EPD – Environmental Product Declaration

TODAS AS OBRAS AND OBRAS ESTRUTURAIS BY VOTORANTIM CIMENTOS

Registration number: S-P-01123
Published on 02-12-2019, valid until 02-12-2024

CEMENT

CEMENTS Todas as Obras and Obras Estruturais

1. COMPANY

Votorantim Cimentos is the market leader in cement in Brazil and the sixth largest global producer in terms of installed capacity, according to the Global Cement Report 2013 data. The company is part of the Votorantim Group and is present in 11 countries through the South America, North America, Europe, Asia and Africa. It is a large industry that produces cement, concrete, aggregates and complementary products such as mortar and lime.

Sustainability is an important pillar of Votorantim Cimentos strategy, Safety comes first, always.
The company promotes eco-efficiency by seeking to develop new products and innovative processes and ensure the open dialogue and relationships with our communities to perpetuate Votorantim Cimentos' legacy and support local development.

2. PRODUCT

This EPD covers 2 cements: Todas as Obras and Obras Estruturais.
Todas as Obras Cement from Salto (SLT) unit is resistant and versatile, developed by Votorantim Cimentos to ensure safety in various types of works. It can be used for plastering, conventional concrete, ground floor and slabs. Fast setting cement with high strength. Very versatile, it can be used from foundation to finishing on site. At Salto Cement unit this category can meet the standards CP II F 32, CP II Z 32 and it is sold in 50kg bags.

Specifications:

- CP II - Compound Portland Cement (pure cement + addition of other material).
- F - Addition of lime filler.
- Z - Addition of pozzolanic material.
- 32 - Minimum compressive strength value (in MPa) after 28 days of curing.

It can be integrated in the following products:

- Coating and bricklaying Mortar
- Mortars and Concrete
- Reinforced concrete with structural function
- Lean concrete (for tours and fillers)
- Unreinforced concrete
- Concrete-mass
- Soil-cement
- Floor of unreinforced or reinforced concrete
- Precast concrete and cement artifacts cured by water sprinklers

Obras Estruturais from Salto (SLT) unit is a high early strength cement, designed for deliver 20% more strength 3 times faster than conventional cement it is used in high performance concrete, ideal product

for the construction of pillars, foundations, beams and slabs. At Salto Cement unit this category can meet the standards CP II F 40, CP II Z 40 and it is sold in 50kg bags.

Specifications:

- CP II – Compound Portland Cement with high early strength.
- F - Addition of lime filler.
- Z - Addition of pozzolanic material.
- 40 - Minimum compressive strength value (in MPa) after 28 days of curing.

It can be integrated in the following products:

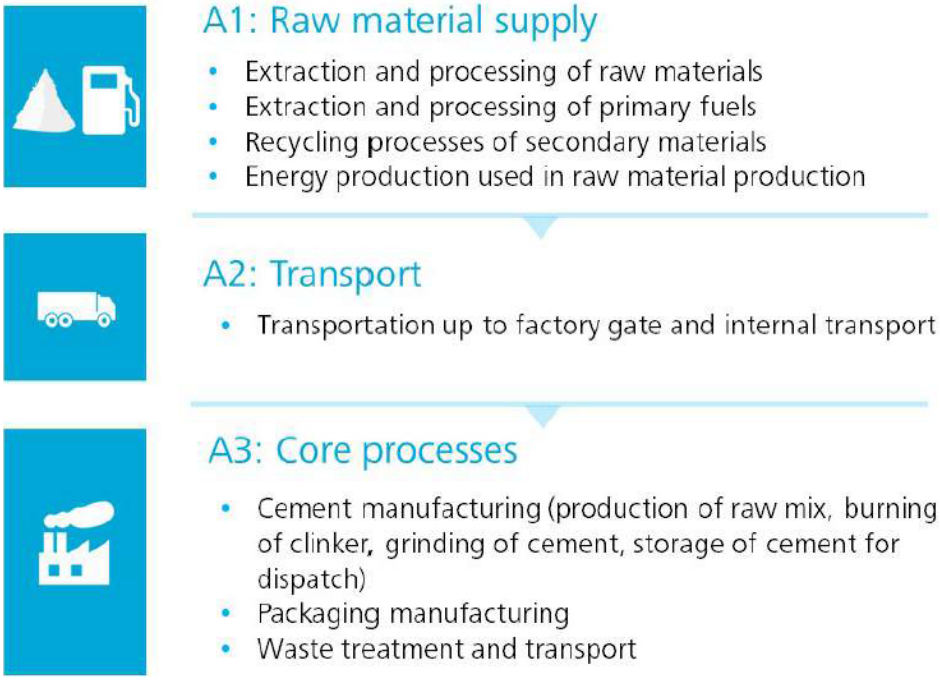
- Reinforced concrete with structural function

