

CEM II/B-M (W-P-LL) 32,5 N CEM IV/A (P) 32,5 N - SR

EPD **Environmental Product Declaration**
for Portland Composite Cement
& Sulfate Resisting Pozzolanic Cement

PATRAS PLANT



Programme: The International EPD® System
Programme operator: EPD International AB
EPD registration number: S-P-04524
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in accordance with ISO14025 and 15804:2012+A2:2019



THE INTERNATIONAL EPD® SYSTEM





> GENERAL INFORMATION

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
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CEN standard EN 15804 serves as the Core Product Category Rules (PCR)

Product category rules (PCR):

PCR 2019:14 Construction products (EN 15804:A2); Version 1.11; 2021-02-05

c-PCR-001 Cement and Building Lime (EN 16908:2017) 2010-12-20

UN CPC: 3744

PCR review was conducted by: PCR review was conducted by the Technical Committee of the International EPD System.

Independent third-party verification of the declaration and data, according to ISO 14025:2006:

☐ EPD process certification ☒ EPD verification

Third party verifier: Eurocert S.A.

In case of accredited certification bodies:

Accredited by: E.SY.D.

In case of recognised individual verifiers:

Approved by: The International EPD® System

Procedure for follow-up of data during EPD validity involves third party verifier:

☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

> COMPANY INFORMATION

Owner of the EPD: Titan Cement Company S.A.

Contact: Panagiotis Papadeas, Environmental & Quality Director, Titan Greece, Cement Division

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Description of the organisation: Building materials manufacturer

Product-related or management system-related certifications: Product group classification: UN CPC 3744, The CEN standard EN 15804 serves as the core Product Category Rules, PCR 2019:14 Construction products (EN 15804:A2); Version 1.11; 2021-02-05 c-PCR-001 Cement and Building Lime (EN 16908:2017) 2010-12-20, PCR review was conducted by The Technical Committee of the International EPD® System and Independent third-party verification of the declaration and data in accordance with ISO 14025:2006.

Name and location of production site(s): Patras cement plant, Drepano Achaïas, Greece

> INTRODUCTION

Building on 119 years of industry experience and driven by its commitment to sustainable growth, TITAN Group has become an international cement and building materials producer, serving customers in more than 25 countries worldwide through a network of 14 integrated cement plants and three cement grinding plants. TITAN also operates quarries, ready-mix plants, terminals, and other production and distribution facilities. We create value by transforming raw materials into products – cement, concrete, aggregates, dry mortars and other building materials. We serve society's need for safe, durable, resilient, and affordable housing and infrastructure.

Climate change has mobilized organizations, in many sectors, towards a carbon-neutral future. In 2020, the Global Cement and Concrete Association (GCCA) announced its members' Climate ambition to drive down the CO₂ footprint of operations and products and deliver carbon-neutral concrete to society by 2050. Meanwhile, there is a growing need for enhanced transparency of environmental performance of building materials, such as greenhouse gas (GHG) emissions. Cement is the key ingredient in manufacturing concrete, the second most used commodity in the world and among the major contributors to the embodied GHG of buildings and infrastructure works.

TITAN is working across the built environment value chain to deliver a carbon-neutral future in a circular economy, life cycle context. Aiming for a 35% reduction of the net direct specific CO₂ emissions by 2030 (compared to 1990 levels), TITAN has defined a road map for developing low-carbon cementitious products and collaborating in carbon capture R&D projects at the cement plants. The publication of the cement Environmental Product Declaration (EPD) is an important milestone in the road map, helping to communicate to customers the environmental performance of TITAN Greece cements.

Cement and other building materials EPDs will help shape the way the construction industry analyses the environmental impact of buildings and infrastructure works, now and in the future. Our EPDs will also provide a rigorous, science-based framework for driving environmental improvement throughout TITAN's sites and supply chain, offering at the same time an advantage to customers wanting to be leaders in the sustainable infrastructure and building industry.



3 Cement Plants

1 Cement Grinding Facility

28 Ready-mix Plants

25 Quarries

1 Dry mortar plant

2 Processed engineered fuel facilities



> PRODUCT INFORMATION

Product name:

CEM II/B-M (W-P-LL) 32,5 N and CEM IV/A (P) 32,5 N - SR

Product identification: Compressive Strength 28 days (Mpa): 32,5 – 52,5

Product description: Cement is an important material used in building and civil engineering construction. It is a finely ground powder that, when mixed with water, forms a paste that sets, hardens, and adheres to other materials and after hardening retains its strength even underwater. It is used as the main raw material in the production of concrete, mortar, grouts and plasters.

