EPD – Environmental Product Declaration

CP II E 40, CP III-40 RS and CP V-ARI by Votorantim Cimentos

Registration number: S-P-00895

Published on 20-06-2016, valid until 20-06-2021

CEMENT

CEMENTS CP II E 40, CP III-40 RS and CP V-ARI

1. COMPANY

Votorantim Cimentos is the market leader in cement in Brazil and the eighth 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 14 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.
Votorantim Cimentos has 23 units certified in ISO 9001 (Quality Management System), 10 units certified in ISO 14001 (Environmental Management System), 6 units certified in OHSAS 18001 (Occupational Health and Safety), 1 unit certified in ISO 50001 (Energy Management), 1 unit certified in SA 8000(Social Accountability), and other certifications such: Greenguard, ECO and Energy Star (Votorantim Cimentos Integrated Report, 2012).
The company is in constant development in order to guarantee the sustainable practices (one of the 4 pillars of the Votorantim Cimentos) and has a commitment to certify, in ISO 14001, 100% of its units by 2020.

2. PRODUCT

This EPD covers 3 cements: CP II E 40, CP III-40 RS and CP V-ARI.
CP II 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.

Specifications:

- CP II - Compound Portland Cement (pure cement + addition of other material).
- E - Addition of Slag 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
- 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

CP III 40 RS from Santa Helena Unit is used for works in contact with aggressive environments, especially sulphates attacks, and applications that require high ultimate strength.

It is suitable for concrete work on bridges, dams, floors, sanitation, mass concrete, reinforced concrete, sidewalks, for the preparation of rendering mortars, as slurry mortar and plaster, settlement and subfloors. It is sold in bulk only.

Specifications:

- CP III – Compound Portland Cement from blast furnace.
- 40 - Minimum compressive strength value (in MPa) after 28 days of curing.
- RS – Resistance to sulphates.

It can be integrated in the following products:

- Coating and bricklaying Mortar
- Mortars and Concrete to aggressive environments (such as seawater and sewage)
- Reinforced concrete with structural function
- Concrete with reactive aggregate
- Lean concrete (for tours and fillers)
- Unreinforced concrete
- Concrete-mass
- Soil-cement

CP V ARI from Santa Helena unit is a high early strength cement, designed for industries and prefabricated groups and suitable for situations where there is need rapid de-forms. Used in concrete artifacts (concrete blocks, concrete prestressed, high performance concrete, interlocking floors and prefabricated concrete in general). It is sold in packages of 40 kg, 50 kg and in bulk.

Specifications:

- CP V ARI – Compound Portland Cement with high early strength.

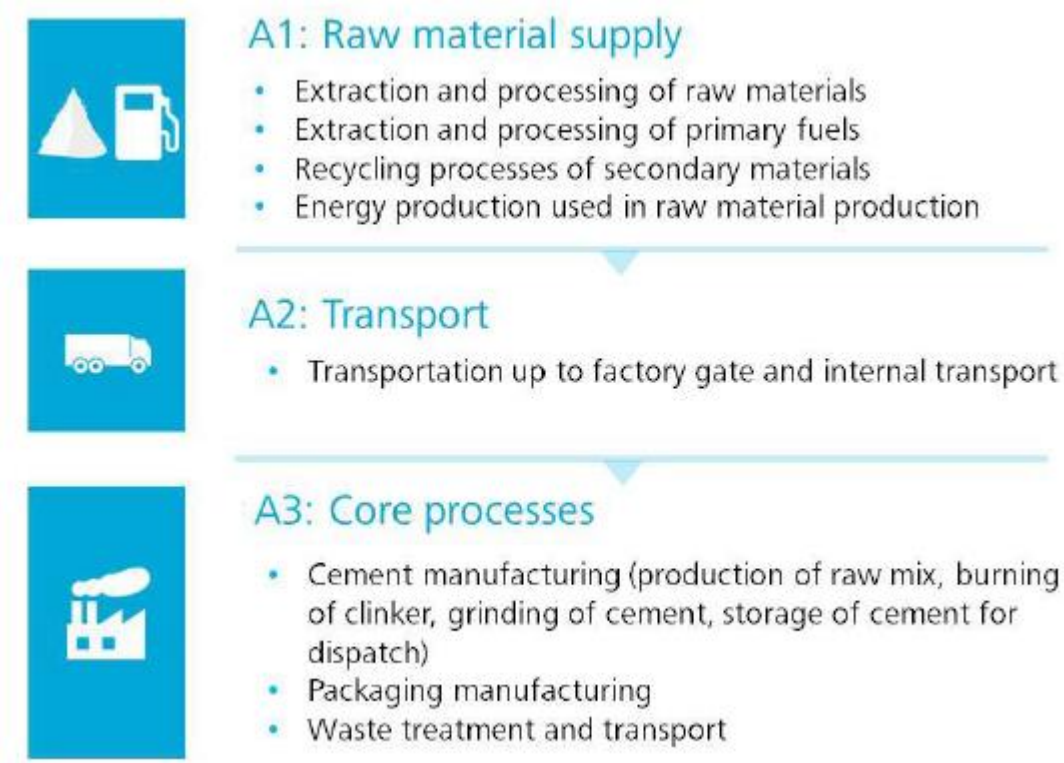
It can be integrated in the following products:

- Reinforced Mortar
- 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
- 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
- Industrial concrete floors
- Precast concrete and cement artifacts cured by water sprinklers
- Precast and cement artifacts for rapid de-forms , cured with thermal curing
- Precast and artifacts for rapid de-forms , cured with water sprinklers

2.1. FUNCTIONAL UNIT AND STUDIED SYSTEM

The life cycle assessment is based on the WBCSD-CSI Tool for concrete and cement EPDs, version 1.4, dated 08/11/2017 (thereafter referred to as “the tool”), verified as compliant in accordance with the PCRs (PCR 2012:01 Construction products and Construction services v.2.2, PCR 2013:02 Concrete v.1.02, PCR 2010:09 Cement v.2.1., hereafter the PCR) 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/.

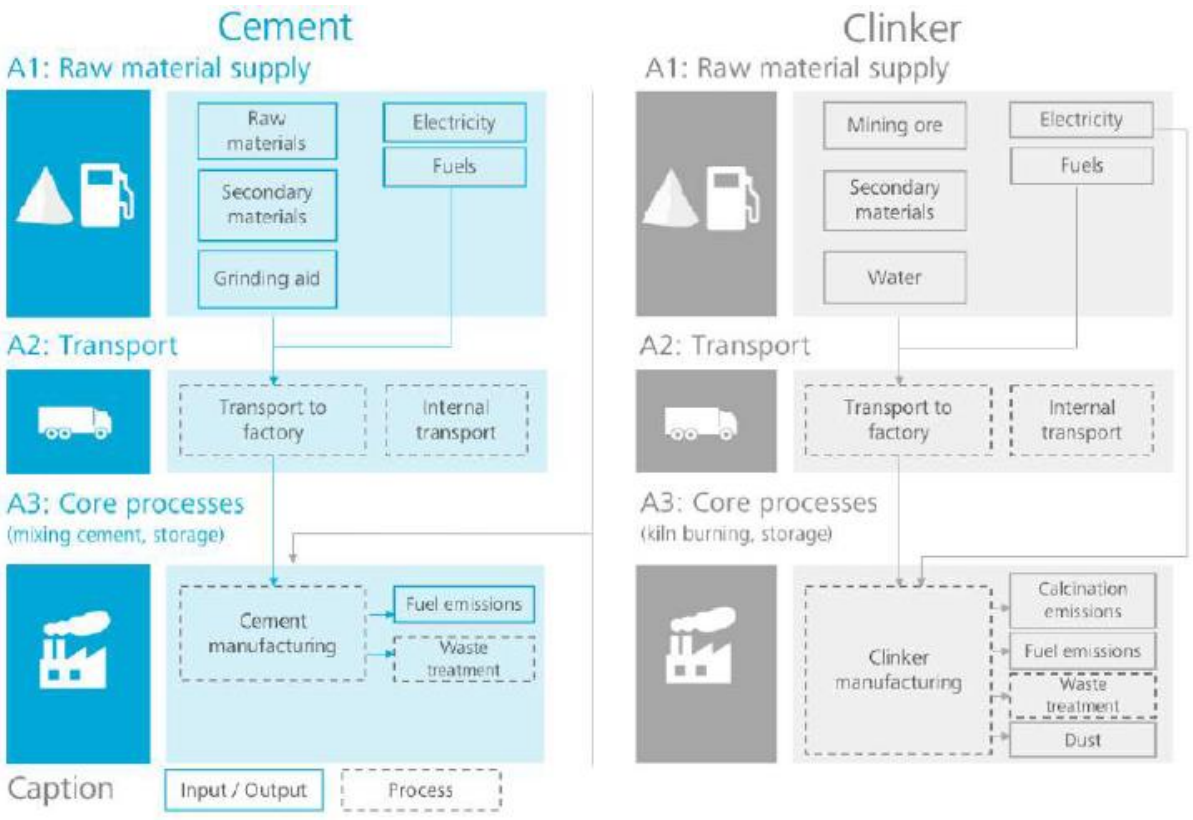
The functional unit is 1 metric tonne of cement, defined in accordance with the tool. The following figure shows the studied system, split between 3 categories: A1 raw material supply, A2 transport and
A3 core processes.



