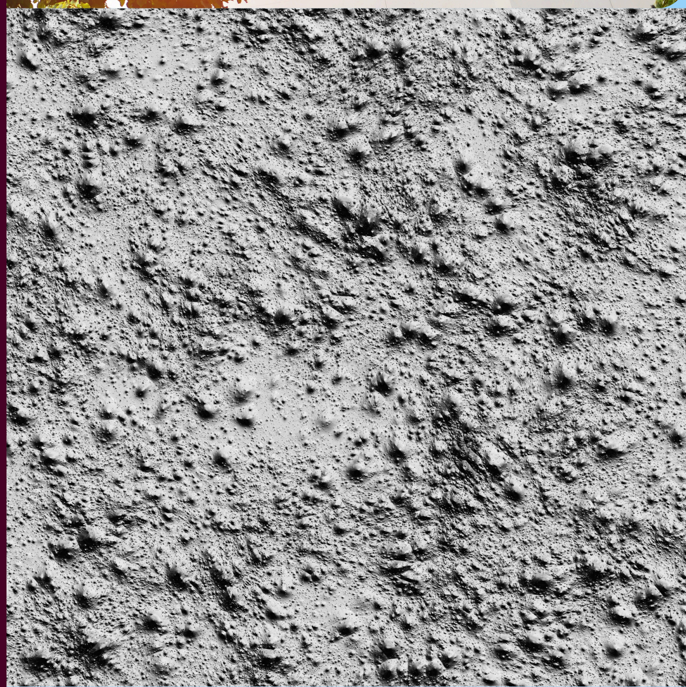
Environmental Product Declaration (EPD)

according to EN 15804


Representative Blast furnace cement (CEM III) produced in Europe

Cement Europe

Owner of the Declaration

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Declaration developed by

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This declaration is based on the European standard EN 15804:2012+A2:2019 and the PCR for cement and building lime, EN 16908:2017. In accordance with EN ISO 14025, it was verified by an external independent expert. The EPD owner has the sole ownership, liability, and responsibility for the EPD.
Independent verification of the declaration and data, according to EN ISO 14025: ☐ internal ☒ external
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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.

Product description

Cement

Cement is a hydraulic binder, i.e. a finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes and which, after hardening, retains its strength and stability even under water.

Use

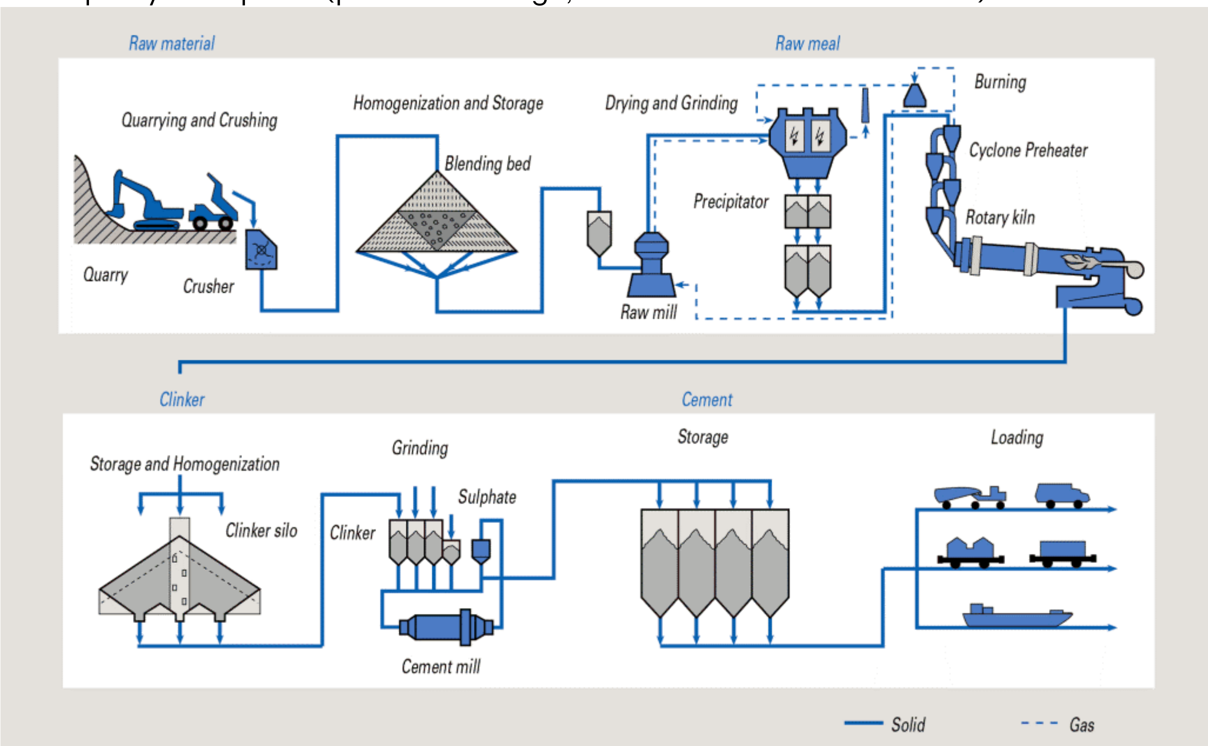
Cement is mainly used as a binder for concrete, mortar or cement screed.