This is an average product-specific EPD for cement types CEM II/B-M (W-P-LL) 32,5 N and CEM IV/A (P) 32,5 N - SR

which comply with the requirements of EN 197-1. These specific cement types are produced at the Patras plant, Achaia Greece of Titan Cement Company S.A.

These specific types of cement have wide range of applications and they are mainly utilized in construction works, ready-mixed concrete production and concrete products.

The products can be delivered in bulk and/or packaged via the following ways:

- Silo truck (bulk)
- Vessels (bulk or packaged)
- 1.5 tn big bags
- In Paper bags of 50 and 25kg



The technical characteristics and composition of the product are shown in the tables below. Product declarations and certificates can be found on the company's website www.titan.gr.

Technical characteristics according to EN 197-1		CEM II/B-M (W-P-LL) 32,5 N	CEM IV/A (P) 32,5 N - SR
Mechanical properties	Compressive Strength 7 days (Mpa)	≥ 16,0	≥ 16,0
	Compressive Strength 28 days (Mpa)	32,5 - 52,5	32,5 - 52,5
Chemical properties	Sulfate content (SO ₃ , % w/w)	≤ 3,5	≤ 3,0
	Chloride content (Cl, % w/w)	≤ 0,1	≤ 0,1
Physical properties	Initial setting time (min)	≥ 75,0	≥ 75,0
	Soudness (mm)	≤ 10,0	≤ 10,0

Composition % by mass*		
Clinker	65 - 79	65 - 79
Fly ash (W) - Limestone (L) - Pozzolana (P)	21 - 35	-
Pozzolana (P)	-	21-35
Minor additional constituents	0 - 5	0 - 5

*Gypsum is not included in the aforementioned composition

The LCIA results of the LCA represents the weighted average product. The deviation in the GWP-GHG indicators does not exceed 10% between the two cement types.

UN CPC code: 3744

> LCA INFORMATION

Functional unit / declared unit: The declared unit is one (1) tn (1.000 kg).

Reference service life: Not relevant due to the cradle-to-gate boundary conditions.

Time representativeness: The data used in this study cover the reporting year of 2020.

Database(s) and LCA software used: GCCA Industry EPD Tool for Cement and Concrete and Ecoinvent database (v.3.5).

Goal and scope: This EPD evaluates the environmental impacts of the production of one (1) tn CEM II/B-M (W-P-LL) 32,5 N and one (1) tn CEM IV/A (P) 32,5 N - SR from Cradle to gate (A1-A3).

Data quality: ISO 14044 was applied in terms of data collection and quality requirements. The data concerning the modules A1 (raw material supply), A2 (transportation) and A3 (product manufacturing) and were provided by Titan Cement Company S.A. and involved all input and output materials to the plant, the consumed utilities (energy, water) and the distances and means of transport for each input stream. Regarding electricity mix, the latest (2020) national residual electricity mix as published in DAPEEP SA, were utilized (<https://www.dapeep.gr/viosimi-anaptixi/energeiako-meigma/>). The background data for the module A1 e.g. electricity generation, raw materials and fuels production were recovered from GCCA Environmental Product Declaration tool (v3.0). GCCA's Industry EPD Tool for Cement and Concrete is a web-based

