Environmental Product Declaration (EPD) for Concrete

Life Cycle Impact Results
(per m³)

Declared Unit: 1 m³ of 40 MPa concrete at 28 days

OPERATIONAL IMPACTS	*Cruz Azul C1-153*
Non-renewable primary energy (MJ)	2,604
Renewable primary energy (MJ)	2.5
Total primary energy (MJ)	2,606
Concrete batch water (m^3)	0.16
Concrete wash water (m3)	0.09
Total consumptive water (m3)	0.17
Non-renewable material resource (kg)	2,453
Renewable material resource (kg)	0.001
On-site waste disposal hazardous (kg)	0.0
On-site waste disposal non-hazardous (kg)	0.0
ENVIRONMENTAL IMPACTS	
Climate Change (kg CO_2 eq)	572
Ozone Depletion (kg CFC 11 eq)	3.3E-06
Acidification Air (kg SO_2 eq)	3.1
Eutrophication (kg N eq)	0.18
Photochemical Ozone Creation (kg O_3 eq)	3.5

TRACI 2.1 Characterization Factors

Concretos Cruz Azul began operating in 1991. We are committed to offering products and services that comply with the regulations established in addition to giving our customers confidence and peace of mind when using our brand of products. We bring the support of a product leader and integrate that into our quality and service - Concretos Cruz Azul.

Our 44 plants are located throughout 4 regions providing coverage in 14 States. Our 5 laboratories accredited by the E.M.A. guarantee the quality of our products.

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NSF Sustainability Certified — Environmental Product Declaration

ENVIRONMENTAL PRODUCT DECLARATION VERIFICATION

EPD Information			
Program Operator		NSF International	
Declaration Holder		Concretos Cruz Azul	
Product: C1-153	Update February 12, 2019	Valid Until March 15, 2022	Declaration Number EPD10122
This EPD was independently verified by NSF International in accordance with ISO 14025 and ISO 21930: ☐ Internal ☒ External		Jenny Oorbeck joorbeck@nsf.org	
This life cycle assessment was independently verified by in accordance with ISO 14044 and the reference PCR.		Jack Geibig jgeibig@ecoform.com	
LCA Information			
Basis LCA		Life Cycle Assessment Manager for Concrete Environmental Product Declaration June 2013	
LCA Preparer		David Green BASF Corporation david.r.green@basf.com	
This life cycle assessment was critically reviewed in accordance with ISO 14044 by:		Bill Stough Sustainable Research Group bstough@sustainableresearchgroup.com	
PCR Information			
Program Operator		Carbon Leadership Forum	
Reference PCR		North American Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) version 1.1	
Date of Issue		November 30, 2012, Revised December 4, 2013	
PCR review was conducted by:		Nick Santero PE International	

ENVIRONMENTAL PRODUCT DECLARATION: DETAILED VERSION

Product Description

Products covered by this Environmental Product Declaration (EPD) are for a specific 40 MPa concrete application developed and produced by Cruz Azul for the Mexico City Airport project. The product facility is located at 19.490387 latitude and -98.995151 longitude. The specified compressive strength is 40 MPA at 28 days with a 18 cm slump.

This EPD reports the impacts for the product concrete further defined by ASTM C94, UNSPSC code 30111500 and CSI Specification Section 03 30 00. The life cycle phases covered are A1 (Raw Material Supply: Upstream Processes), A2 (Transportation from Supplier to Gate of Producer) and A3 (Concrete Production – Core Process). This EPD is based on a cradle-to-gate system boundary deemed appropriate as concrete mixtures are supplied to a variety of different products and the function of the final product is not specifically determined.
Life cycle stages that are not included in this EPD are A4 (Transportation to the Construction Site), A5 (Construction and Installation Process), B1-7 (Use Phase) and C1-4 (End of Life Stage).

Product Components

The product components for the mixes identified for this EPD meet the following ASTM Standards:

Component	***Standard***	***Specification for:***
Portland Cement	ASTM C150	Portland Cement
Fly Ash	ASTM C618	Fly ash used in cementitious mixtures
Silica Fume	ASTM C1240	Silica fume used in cementitious mixtures
Natural and Crushed Aggregates	ASTM C33	Concrete aggregates
Admixtures	ASTM C494	Chemical Admixtures for Concrete
Batch Water	ASTM C1602	Mixing water used in the production of hydraulic cement concrete

Declared Unit

The declared unit is 1 m^3 of Cruz Azul concrete produced for commercial applications with a specified compressive strength of 40 MPa (5,800 psi) at 28 days.

Cut-off Criteria

The cut-off criteria for raw material/energy consumption and environmental impacts for inclusion is less than 1% however for the Carbon Leadership Forum PCR all inputs and outputs for which data is available shall be included. The total of the estimated neglected input flows does not exceed 5% for the total impacts from energy, mass or climate change.

Life Cycle Assessment (LCA)

The LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
A summary of the life cycle stages ***included*** in the EPD is as follows:

1. Raw Material Supply (upstream processes): Extraction, handling and processing of the raw materials used in production of concrete: cement, supplementary cementitious materials, aggregate (course and fine), water, admixtures and other materials or chemicals used in concrete mixtures.
2. Transportation: Transportation of these materials from supplier to the 'gate' of the concrete producer.
3. Manufacturing (core processes): The core processes result from the energy used to store, batch, mix and distribute the concrete and operate the facility (concrete plant).
4. Water use in mixing and distributing concrete.

