Santa Helena manufacturing site

EPD

Environmental Product Declaration for Cement CP II E 40

VOTORANTIM cimentos

EPD®

BRASIL EPD®

ECO PLATFORM EPD VERIFIED

Programme: The International EPD® System
Programme operator: EPD International AB
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In accordance with ISO 14025 and EN 15804:2022+A2:2019

Programme Information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

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

PCR 2019:14 c-PCR-001 Cement and Building Lime (EN 16908); Version 2022-05-18

UN CPC 375

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: Maurizio Fieschi, fieschi@studiofieschi.it, www.studiofieschi.it

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: Votorantim Cimentos S.A, Gomes de Carvalho Street - 11ºfloor - 12º floor - 04547-006 – São Paulo, SP, Brazil.

Contact: Fabio Cirilo, Sustainability Manager, Votorantim Cimentos Brazil, T: +55 11 4572-4000, E: fabio.cirilo@vcimentos.com

Description of the organisation: Building materials manufacturer

Diferences versus Previous Versions

Diferences versus Previous Versions: the previous version included 3 datasets (CP II E 40, CP III 40 RS and CP V ARI) and now it contains only CP-II E 40.

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Votorantim Cimentos is an international building materials and sustainable solutions company, in operation since 1933. The company is part of the Votorantim Group and is present in 11 countries through the South America, North America, Europe, Middle East and Africa.

Votorantim Cimentos is one of the most vertically integrated companies in the industry, with a diverse portfolio that includes cement, concrete, aggregates, mortars, grouts, finishing products, plasticizers, aglime and waste management (co-processing).

Sustainability is part of Votorantim Cimentos strategy, and the company has a long history in this constant pursuit of more advanced technologies to reduce the environmental footprint, improve energy efficiency, ensure the health, safety and well being and promote social and environmental development of the communities around its operation.

VOTORANTIM CIMENTOS HAS 32 CEMENT PLANTS AND 16 GRINDING PLANTS WORLDWIDE.

Product Information

Product name:

CPII E 40, Todas as obras – Santa Helena

Product identification:

CPII E 40

Product description:

- CP II – Compound Portland Cement
- E – Addition of Slag material
- 40 – Minimum compressive strength value (in MPa) after 28 days of curing

The CPII E 40 is developed for concrete producers, industries and prefabricated in general. It is suitable for high performance concrete, with early and final high strength, combined with the properties conferred by the addition of blast-furnace slag. Also used in conventional concrete, in prestressed parts, floors and interlocking prefabricated in general. It is sold in bulk only.

Product application:

It can be integrated in the following products.

- Reinforced concrete with structural function
- Reinforced concrete for quick de-forms, cured with thermal curing
- Reinforced concrete for quick de-forms, cured by chemical product
- Lean concrete (for tours and fillers)
- Prestressed concrete with prestressing bars after concrete hardening
- Prestressed concrete with prestressing bars before the release of concrete
- Unreinforced concrete
- Floor of unreinforced or reinforced concrete
- Precast concrete and cement artifacts cured by water sprinklers

Technical characteristics		ABNT NBR 16697	CPII E 40
Mechanical properties	Compressive Strength – 3 days (Mpa)	≥ 15.0	34.6
	Compressive Strength – 7 days (Mpa)	≥ 25.0	41.9
	Compressive Strength – 28 days (Mpa)	≥ 40	53.2
Chemical Properties	Sulfate Content (%)	≤ 4.5	3.47
	Loss of ignition (%)	≤ 8.5	2.75
	Insoluble residue (%)	≤ 5.0	0.99
Physical Properties	Initial setting (min)	≥ 60	169
	Final setting (min)	≤ 600	246
	Specific Surface #200 (%)	≤ 10.0	0.04

Upstream processes: raw material acquisition and refinement

The cement manufacturing process begins with the mining of limestone, the main raw material for cement. The material is extracted from mines and transported to the pre-blending yard.

Core process: Cement Production

1 **Pre-homogenization** - The extracted material from the mines is stored in the pre-blending yard. In this phase, samples are collected for analysis in the quality lab. The limestone chemical composition is drawn (content of calcium, silicon, iron and aluminum).

2 **Flour milling** - In the flour mill, the limestone is ground with clay and specific additives (such as ferrous and aluminic ores or substitutes co- processed materials). The clay is a product that is rich in silica, iron and aluminum, which are essential for the quality of cement. The final product is composed of very fine grains, hence the name flour. A filter installed in the mill prevents dust emissions to the atmosphere. The flour is stored in special silos to be sent to the rotary kiln.