2.1. FUNCTIONAL UNIT AND STUDIED SYSTEM

The life cycle assessment is based on the GCCA Tool for EPD of concrete and cement (v2.0), dated 13/09/2019 (thereafter referred to as "the tool"), verified as compliant in accordance with the PCRs (PCR 2012:01 Construction products and Construction services v.2.3, PCR 2012:01-SUB-PCR-G concrete and concrete elements (EN 16757:2017), PCR 2012:01-SUB-PCR-H cement and building lime (EN 16908:2017) and the General Programme Instructions (GPI 2.5) for the International EPD® System. This tool may be accessed at the following address: https://concrete-epd-tool.org/.
CEN standard EN 15804 serves as the Core Product Category Rules (PCR).

The functional unit is 1 metric tonne of cement, defined in accordance with the tool. The Reference Service Life (RSL) is not specified.

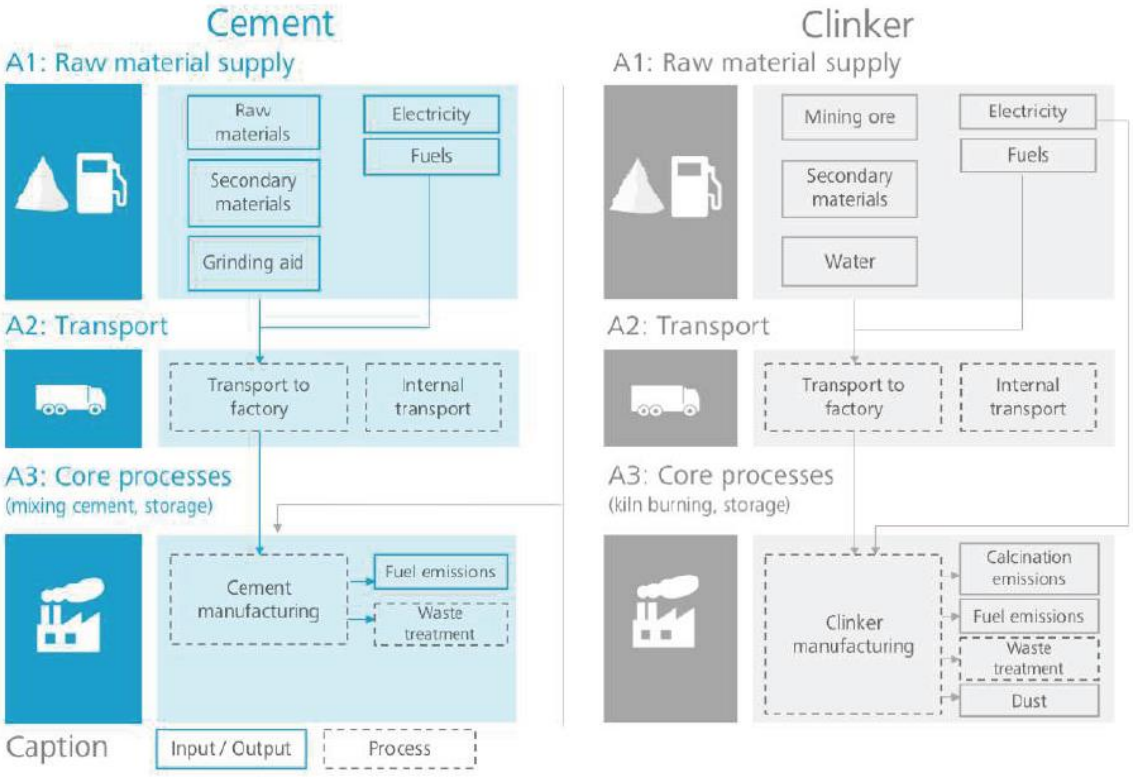
The following figure shows the studied system, split between 3 categories: A1 raw material supply, A2 transport and A3 core processes.