Manufacturing process

The most important component of cement according to EN 197-1 and EN 197-5 is clinker. It is produced from raw materials such as limestone and clay 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 calcium, silicium, 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.

The following figure is a schematic representation of the cement manufacturing process from quarry to dispatch (production stage, information modules A1 to A3).



Main product components
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

Main constituents (EN 197-1, clause 5.2)	Portland cement clinker and e.g. limestone, blast furnace slag
Minor additional constituents (EN 197-1, clause 5.3)	added to improve the physical properties of the cement, such as workability or water retention
Calcium sulfate (gypsum/anhydrite/artificial gypsum) (EN 197-1, clause 5.4)	added to the other constituents of cement during its manufacture to control setting
Additives (EN 197-1, clause 5.5)	added to improve the manufacture or the properties of the cement. The total quantity of additives shall not exceed 1.0 % by mass of the cement (except for pigments).

In **Blast furnace cement (CEM III)** the total of main constituents and minor additional constituents is composed of 5 M.-% to 64 M.-% cement clinker, 36 M.-% to 95 M.-% blast furnace slag and 0 M.-% to 5 M.-% minor additional constituents.

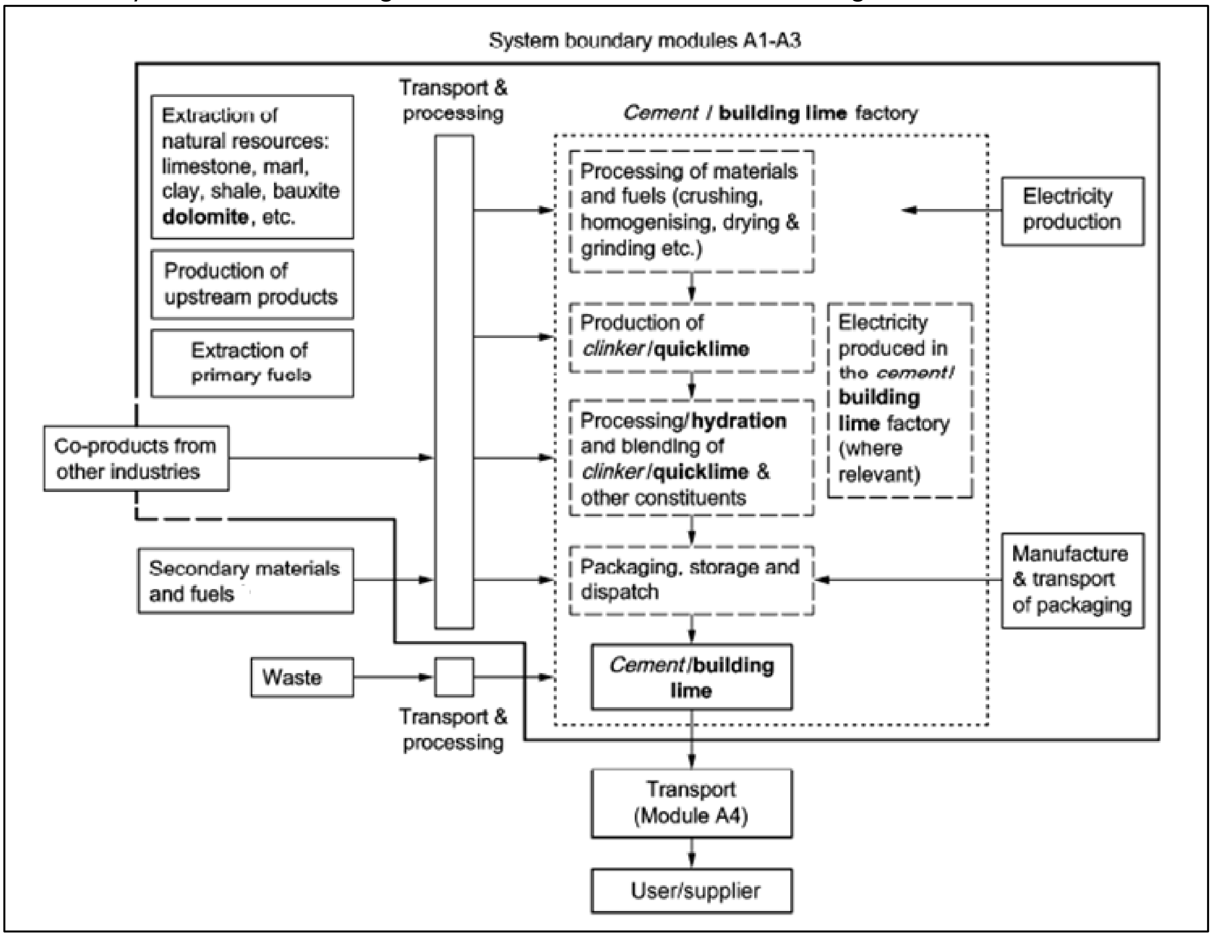
Based on the data provided by Cement Europe members in the context of the development of this EPD, the following representative CEM III composition was used in the LCA model:

Portland cement clinker	485 kg/t
Blast furnace slag	445 kg/t
Limestone	10 kg/t
Calcium sulfate	43 kg/t
Others (chromate reducing agents, filter dust)	17 kg/t
total	**1000 kg**

LCA Rules

Declared unit
The declared unit is 1 tonne of representative European Blast furnace cement (CEM III) according to EN 197-1 (bulk cement, not packed).