3 **Clinker production**- Before being inserted in the rotary kiln, the flour passes through the cyclone tower to be heated by the hot gases originated by the kiln lying below. When the flour arrives at the rotary kiln, it is already around 900ºC, this helps in reducing energy consumption. Inside the kiln, temperature reaches 1450ºC producing the clinker.

4 **Cooling** - To complete the clinker production process, the material is cooled in a cooler and the temperature reduced to less than 200ºC. A filter is installed in the machine's output, releasing the cooling air without pollutants into the atmosphere. A new sample collection is performed for chemical testing in the Quality Control Laboratory. The clinker is transported to the hoppers, where others raw materials that make up the cement are stored, such as: gypsum, limestone and pozzolan or slag. Depending on the percentage of each product, obtains a cement specification

5 **Cement milling** - The mixture goes to the cement mill where all the components are milled until they reach the ideal particle size, resulting in high-quality cement.

6 **Cement shipment** - After its grinding, the cement is stored in silos to be bagged and marketed.

Functional unit / declared unit: The declared unit is one (1) metric tonne (t) of cement.

Reference service life: not specified.

Time representativeness: The data used in this study cover from January 2021 to December 2021.

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

System boundaries: This EPD evaluates the environmental impacts of one metric tonne of cement from Cradle to gate (A1-A3).

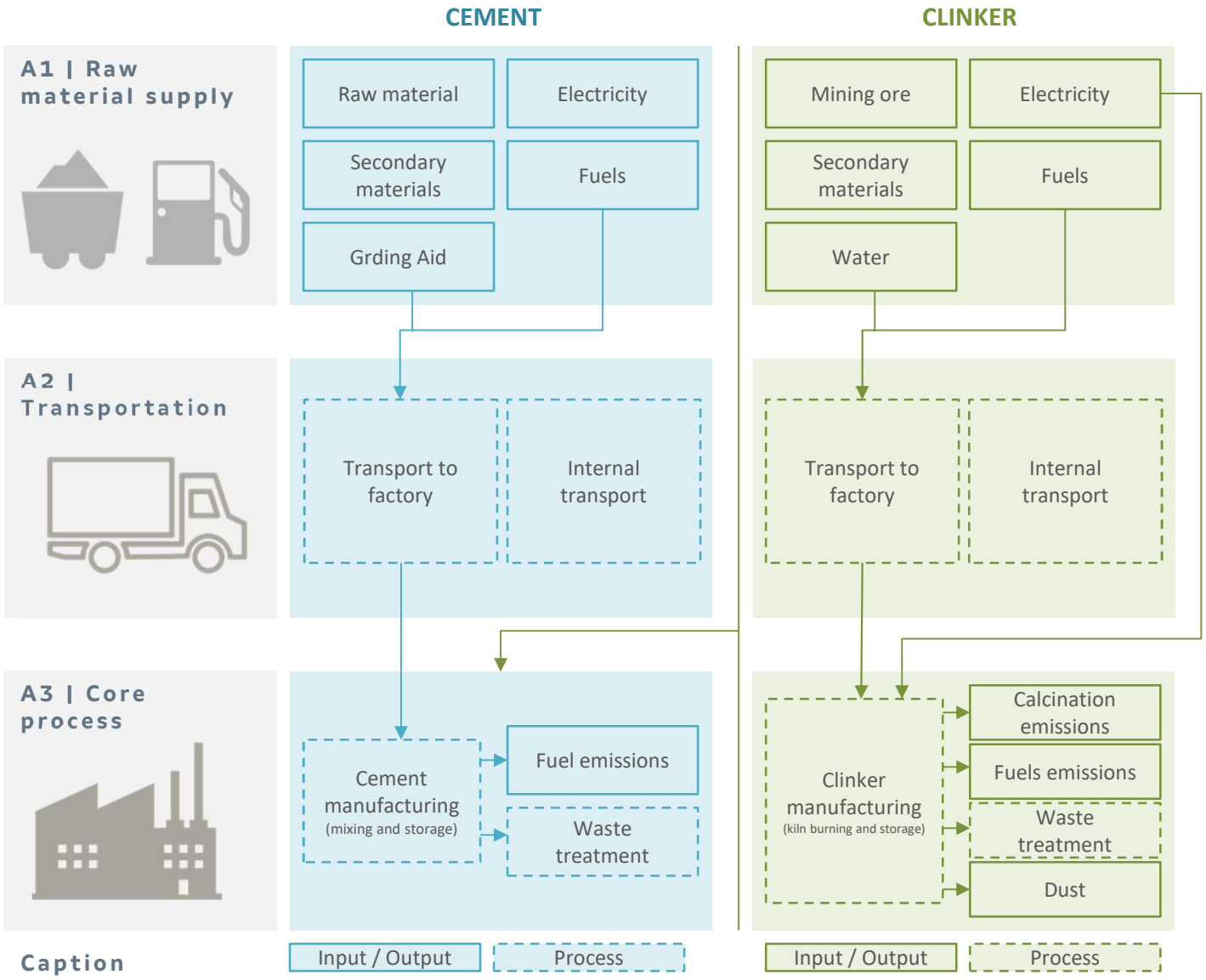
The defined system is split in three categories:

A1 | Raw Material Supply: Includes the production of raw materials and fuels, recycling processes of secondary materials and energy required in the production process.

A2 | Transportation: Transportation up to factory gate and internal transport

A3 | Core process: Cement and packaging manufacturing and waste treatment and transport

The figure below shows the system boundaries in a cradle to grave approach.



	Product stage			Construction process stage		Use stage								End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND
Geography	BRA	BRA	BRA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	Not relevant					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	Not relevant					-	-	-	-	-	-	-	-	-	-	-	-

*X = Module Declared; MND = Module Not Declared; BRA = Brazil

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) were provided by Votorantim Cimentos S.A. and involved all input and output materials of the cement plant, the consumed utilities (energy) and the distances and means of transport for each input stream. Regarding electricity mix, it was used the national electricity mix supply of 2020 as published in the Brazilian Energy Balance 2021 (BEN2021) from Empresa de Pesquisa Energética (EPE) (https://www.epe.gov.br/pt/abcdenergia/matriz-energetica-e-eletrica).

The GCCA Environmental Product Declaration tool (v3.1). GCCA's Industry EPD Tool for Cement and Concrete is a web based calculation tool for EPDs of clinker, cement, concrete, mortars and precast elements, available in both International and North American versions. The present report refers to the International version only.

The latter complies with PCR 2019:14 Construction products (EN 15804:A2) and complementary PCRs c-PCR-001 Cement and building limes (EN 16908) as well as with the General Programme Instructions (GPI 3.01) of the International EPD® System.

LCA Information

The GCCA EPD tool (v3.1) 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/gnrgcca-in-numbers/).

There is no missing data for this cement product, since all the required raw data were provided from the ERP system (SAP) that company uses.

Geographical scope: São Paulo Metropolitan Region (Brazil)

Assumptions: This EPD was developed by using GCCA international modelling of energy use and environmental impact to obtain a suitable estimation for products manufactured.

Pre-defined data from GCCA tool for clinker was not used. For this EDP was used clinker data from Votorantim Cimentos' cement plant called Santa Helena.

All modelling assumptions adopted from the GCCA EPD tool.

Raw material (inbound) transport distances are generated from ERP data and are accurate across operations.

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.

Portland cement (CAS 65997-15-1) is consisting essentially of portland clinker finely ground and plaster. The clinker can also be mixed with others raw materials allowing the production of many types of cement Portland, such as Common Portland Cement; Compound Portland Cement; Blast Furnace Portland Cement; Pozzolanic Portland Cement and others. It may have the following composition as the mixture that is prepared:

	CAS NUMBER	CONCENTRATION RANGE
Tricalcium silicate	12168-85-3	20 - 70
Dicalcium silicate	10034-77-2	10 - 60
Calcium aluminate-iron	12068-35-8	5 - 15
Calcium sulphate	various	2 - 10
Tricalcium aluminate	12042-78-3	1 - 15
Calcium carbonate	1317-65-3	0 - 5
Magnesium oxide	1309-48-4	0 - 4
Calcium oxide	1305-78-8	0 - 0,2

For CPII E 40, the products components are:

Product components	Range (%)
Clinker	72 ~ 76
Limestone	5 ~ 8
Slag	12 ~ 16
Gypsum	5 ~ 8
Grinding aids	0.07 ~ 0.09

Substance, Reach – Very High Concern: The products does not contain any SVHS – Substances of Very High Concern, listed by European Chemicals Agency.

The following tables contain the environmental indicators for the Santa Helena plant, located in the city of Votorantim in the state of São Paulo, Brazil.