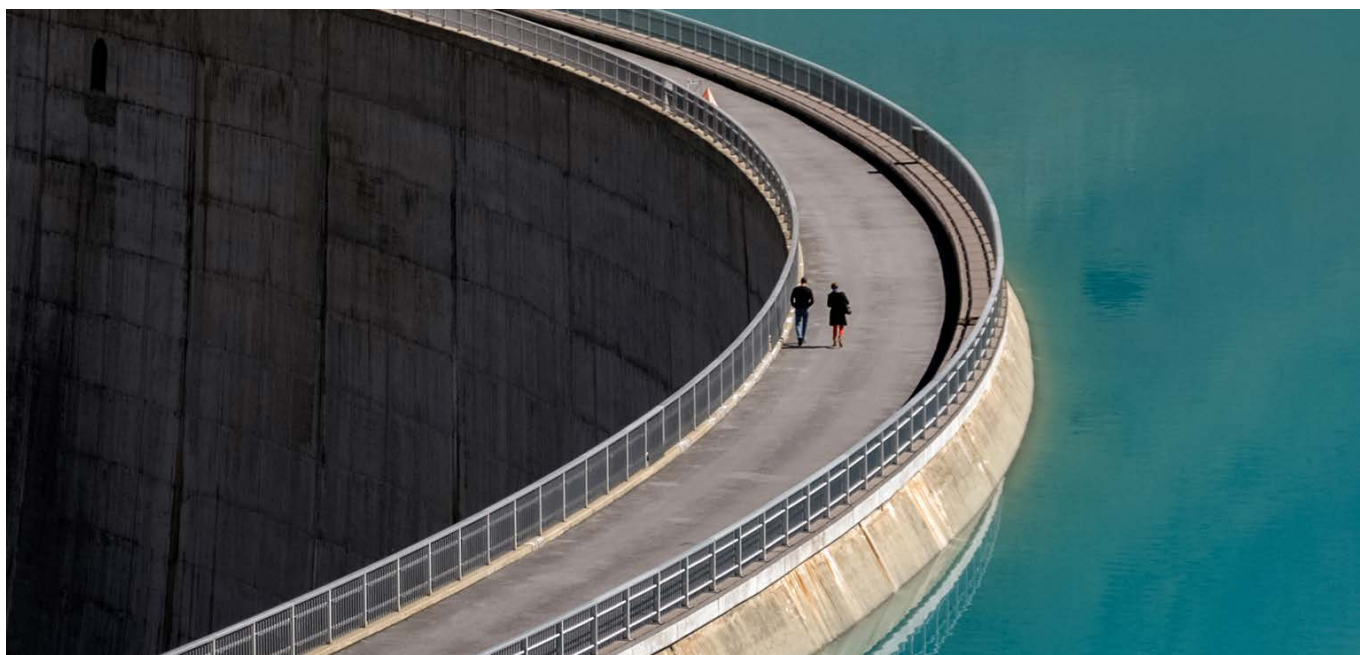
calculation tool for EPDs of clinker, cement, concrete and precast elements, available in both International and North American versions. The present report refers to the International version only.

The latter complies with the latest cement and concrete PCRs registered at the International EPD® System (Environdec), namely c-PCR-001 Cement and building limes (EN 16908) for cement and c-PCR003 Concrete and concrete elements (EN 16757) for concrete and precast elements, both registered as complementary PCRs of PCR 2019:14 Construction products (EN 15804+A2).

The GCCA EPD tool (v3.0) is developed by Quantis <https://quantis-intl.com/> and verified by Studio Fieschi <http://www.studiofieschi.it/en>. The International EPD® System, which provides the framework to develop and publish EPDs based on ISO 14025 and EN 15804, gives the final approval of the tool's compliance with the rules. The underpinning database for the GCCA EPD tool is the version of the Ecoinvent database (v.3.5) and cement manufacturing data obtained through the GNR process (<https://gccassociation.org/sustainability-innovation/gnr-gcca-in-numbers/>).

The database of Ecoinvent v.3.5 was used to complete any missing data. Generic data used in this study concerning:

- CO₂ emission factors for different transportation way
- CO₂ emission factors for fuels and raw materials
- Specific emission factor of used energy mix (kg CO₂/kWh)



There is no missing data for the case of Patras plant, since all the required raw data were provided by the technical staff of the plant, using all the available sources which are:

- i) The ERP system (SAP) that company uses
- ii) Flow meters for consumed and recycled water
- iii) Data, for emissions, which are continuously recorded, were obtained by the recording system that it is installed in each cement plant (MEAC). The emissions are: Dust, NO_x, SO₂, TOC, NH₃, HCl and HF. All the other emissions are spot measured by independent laboratory. The reports, which laboratory generates after the spot measurements, were utilized in order for average values to be calculated.

Geographical scope: Worldwide

Allocations: The allocation has been avoided where that was possible. Production was split into two sub-processes, clinker and cement, and the associated input and output data for each sub-process were recorded. When data could not be directly attributed to a specific product, they were assigned by physical properties (mass). No by-products occur during clinker and cement production; therefore, there is no need for allocations in by-products.

For water (consumed and recycled), wastes and emissions allocation, the “clinker to cement ratio” was used for allocating the volumes to clinker or cement respectively.

The study does not include the followings:

- Capital equipment production
- Equipment maintenance
- Human labour and employee transport

Assumptions: For the road and sea transportation a lorry 16-32 metric ton, EURO4 and bulk carrier for dry goods were used respectively. The cement recipe (materials percentage participation) was defined by the pre-verified and automated ERP system (SAP) that company uses.

For water (consumed and recycled), wastes and emissions allocation, the “clinker to cement ratio” was used for allocating the volumes to clinker or cement respectively.

For the cement types CEM II/B-M (W-P-LL) 32,5 N and CEM IV/A (P) 32,5 N - SR the packaging has been taken into account and the

results of the specific cement types include the amount of cement, which is packaged.