2.2. LIFE CYCLE STAGES

SYSTEM BONDARIES

The system boundaries are presented in the following figure and represent a cradle-to-gate approach.



FLOW DIAGRAM

Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
Raw materials	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
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

*MND – Module Not Declared

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

Pre-homogenization 1

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).

Flour milling 2

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.

Clinker production 3

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.

Cooling 4

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.

Cement milling 5

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.

Cement shipment 6

After its grinding, the cement is stored in silos to be bagged and marketed.

2.3. DATA COLLECTION

All the data related with clinker and cement production are direct data from Votorantim Cimentos operation, extracted from SAP software and aggregated to determine the inputs and outputs used for the EPD calculation.

3. CONTENT DECLARATION

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. The products does not contain any SVHC - Substances of Very High Concern, listed by European Chemicals Agency.
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

4. ENVIRONMENTAL PERFORMANCE-RELATED INFORMATION

The environmental performance-related information is representative of cement production in 2018 calculated with the GCCA Tool for concrete and cement EPDs. Additional information on the impact calculation are available in the tool documentation (GCCA 2015).
In agreement with the PCR, the environmental impact indicators are calculated using characterization factors from the latest CML baseline indicators from the Institute of Environmental Sciences, Faculty of Science, University of Leiden, Netherlands (CML 2001 v4.21).

4.1. USE OF RESOURCES

	TODAS AS OBRAS	UNIT
RESOURCE USE	TOTAL (A1-A3)	
Renewable primary energy used as energy resource	576	MJ
Renewable primary energy used as raw materials	0.00	MJ
Total renewable primary energy	576	MJ
Non-renewable primary energy used as energy resource	1,490	MJ
Non-renewable primary energy used as raw materials	0.00	MJ
Total non-renewable primary energy	1,490	MJ
Secondary material	125	kg
Renewable secondary fuels	90.3	MJ
Non-renewable secondary fuels	238	MJ
Net fresh water	4.71	m^3

	OBRAS ESTRUTURAIS	UNIT
RESOURCE USE	TOTAL (A1-A3)	
Renewable primary energy used as energy resource	716	MJ
Renewable primary energy used as raw materials	0.00	MJ
Total renewable primary energy	716	MJ
Non-renewable primary energy used as energy resource	1,666	MJ
Non-renewable primary energy used as raw materials	0.00	MJ
Total non-renewable primary energy	1,666	MJ
Secondary material	70.0	kg
Renewable secondary fuels	106	MJ
Non-renewable secondary fuels	280	MJ
Net fresh water	5.34	m^3

4.2. POTENTIAL ENVIRONMENTAL IMPACTS

	TODAS AS OBRAS	UNIT
ENVIRONMENTAL IMPACTS	TOTAL (A1-A3)	
Global warming potential, GWP (100 years)	682	kg CO2-eq.
Depletion potential of the stratospheric ozone layer, ODP	1.64E-05	kg CFC 11-eq.
Acidification potential of soil and water, AP	1.3	kg SO2-eq.
Eutrophication potential, EP	0.32	kg PO43--eq.
Formation potential of tropospheric ozone, POCP	0.06	kg C2H4-eq
Abiotic depletion potential for non-fossil resources, ADP-elements	3.10E-04	kg Sb-eq.
Abiotic depletion potential for fossil resources, ADP-fossil fuels	1,417	MJ

	OBRAS ESTRUTURAIS	UNIT
ENVIRONMENTAL IMPACTS	TOTAL (A1-A3)	
Global warming potential, GWP (100 years)	797	kg CO2-eq.
Depletion potential of the stratospheric ozone layer, ODP	1.88E-05	kg CFC 11-eq.
Acidification potential of soil and water, AP	1.5	kg SO2-eq.
Eutrophication potential, EP	0.37	kg PO43--eq.
Formation potential of tropospheric ozone, POCP	0.06	kg C2H4-eq
Abiotic depletion potential for non-fossil resources, ADP-elements	3.32E-04	kg Sb-eq.
Abiotic depletion potential for fossil resources, ADP-fossil fuels	1,583	MJ

4.3. WASTE PRODUCTION

	TODAS AS OBRAS	UNIT
WASTES*	TOTAL (A1-A3)	
Hazardous waste disposed	0.005	kg
Non-hazardous waste disposed	3.55	kg
Radioactive waste disposed	0.00	kg

	OBRAS ESTRUTURAIS	UNIT
WASTES*	TOTAL (A1-A3)	
Hazardous waste disposed	0.006	kg
Non-hazardous waste disposed	4.17	kg
Radioactive waste disposed	0.00	kg

*The contribution of activities situated upstream of the clinker manufacturing are not included in the results.