Life cycle stages/system boundaries
The EPD covers the product stage ("cradle to gate", A1-A3).
The selected system boundaries comprise the production of cement including raw material extraction up to the finished product at the factory gate. They are in accordance with the system boundaries given in EN 16908:2017+A1:2022, Figure 1:



The product stage contains:
Module A1: extraction and processing of raw materials and primary fuels
Module A2: transportation up to the factory gate and internal transports
Module A3: cement production

Background data
The inventory analysis is based on

- Information for the year 2022 from the "Getting the Numbers Right" database on https://workbench-eu.pwc.com/:
  - the "GNR2.0_global" report
  - the "GNR 2.0 Cement Europe" report.

  The independent third-party service provider PwC runs the database. This includes providing appropriate data quality checking procedures.

  - The "GNR2.0_global" report was mainly used as an information source for the fuel mix, the total fuel energy, the electricity use and the CO_2 emissions related to clinker production. The coverage for Cement Europe members for 2022 is indicated as 95%. As however the available data included Turkey, which is not a

Cement Europe member anymore, the data had to be corrected by Cement Europe to exclude the Turkish data. The information obtained by the "GNR2.0_global" report was weighted by the clinker production volume of the plants reporting.
- The "GNR 2.0 Cement Europe" report was used as an information source for the raw material mix and the stack emissions related to clinker production. For 2022, 191 installations (out of 215 total Cement Europe installations) reported their raw material data to PwC. This corresponds to a coverage of 89%. The information obtained by the "GNR2.0 Cement Europe" report was weighted by the clinker production volume of the plants reporting.