A summary of life cycle stages ***excluded*** from the EPD is as follows:

1. Production, manufacture and construction of buildings, capital goods and infrastructure with an expected lifespan of over 5 years.
2. Production and manufacture of concrete production equipment, concrete delivery vehicles, earthmoving equipment and laboratory equipment with an expected lifespan of over 5 years.
3. Personnel-related activities (travel, furniture, office supplies).
4. Energy and water use related to company management and sales activities.
5. Water use in upstream manufacturing processes and in the placement and curing of concrete. Better data and methodology is required to track and report these numbers.

A summary of the limitations of this EPD include:

1. This EPD does not report all of the environmental impacts due to manufacturing of the product, but rather reports the environmental impacts for those categories with established life cycle assessment based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, water use in the upstream manufacturing process and habitat destruction.
2. This EPD report the results of an LCA for 'cradle-to-gate' analysis. Thus, declarations are not comparative assertions defined as an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. An EPD does not make any statements that the product covered by the EPD is better or worse than any other product.
3. In order to assess the local impacts of product manufacturing, additional analysis is required.
4. Life Cycle Impact Assessment results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

EPD of concrete mixtures may not be comparable if they do not comply with this standard and data from this EPD. While EPD can be used to compare concrete mixtures, the data cannot be used to compare between construction products or concrete mixtures used in different concrete products unless the data is integrated into a comprehensive LCA. For example, precast concrete, concrete masonry units and site cast concrete all have different manufacturing processes whose impacts are attributed to different LCA stages. This precludes direct comparison between mixtures used in these different products unless all life cycle phases are included.

Data Quality and Variability

This EPD was created using industry average data for upstream materials. Variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel type used. A range of climate change impacts is not available at this time due a lack of industry average data. The EPD will be updated as industry average data becomes available for any/all inputs. The data sources used in the life-cycle assessment are included in Table 1. An assessment of the data quality selected for this EPD was conducted using the five data quality indicators per the "Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard". A summary of the assessment is shown in Table 2 with data quality rated from low to high in the categories of "Technological Representativeness", "Geographical Representativeness", "Temporal Representativeness", "Completeness" and "Reliability".

LCI	Data Source	Version	Year (Updated)	Region	Technology
Portland Cement	GaBi	8.5.0.79	2016	United States	Current
Fly Ash	GaBi	8.5.0.79	2016	North America	Current
Silica Fume	GaBi	8.5.0.79	2017	North America	Current
Metakaolin	GaBi	8.5.0.79	2016	North America	Current
Natural Aggregate	GaBi	8.5.0.79	2016	North America	Current
Natural Course Aggregate	GaBi	8.5.0.79	2017	North America	Current
Water	GaBi	8.5.0.79	2018	Mexico	Current
Electricity	GaBi	8.5.0.79	2015	Mexico	Current
Diesel	GaBi	8.5.0.79	2017	Mexico	Current
Natural Gas	GaBi	8.5.0.79	2018	Mexico	Current
MasterGlenium	GaBi/BASF	8.5.0.79	2017	North America	Current
MasterPolyheed	GaBi/BASF	8.5.0.79	2017	North America	Current
Truck Transport	USLCI	8.5.0.79	2018	North America	Current
Rail Transport	USLCI	8.5.0.79	2016	United States	Current
Ocean Transport	USLCI	8.5.0.79	2018	United States	Current

Table 1: Data Sources

Profile	Technology	Temporal	Geography	Completeness	Reliability
Portland Cement	High	Med-High	Med-High	Med-High	High
Fly Ash	Med-High	Med-High	Med-High	Med-High	High
Silica Fume	Med-High	Med-High	Med-High	Med-High	High
Metakaolin	High	Med-High	Med-High	Med-High	High
Natural Aggregate	High	Med-High	Med-High	Med-High	High
Natural Course Aggregate	High	Med-High	Med-High	Med-High	High
Water	High	Med-High	High	High	High
Electricity	High	Med-High	High	High	High
Diesel	Med-High	Med-High	High	High	High
Natural Gas	Med-High	Med-High	High	High	High
MasterGlenium	High	High	Med-High	High	High
MasterPolyheed	High	High	Med-High	High	High
Truck Transport	Med-High	Med-High	Med-High	Med-High	High
Rail Transport	Med-High	Med-High	Med-High	Med-High	High
Sea Transport	Med-High	Med-High	Med-High	Med-High	High

Table 2: Data Quality Assessment

References

1. North American Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) and/or GHG Protocol Conformant Product ‘Carbon Footprint’ of Concrete.
2. Saling, P., A. Kicherer, B. Dittrich-Kraemer, R. Wittlinger, W. Zombik, I. Schmidt, W. Schrott, and S. Schmidt. 2002. Eco-efficiency Analysis by BASF: The Method. Int. J. Life Cycle Assess., 7 (4): 203.
3. Shonnard, D.; Kicherer, A; and Saling, P. Industrial Applications Using BASF Eco-Efficiency Analysis: Perspectives on Green Engineering Principles. Environ. Sci. Technol. 2003, 37, 5340-5348.
4. ISO, International Organization for Standardization. Environmental Management-Life Cycle Assessment-Principles and Framework; ISO 14040:2006; ISO 14044:2006. ISO, Geneva, Switzerland, www.iso.org (2006)
5. ISO, International Organization for Standardization. Environmental Management- Eco-efficiency assessment of product systems -- Principles, requirements and guidelines; ISO 14045. ISO, Geneva, Switzerland, www.iso.org (2012)
6. Thinkstep: GaBi Software-System and Database for Life Cycle Engineering, Copyright © 1992-2016 thinkstep AG