4.4. OTHER ENVIRONMENTAL INDICATORS

	TODAS AS OBRAS	UNIT
OUTPUT FLOWS	TOTAL (A1-A3)	
Components for re-use	0.00	kg
Materials for recycling	1.46	kg
Materials for energy recovery	0.00	kg
Exported energy	0.00	MJ

OUTPUT FLOWS	OBRAS ESTRUTURAIS TOTAL (A1-A3)	UNIT
Components for re-use	0.00	kg
Materials for recycling	1.72	kg
Materials for energy recovery	0.00	kg
Exported energy	0.00	MJ

5. ADDITIONAL INFORMATION

The production of Portland Cement is in line with Votorantim Cimentos vision, which includes Customer Focus, Empowered People, Best in Class Operations and Sustainable Practices. We believe that cement production must use clean technologies that constantly improve natural resource allocation, reduce emissions and waste. The company invests in R&D to develop new technologies and improve existing ones to promote eco-efficiency in its processes and products. Moreover, we are committed to protecting water sources and biodiversity, through the management of protected areas in the boundaries of our units.

6. PROGRAMME-RELATED INFORMATION

PROGRAMME:	THE INTERNATIONAL EPD® SYSTEM EPD INTERNATIONAL AB BOX 210 60 SE-100 31 STOCKHOLM SWEDEN WWW.ENVIRONDEC.COM
EPD registration number:	S-P-00123
Published:	02-12-2019
Valid until:	02-12-2024
Product Category Rules:	PCR 2012:01-SUB-PCR-H cement and building lime (EN 16908:2017)
Product group classification:	UN CPC 3744 CEMENT
Reference year for data:	2018
Geographical scope:	Brazil

PRODUCT CATEGORY RULES (PCR):
PCR 2012:01-SUB-PCR-H cement and building lime (EN 16908:2017)

PCR review was conducted by:
The Technical Committee of the International EPD® System. Chair: Massimo Marino Contact via info@environdec.com.

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

☐ EPD Process Certification (internal) ☒ EPD Verification (external)

Third party verifier*:*
Maurizio Fieschi, fieschi@studiofieschi.it, **www.studiofieschi.it**

Approved by:

The International EPD® System

6.1. MANDATORY STATEMENTS

Environmental Product Declaration in accordance with ISO 14025 and EN 15804.
EPD of construction products may not be comparable if they do not comply with EN 15804.
EPDs within the same product category but from different programmes may not be comparable.

6.2. CONTACT INFORMATION

EPD OWNER:	**Fábio Cirilo** **Fabio.cirilo@vcimentos.com** +551145724596 1996, Gomes de Carvalho Street- 11º floor-13º floor - 04547-006 São Paulo SP - Brazil www.votorantimcimentos.com
LCA AUTHOR:	**Anna Kounina** anna.kounina@quantis-intl.com +41 21 693 91 95 EPFL Innovation Park Bâtiment D 1015 Lausanne Switzerland www.quantis-intl.com
PROGRAMME OPERATOR:	EPD International AB info@environdec.com EPD registered through the fully aligned regional hub: THE INTERNATIONAL EPD® SYSTEM Fundação Vanzolini www.epdbrasil.com.br EPD International AB: Box 210 60 SE-100 31 Stockholm, Sweden EPD Brasil: 255, Camburiú street, Alto da Lapa 05058-020, São Paulo, SP, Brazil info@epdbrasil.com.br

7. REFERENCES

General Programme Instructions of the International EPD® System. Version 2.5.
PCR 2012:01-SUB-PCR-H cement and building lime (EN 16908:2017)
GCCA Tool for EPD of concrete and cement (v2.0): LCA core model and database report v2.0/CML v4.7
VOTORANTIM CIMENTOS. Integrated Report 2018. Published in May 2019. São Paulo.

VOTORANTIM CIMENTOS

1996 Gomes de Carvalho Street - 11ºfloor - 13º floor - 04547-006 – São Paulo, SP, Brazil.

www.votorantimcimentos.com
www.votorantimcimentos.com.br