- Data mining carried out in 2025 among Cement Europe member countries (national aggregated LCI data for the cement production in the respective countries for a calendar year between 2020 and 2023), particularly for the cement composition, electricity use and transport distances. The cement production volume in the countries that provided data corresponds to 68 % of the total Cement Europe production volume (based on production volumes from 2022).

In a first step, a representative European cement clinker was modelled by using the information from the "Getting the Numbers Right" database, complemented by information from the data mining carried out in the context of this project.
In a second step, this representative cement clinker was used as a basis of the LCA of the CEM III cement. Weighted averages (weighted by the cement production volume in each contributing country) of the available European production data were calculated to be used as LCA input data.
It was assumed that the factors influencing the LCA results (i.e. technology, fuel mix, electricity mix and cement composition) for the production volume not covered by data mining were similar to those for the production volume covered.
The "LCA for Experts" Software (version 10.9.0.31) and database (Cup 2024.2) were used for the LCA in this project.

Cut-off rules
The rules of EN 15804 apply: The cut-off criteria are 1 % of renewable and non-renewable primary energy usage and 1 % of the total mass input of that unit process. The total of neglected input flows per module A1-A3 shall be a maximum of 5 % of energy usage and mass.
Apart from allocated impacts from the production of artificial gypsum (see below), no relevant processes were excluded from the LCA study.

Allocation rules
The rules of EN 15804 apply.
- In the case of blast furnace slag, a co-product of the steel industry used as a cement constituent, economic allocation was applied. The ratio of economic values between pig iron and BFS followed an assessment which formed the basis of the LCA in a published EPD for granulated blast furnace slag.
- In the case of fly ash, a co-product from electricity production used as a cement constituent, economic allocation was applied.
- For artificial gypsum, allocated impacts from the joint process are neglected in the cement LCA due to its very low impact.

Subsequent processes (e.g. granulation and grinding of blast furnace slag) were entirely allocated to the co-products.

LCA Results

SYSTEM BOUNDARIES (X = INCLUDED IN LCA; ND = NOT DECLARED)

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport	Construction installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction 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**
X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 tonne Cement CEM III		
		production
Parameter	**Unit**	**A1 - A3**
Global warming potential total (GWP total)	kg CO_2 eq.	449,8
Global warming potential fossil (GWP fossil)	kg CO_2 eq.	449,5 1)
Global warming potential biogenic (GWP biogenic)	kg CO_2 eq.	0,043 2)
Global warming potential land use and land use change (GWP luluc)	kg CO2 eq.	0,179
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq.	1,81E-07
Acidification potential, accumulated exceedance (AP)	mol H+ eq.	0,938
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg P eq.	1,60E-02
Eutrophication potential, fraction of nutrients reaching marine end compartment (EP-marine)	kg N eq.	0,286
Eutrophication potential, accumulated exceedance (EP-terrestrial)	mol N eq.	3,36
Formation potential of tropospheric ozone (POCP)	kg NMVOC eq.	0,84
Abiotic depletion potential for non-fossil resources (ADP-minerals and metals) *3)	kg Sb eq.	3,42E-05
Abiotic depletion potential for fossil resources (ADP-fossil fuels) *3)	MJ, net calorific value	2602,8
Water (user) deprivation potential, deprivation weighted water consumption *3)	m^3 world eq. deprived	17,4

*1) According to the polluter pays principle, the system that generates the waste is responsible for declaring the impacts of waste processing until the end of waste stage is reached. The indicated value (net value) therefore does not include the CO_2 -emissions from waste incineration. The gross value (including the emissions from the incineration of fossil waste) is 503,4 kg CO_2–eq.
*2) The indicated value (net value) does not include the CO_2 -emissions from waste incineration. The gross value (including the emissions from the incineration of biogenic waste) is 26,5 kg CO_2 -eq.
*3) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