The used materials for cement packaging are:

- i) wooden pallets
- ii) paper bags
- iii) plastic film

By using the sales of bagged cement of 2020, the impact of packaging were incorporated into the final results. Sales of bagged cement were separated from bulk sales and the weighted average burden by packaging was calculated. Thus, the results of CEM II/B-M (W-P-LL) 32,5 N and CEM IV/A (P) 32,5 N - SR include both the part of bulk and bagged cement.

Cut-off rules: The cut-off rule for insufficient data or data gaps that are less than 1% of the total input mass or mass per module was applied. In case of insufficient input data or data gaps for a unit process, the cut-off criteria shall be 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 for the stages ‘cradle through gate’ shall be a maximum of 5% of energy usage and mass.” (EN 15804:2012+A2:2019). Regarding the LCA model, the default cut-off criteria are applied for all processes from the Ecoinvent database. In addition, all custom processes developed for the specific purposes of the project are consistent with the rules and guidelines of the Ecoinvent database, and hence the same cut-off criteria are applied.

Comparability: EPD performance for construction products that they do not comply with EN 15804 may not be comparable. EPDs from separate programs but within the same product category may not be comparable as well.

Description of system boundaries:

The scope of this study is “Gradle to gate” covering the product stage (modules A1-A3), since the product fulfils the three conditions required by EN 15804:2012+A2:2019, about the exclusion of modules C1-C4 and D.

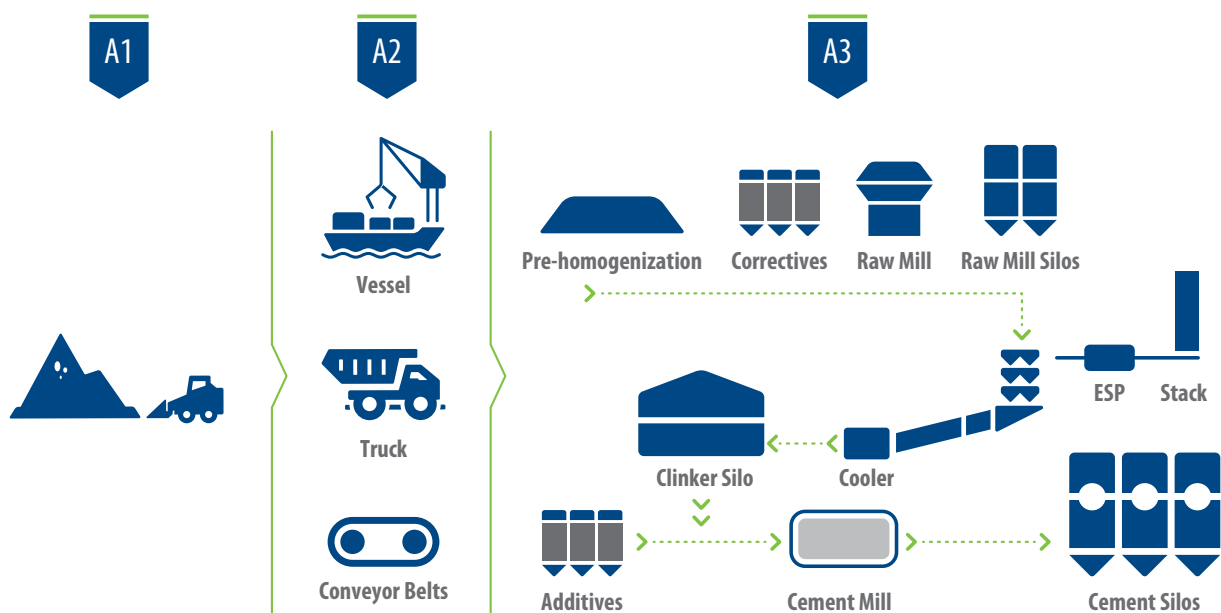
The EPD covers the product stage (“cradle to gate”, A1-A3), since the three criteria of EN 15804 are met for the exclusion of stages B1-B7, C1-C4 and D.

SYSTEM DIAGRAM

The scope of this study is “Gradle to gate” covering the product stage (modules A1-A3), since the product fulfills the three conditions required by EN 15804:2012+A2:2019, about the exclusion of modules C1-C4 and D.

Product Stage			Construction Stage		Use Stage							End-of-life Stage				Resource Recovery
Raw Materials Supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction and demolition	Transport	Waste processing for reuse, recovery and/or recycling	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

More information: X= included, MND = module not declared



> ENVIRONMENTAL INFORMATION

For construction services, the total value of A1-A3 shall be replaced with the total value of A1-A5.