2.2. LIFE CYCLE STAGES

SYSTEM BOUNDARIES

The system boundaries are presented in the following figure.



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.

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.
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 concrete production in 2016 calculated with the WBCSD-CSI Tool for concrete and cement EPDs. Additional information on the impact calculation are available in the tool documentation (WBCSD CSI 2016).
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). CEN standard EN 15804 served as the core PCR

EPDs of construction products may not be comparable if they do not comply with the requirements of comparability set in EN 15804.

4.1. USE OF RESOURCES

RESOURCE USE	CP II E 40			UNIT
	A1 –A2	A3	TOTAL	
Renewable primary energy used as energy resource	12,0	599,1	611,1	MJ
Renewable primary energy used as raw materials	0,0	0,0	0,0	MJ
Total renewable primary energy	12,0	599,1	611,1	MJ
Non-renewable primary energy used as energy resource	417,3	1491,5	1908,8	MJ
Non-renewable primary energy used as raw materials	0,0	0,0	0,0	MJ
Total non-renewable primary energy	417,3	1491,5	1908,8	MJ
Secondary material	200,0	0,0	200,0	kg
Renewable secondary fuels	0,0	0,0	0,0	MJ
Non-renewable secondary fuels	0,0	0,0	0,0	MJ
Net fresh water	1,1	4,3	5,5	m^3

RESOURCE USE	CP III E 40 RS			UNIT
	A1 –A2	A3	TOTAL	
Renewable primary energy used as energy resource	17,2	432,8	450,0	MJ
Renewable primary energy used as raw materials	0,0	0,0	0,0	MJ
Total renewable primary energy	17,2	432,8	450,0	MJ
Non-renewable primary energy used as energy resource	1041,3	1048,4	2089,7	MJ
Non-renewable primary energy used as raw materials	0,0	0,0	0,0	MJ
Total non-renewable primary energy	1041,3	1048,4	2089,7	MJ
Secondary material	456,0	0,0	456,0	kg
Renewable secondary fuels	0,0	0,0	0,0	MJ
Non-renewable secondary fuels	0,0	0,0	0,0	MJ
Net fresh water	1,3	3,1	4,4	m^3

RESOURCE USE	CP V - ARI			UNIT
	A1 –A2	A3	TOTAL	
Renewable primary energy used as energy resource	8,8	715,8	724,7	MJ
Renewable primary energy used as raw materials	0,0	0,0	0,0	MJ
Total renewable primary energy	8,8	715,8	724,7	MJ
Non-renewable primary energy used as energy resource	231,2	1757,2	1988,4	MJ
Non-renewable primary energy used as raw materials	0,0	0,0	0,0	MJ
Total non-renewable primary energy	231,2	1757,2	1988,4	MJ
Secondary material	70,0	0,0	70,0	kg
Renewable secondary fuels	0,0	0,0	0,0	MJ
Non-renewable secondary fuels	0,0	0,0	0,0	MJ
Net fresh water	1,0	5,2	6,2	m^3

4.2. POTENTIAL ENVIRONMENTAL IMPACTS

ENVIRONMENTAL IMPACTS	CP II E 40			UNIT
	A1 –A2	A3	TOTAL	
Global warming potential, GWP (100 years)	25,9	763,2	789,1	kg CO_2-eq.
Depletion potential of the stratospheric ozone layer, ODP	0,0	0,0	0,0	kg CFC 11-eq.
Acidification potential of soil and water, AP	0,1	1,5	1,7	kg SO_2-eq.
Eutrophication potential, EP	0,0	0,2	0,2	kg PO_4^{3-}-eq.
Formation potential of tropospheric ozone, POCP	0,0	0,1	0,1	kg C_2H_4-eq
Abiotic depletion potential for non-fossil resources, ADP-elements	0,0	0,0	0,0	kg Sb-eq.
Abiotic depletion potential for fossil resources, ADP-fossil fuels	407,5	1419,7	1827,2	MJ

ENVIRONMENTAL IMPACTS	CP III E 40 RS	UNIT

	A1 –A2	A3	TOTAL	
Global warming potential, GWP (100 years)	64,2	522,6	586,7	kg CO_2-eq.
Depletion potential of the stratospheric ozone layer, ODP	0,0	0,0	0,0	kg CFC 11-eq.
Acidification potential of soil and water, AP	0,3	1,1	1,3	kg SO_2-eq.
Eutrophication potential, EP	0,1	0,1	0,2	kg PO_4^{3-}-eq.
Formation potential of tropospheric ozone, POCP	0,0	0,1	0,1	kg C_2H_4-eq
Abiotic depletion potential for non-fossil resources, ADP-elements	0,0	0,0	0,0	kg Sb-eq.
Abiotic depletion potential for fossil resources, ADP-fossil fuels	1024,3	996,7	2020,9	MJ