PARAMETERS DESCRIBING RESOURCE USE: 1 tonne Cement CEM III		
		production
Parameter	**Unit**	**A1 – A3**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	203,3
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	0
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ, net calorific value	203,3
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	2602,8
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ, net calorific value	2602,8
Use of secondary material	kg	40,4
Use of renewable secondary fuels	MJ, net calorific value	317,5
Use of non-renewable secondary fuels	MJ, net calorific value	689,5
Net use of fresh water	m^3	0,553

OTHER ENVIRONMENTAL INFORMATION DESCRIBING WASTE CATEGORIES: 1 tonne CEM I		
		production
Parameter	**Unit**	**A1 – A3**
Hazardous waste disposed	kg	0,407
Non-hazardous waste disposed	kg	1,804
Radioactive waste disposed	kg	0,112

OTHER ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS: 1 tonne CEM I		
		production
Parameter	**Unit**	**A1 – A3**
Components for re-use	kg	0
Materials for recycling	kg	0
Materials for energy recovery	kg	0
Exported energy	kg	0

ADDITIONAL ENVIRONMENTAL INDICATORS:1 tonne CEM I		
		production
Parameter	**Unit**	**A1 – A3**
Potential incidence of disease due to particulate matter emissions	disease incidence	9,48E-06
Ionising radiation, potential human exposure efficiency relative to U235 [1)]	kBq U235 eq.	14,2
Eco-toxicity (freshwater) potential	Comparative toxic unit for ecosystems (CTUe)	ND
Human toxicity (cancer effects) potential	Comparative toxic unit for humans (CTUh)	ND
Human toxicity (non-cancer effects) potential	Comparative toxic unit for humans (CTUh)	ND
Land use related impacts/Soil quality potential	-	ND

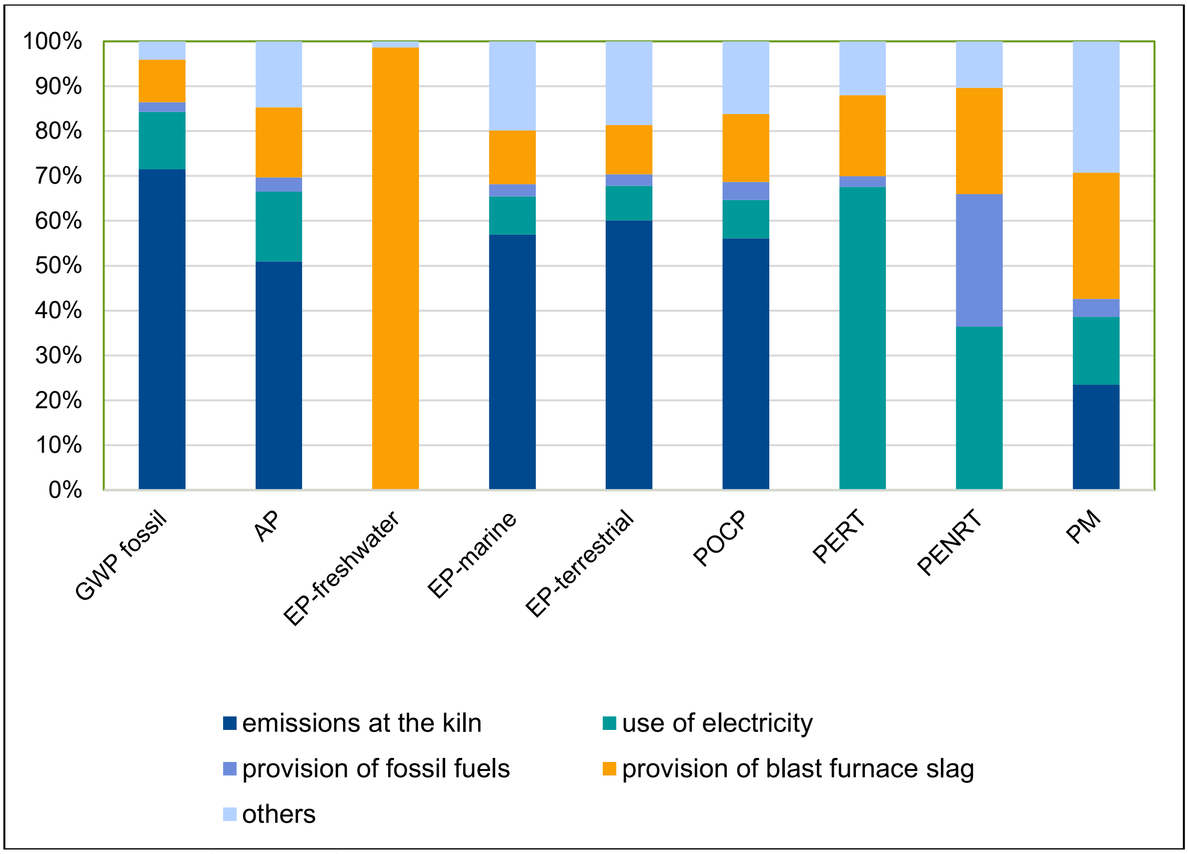
*1) This impact category deals mainly with the eventual impacts of low dose ionising radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionising radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