Core Enviromental Impact Indicators	Unit	A1-A3
GWP-tot	kg CO_2 eq.	7.16E+2
GWP-fos	kg CO_2 eq.	7.15E+2
GWP-bio	kg CO_2 eq.	1.60E-1
GWP-luc	kg CO_2 eq.	3.0E-1
ODP	kg CFC 11 eq.	1.58E-5
AP	mol H+ eq.	3.04E+0
EP-fw	kg PO_4 eq.	4.87E-2
EP-fw	kg P eq.	1.59E-2
EP-mar	kg N eq.	1.28E-3
EP-ter	mol N eq.	1.09E+1
POCP	kg NMVOC eq.	2.57E+0
ADPE*	kg Sb eq.	1.54E-4
ADPF*	MJ, net calorific value	1.34E+3
WDP*	m^3 world eq. deprived	3.91E+1

GWP-tot (Global Warming Potential total) • GWP-fos (Global Warming Potential fossil fuels) • GWP-bio (Global Warming Potential biogenic) • GWP-luc (Global Warming Potential land use and land use change) • ODP (Depletion potential of the stratospheric ozone layer) • AP (Acidification potential, Accumulated Exceedance) • EP-fw (Eutrophication potential, fraction of nutrients reaching freshwater end compartment) • EP-fw* (Eutrophication potential, fraction of nutrients reaching freshwater end compartment*) • EP-mar (Eutrophication potential, fraction of nutrients reaching marine end compartment) • EP-ter (Eutrophication potential, Accumulated Exceedance) • POCP (Formation potential of tropospheric ozone) • ADPE (Abiotic depletion potential for non- fossil resources) • ADPF (Abiotic depletion for fossil resources potential) • WDP (Water (user) deprivation potential, deprivationweighted water consumption)

*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.

Potential environmental impact – additional mandatory	Unit	A1-A3
GWP-GHG	kg CO_2 eq.	7.16E+2

The GWP-GHG indicator is not calculated by GCCA EPD Tool. The GWP-GHG indicator can be assimilated to the GWP-tot indicator

Parameters describing resource use	Unit	A1-A3
PERE	MJ, net calorific value	7.29E+2
PERM	MJ, net calorific value	0E+0
PERT	MJ, net calorific value	7.29E+2
PENRE	MJ, net calorific value	1.50E+3
PENRM	MJ, net calorific value	0E+0
PENRT	MJ, net calorific value	1.50E+3
SM	kg	1.45E+2
RSF	MJ, net calorific value	0E+0
NRSF	MJ, net calorific value	0E+0
NFW	m^3	9.83E-1

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 resources) • SM (Use of secondary materials) • RSF (Use of renewable secondary fuels) • NRSF (Use of non-renewable secondary fuels) • NFW (Net use of fresh water)

Other environmental information describing waste categories	Unit	A1-A3
HWD	kg	2.21E-2
NHWD	kg	0E+0
RWD	kg	ND

HWD (Hazardous waste disposed) • NHWD (Non-hazardous waste disposed) • RWD (Radioactive waste disposed)

Environmental information describing output flows	Unit	A1-A3
CRU	kg	0E+0
MFR	kg	6.50E+0
MER	kg	5.44E-2
EE	MJ per energy carrier	0E+0

CRU (Components for re-use) • MFR (Materials for recycling) • MER (Materials for energy recovery) • EE (Exported energy)

EPD OWNER:	**Fábio Cirilo** **fabio.cirilo@vcimentos.com** +55 4572-4000 1996, Gomes de Carvalho Street- 11º floor-12º floor - 04547-006 São Paulo SP - Brazil www.votorantimcimentos.com
PROGRAMME OPERATOR:	EPD International AB info@environdec.com EPD International AB: Box 210 60 SE-100 31 Stockholm, Sweden EPD registered through the fully aligned regional hub: Fundação Vanzolini www.epdbrasil.com.br EPD Brasil: 255, Camburiú street, Alto da Lapa 05058-020, São Paulo, SP, Brazil info@epdbrasil.com.br

International EPD® System, General Program Instructions for the International EPD System, version 3.01

International EPD® System, PCR 2019:14 Construction products, version 1.11 (EN 15804:A2)

International EPD® System, c-PCR-001 Cement and Building Lime (EN 16908)

International EPD® System, General Programme Instructions EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

GCCA's Industry EPD Tool for Cement and Concrete (V3.1), International version

Votorantim Cimentos Integrated Report 2021. Published in March 2021. São Paulo.

ABNT NBR 16697- Cimento Portland

Brazilian Energy Balance 2021 – base year 2020 – Ministry of Mines and Energy, Brazil