ENVIRONMENTAL IMPACTS	CP V - ARI			UNIT
	A1 –A2	A3	TOTAL	
Global warming potential, GWP (100 years)	14,3	891,7	906,0	kg CO_2-eq.
Depletion potential of the stratospheric ozone layer, ODP	0,0	0,0	0,0	kg CFC 11-eq.
Acidification potential of soil and water, AP	0,1	1,8	1,9	kg SO_2-eq.
Eutrophication potential, EP	0,0	0,2	0,3	kg PO_4^{3-}-eq.
Formation potential of tropospheric ozone, POCP	0,0	0,1	0,1	kg C_2H_4-eq
Abiotic depletion potential for non-fossil resources, ADP-elements	0,0	0,0	0,0	kg Sb-eq.
Abiotic depletion potential for fossil resources, ADP-fossil fuels	224,0	1671,7	1895,7	MJ

4.3. WASTE PRODUCTION

WASTES*	CP II E 40			UNIT
	A1 –A2	A3	TOTAL	
Hazardous waste disposed	0.00E+00	2.39E-04	2.39E-04	kg
Non-hazardous waste disposed	0.00E+00	1.68E-01	1.68E-01	kg
Radioactive waste disposed	0.00E+00	0.00E+00	0.00E+00	kg

WASTES*	CP III E 40 RS			UNIT
	A1 –A2	A3	TOTAL	
Hazardous waste disposed	0.00E+00	1.15E-04	1.15E-04	kg
Non-hazardous waste disposed	0.00E+00	1.82E+00	1.82E+00	kg
Radioactive waste disposed	0.00E+00	0.00E+00	0.00E+00	kg

WASTES*	CP V - ARI			UNIT
	A1 –A2	A3	TOTAL	
Hazardous waste disposed	0.00E+00	2.82E-04	2.82E-04	kg
Non-hazardous waste disposed	0.00E+00	1.99E-01	1.99E-01	kg
Radioactive waste disposed	0.00E+00	0.00E+00	0.00E+00	kg

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

4.4. OTHER ENVIRONMENTAL INDICATORS

OUTPUT FLOWS	CP II E 40			UNIT
	A1 –A2	A3	TOTAL	
Components for re-use	0,0	0,0	0,0	kg
Materials for recycling	0,0	0,8	0,8	kg
Materials for energy recovery	0,0	0,0	0,0	kg
Exported energy	0,0	0,0	0,0	MJ
Dust	0,0	0,045	0,045	kg

OUTPUT FLOWS	CP III E 40 RS			UNIT
	A1 –A2	A3	TOTAL	
Components for re-use	0,0	0,0	0,0	kg
Materials for recycling	0,0	0,5	0,5	kg
Materials for energy recovery	0,0	0,0	0,0	kg
Exported energy	0,0	0,0	0,0	MJ
Dust	0,0	0,03	0,03	kg

OUTPUT FLOWS	CP V - ARI			UNIT
	A1 –A2	A3	TOTAL	
Components for re-use	0,0	0,0	0,0	kg
Materials for recycling	0,9	0,0	0,9	kg
Materials for energy recovery	0,0	0,0	0,0	kg
Exported energy	0,0	0,0	0,0	MJ
Dust	0,0	0,05	0,05	kg

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 vicinity 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-00895
Published:	2016-06-20
Valid until:	2021-06-20
Revision date:	2017-12-21
Product Category Rules:	PCR 2010:09 Cement, Version 2.1
Product group classification:	UN CPC 3744 CEMENT
Reference year for data:	2016
Geographical scope:	Brazil

See PCR for detailed requirements.

PRODUCT CATEGORY RULES (PCR): PCR 2010:09 CEMENT, VERSION 2.1	
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 Accredited by: The International EPD® System	

6.1. MANDATORY STATEMENTS

EPDs within the same product category but from different programmes may not be comparable.

6.2. CONTACT INFORMATION

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PROGRAMME OPERATOR:	EPD International AB info@environdec.com

7. REFERENCES

General Programme Instructions of the International EPD® System. Version 2.5.
PCR 2010:09 Cement, Version 2.1
WBCSD-CSI (2015) WBCSD-CSI tool for EPDs of concrete and cement: LCA core model and database report v1.4/CML v4.7
VOTORANTIM CIMENTOS. Integrated Report 2012. Published in October 2013. São Paulo.

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For us, sustainability means achieving our growth ambitions, in the following way: taking the present and future needs of society into account; offering eco-efficient and innovative building materials, and services, to our customers; acting in an ethical, transparent manner and in accordance with the laws and regulations; providing a motivating, healthy and safe work environment for our employees and contract staff; supporting our local communities and encouraging their progress.