OTHER ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS: 1 tonne CEM I		
		production
Parameter	**Unit**	**A1 – A3**
Biogenic carbon content in product	kg C	0
Biogenic carbon content in accompanying packaging (from silo)	kg C	0

LCA Interpretation

Main influencing factors

The following diagram shows the most important factors that influence selected LCA indicators:



See the tables under 'LCA Results' for the abbreviations used for the indicators.

Variability of LCA indicators

For CEM III, EN 197-1 allows a share of Portland cement clinker in the range of 5 % to 64 % of the cement main constituents. For the GWP_{total}, considering the influence of clinker production on the declared representative LCIA value and an estimated variation of the
CO_2-emissions from clinker production, it is estimated that European CEM III cements according to EN 197-1 may show values from approximately - 75 % to + 30% of the representative values declared above. It is estimated that for the other impact indicators, the possible variation is in a similar order of magnitude (apart from Eutrophication potential freshwater, which is mainly influenced by the use of blast furnace slag).

For very detailed calculations requiring LCA data for specific cements, please refer to EPDs from Cement Europe members or individual cement companies.

Additional information

Chromate
Prolonged physical contact with non-low chromate cements can cause allergic skin reactions. The REACH Regulation (EC 1907/2006) imposes requirements on the chromate content permissible for cement products. In line with this, only low chromate cements may now be used for the manufacture of concrete and mortar if the possibility of physical contact with these concretes and mortars during processing cannot be ruled out. The permissible chromate content is less than 2 ppm, or 2 grams per tonne. Non-low chromate cements can now only be used by processors with a closed production system where skin contact is not possible.

Carbonation
During and after the lifetime of concrete structures or other cement-containing products, hydrated cement contained within the product reacts with CO_2 in the air. Part of the CO_2 emitted during cement production is reabsorbed by the cement through carbonation, a reaction also referred to as cement carbonation. The quantity of CO_2 taken up will depend on the type of application and also its treatment after its lifetime. This reaction takes place mainly on the surface of cement-based products. Structural concrete applications are designed according to strict codes which ensure that carbonation at the concrete surface does not lead to corrosion of reinforcement. Carbonation can nevertheless be particularly relevant after demolition when the surface in contact with air increases very significantly. Carbonation contributes to a reduced GWP impact of cement products over their whole life.

Since carbonation will depend on the application in question, please refer to the respective PCR/EPDs for ready-mix concrete, precast concrete, mortar, cement screed or other cement-based products.

Installation of cement
Information on the safe and effective installation of cement can be obtained from the cement supplier.

References

EN 197-1:2011: Cement - part 1: Composition, specifications and conformity criteria for common cements

EN 197-5:2021: Cement - Part 5: Portland-composite cement CEM II/C-M and Composite cement CEM VI

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+A1:2022: Cement and building lime - Environmental product declarations - Product Category Rules complementary to EN 15804

Arcelor Mittal – EPD Granulated Blast Furnace Slag – Institut Bauen und Umwelt e.V. (IBU), 11 April 2022

ECRA (European Cement Research Academy) – Background report "Environmental Product Declarations for representative European cements ", November 2025 (confidential, reviewed and approved by the third party verifier)