Potential environmental impact – mandatory indicators according to EN 15804 Results per functional or declared unit

Indicator	Unit	Tot.A1-A3
GWP-total	kg CO ₂ eq.	7,00E+02
GWP-fossil	kg CO ₂ eq.	7,00E+02
GWP-biogenic	kg CO ₂ eq.	6,98E-02
GWP-luluc	kg CO ₂ eq.	6,58E-02
ODP	kg CFC 11 eq.	1,48E-05
AP	mol H ⁺ eq.	1,60E+00
EP-freshwater	kg PO ₄ ⁻³ eq.	1,82E-01
EP-freshwater ⁽¹⁾	kg P eq.	5,92E-02
EP-marine	kg N eq.	0,42E-02
EP-terrestrial	mol N eq.	5,67E+00
POCP	kg NMVOC eq.	1,45E+00
ADP-minerals&metals* ⁽²⁾	kg Sb eq.	1,54E-04
ADP-fossil* ⁽²⁾	MJ	2,47E+03
WDP ⁽²⁾	m ³	3,73E+01

Acronyms

GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption

1. Eutrophication aquatic freshwater shall be given in both kg PO₄⁻³ eq and kg P eq.
2. 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 experienced with the indicator.

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Use of resources

Results per functional or declared unit		
Indicator	Unit	Tot.A1-A3
PERE	MJ	2,14E+02
PERM	MJ	1,14E+02
PERT	MJ	3,28E+02
PENRE	MJ	2,73E+03
PENRM	MJ	6,21E+00
PENRT	MJ	2,74E+03
NFW	m ³	10,24E-01

Acronyms

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; NFW = Use of net fresh water

Extra indicators

Results per functional or declared unit		
Indicator	Unit	Tot.A1-A3
CC	kg CO ₂ eq.	3,57E+02
CWRS	kg CO ₂ eq.	0,00E+00
CWNRS	kg CO ₂ eq.	0,00E+00

Acronyms

CC = Emissions from calcination and removals from carbonation; CWRS = Emissions from combustion of waste from renewable sources used in production processes; CWNRS = Emissions from combustion of waste from non-renewable sources used in production processes

Information on biogenic carbon content

Results per functional or declared unit		
Biogenic carbon content	Unit	Tot.A1-A3
Biogenic carbon content in product	kg C	≤2,5
Biogenic carbon content in packaging	kg C	≤2,5

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO₂.

> ADDITIONAL INFORMATION

Titan Cement Company S.A. hereby declares that all cement products are in compliance with the REACH Regulation (EC) No 1907/2006, concerning the Registration, Evaluation, Authorization and Restriction of Chemicals. Cement does not contain any Substances of Very High Concern (SVHC) currently on the candidate list. REACH SVHC list is not static and is updated frequently, thus the company will continue to evaluate, research and review to fulfil the demands of the regulation. More information about cement safety handling is available at the Safety Data Sheet (SDS) published at the company's website www.titan.gr.

Differences versus previous versions

First EPD version – No previous versions

References

- **General Programme Instructions of the International EPD® System. Version 3.01**
- **GPI v.3.01:2019-09-18** General Programme Instructions of the International EPD® System
- **PCR 2019:14 v.1.11** Product Category rules | Construction products | The International EPD® System
- **EN 15804:2012+A2:2019** Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products
- **EN 197-1:2011** Cement - Part 1: Composition, specifications and conformity criteria for common cements
- **CPC 374, c-PCR-001** Cement and building lime (EN 16908:2017) | The International EPD® System
- **EN 16908:2017** Cement and building lime - Environmental product declarations - Product category rules complementary to EN 15804
- **ISO 14020:2000** Environmental labels and declarations - General principles
- **ISO 14025:2006** Environmental labels and declarations - Type III environmental declarations - Principles and procedures
- **ISO 14040:2006** Environmental management - Life Cycle Assessment - Principles and framework
- **ISO 14044:2006** Environmental management - Life Cycle Assessment - Requirements and guidelines
- **Industry EPD Tool for Cement and Concrete** (<https://concrete-epd-tool.org/>)
 - User Guide (v3.0, International version, 25 November 2020)
 - LCA Model (v3.0, International version, 25 November 2020)
 - LCA Database (v3.0, 1 April 2021)
- **DAPEEP SA:** Renewable Energy Sources Operator & Guarantees of Origin | Greece | www.dapeep.gr

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