Environmental Product Declaration

Environmental Product Declaration for cement products produced by CTS Cement Manufacturing Corporation at their CTS Cement Mfg. Corp. MO plant facility in México

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ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers cement products produced by CTS. Declared unit: 1 kg of blended and bagged product with packaging
Declaration Owner:	**CTS Cement Manufacturing Corporation** 12442 Knott Street Garden Grove, CA https://www.ctscement.com
Program Operator:	Labeling Sustainability Address, 11670 W Sunset Blvd. City, State, Los Angeles, CA http://labelingsustainability.com/
Product Category Rule:	Core PCR: ISO 21930:2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services; SubPCR: (Used as a guidance document only) NSF International (March 2020). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPD) of Portland, Blended, Masonry, Mortar, and Plastic (stucco) Cements. Valid through March 31, 2025. PCR Program Operator: NSF International Sub-category PCR review was conducted by: Thomas P. Gloria, Ph. D. of Industrial Ecology Consultants: 35 Bracebridge Rd., Newton, MA 02459-1728, t.gloria@industrial-ecology.com. Mr. Bill Stough, Sustainable Research Group: PO Box 1684, Grand Rapids, MI 49501-1684, bstough@sustainableresearchgroup.com. Mr. Jack Geilbig, EcoForm: 2624 Abelia Way, Suite 611, Knoxville, TN 37931, jgeilbig@ecoform.com.
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025. The life cycle assessment was independently reviewed in accordance ISO 14044 and the referenced PCR. Independent verification of the declaration, according to ISO 14025:2006 Internal ☐ ; External ☐ X Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the CSA group (www.csaregistries.ca), Labeling Sustainability (www.labelingsustainability.com), P3Optima (www.P3Optima.com)
Date of Issue:	28 November 2023
Period of Validity:	5 years; valid until 28 November 2028
EPD Number:	c43bc8fc-496b-4247-ab15-aca9f05f6d6c-3

COMPANY DESCRIPTION

CTS Cement Manufacturing Corporation is a leading manufacturer and supplier of high-quality construction products, dedicated to developing and delivering innovative, top-quality, high-performance products for new construction, restoration & repair works and solutions with value, service, and customer connectivity. CTS Cement's diverse product portfolio includes a wide range of applications in repair and restoration, flooring, grouting, pavements and overlays, stucco, shotcrete, shrinkage compensating cement, sealants and adhesives, and additives.

A hallmark of CTS offerings is the remarkably low carbon footprint associated with our products, establishing a pioneering benchmark for environmentally responsible manufacturing. Thus, contributing to a more sustainable built environment in the construction industry.

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, www.labelingsustainability.com. This level of study is in accordance with EPD Product Category Rule (PCR) for Repair binders published by; International Standards Organization (ISO) 14025:2006 Environmental labels and declarations, Type III environmental declarations-Principles and procedures; ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate CTS Cement Manufacturing Corporation from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of CTS Cement Manufacturing Corporation by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen CTS Cement Manufacturing Corporation's license to operate in the community. The intended audience for this LCA report is CTS Cement Manufacturing Corporation's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

DESCRIPTION OF PRODUCT AND SCOPE

This EPD covers seven (7) different bagged material products blended and bagged at the CTS Cement Manufacturing Corp. Missouri facility in Mexico, Missouri. Although the product names include cement, concrete, and asphalt as part of their names, they do not follow the respective Product Category Rules (PCRs) because, as specialty versions of the products packaged in bags, they do not meet the individual ASTMs as outlined in those PCRs. The three overarching categories of blended and bagged products in this EPD study are used for repair, restoration and general purpose projects.

This LCA assumes the impacts from products manufactured in accordance with the standards outlined in this report. This LCA is a cradle-to-gate study, and therefore, stages extending beyond the plant gate are not included in this LCA. Excluded stages include transportation of the manufactured material to the construction site; on-site construction processes and components; building (infrastructure) use and maintenance; and "end-of-life" effects.

CEMENT DESIGN SUMMARY

The following tables provide a list of the cement products considered in this EPD along with key performance parameters.

Table 1: **Declared products with cement considered in this environmental product declaration**

Prod#	Unique name/ID	Short description	Product type	Unit	Density, dry kg/Unit	Density, wet kg/Unit	productGroup
1	DOT Cement, 2000 lb bag	High-performance industrial grade, fast-setting cement	Repair Material	kg	1.00	1.00	Repair Material
2	DOT Cement, 50 lb bag	High-performance industrial grade, fast-setting cement	Repair Material	kg	1.00	1.00	Repair Material
3	Komponent, 50 lb bag	CSA-based Shrinkage-Compensating Cement Additive	Additive	kg	1.00	1.00	Additive
4	Rapid Set, 2000 lb bag	High performance, very rapid hardening CSA-based cement	Rapid Hardening	kg	1.00	1.00	Rapid Hardening
5	Rapid Set, 50 lb bag	High performance, very rapid hardening CSA-based cement	Rapid Hardening	kg	1.00	1.00	Rapid Hardening
6	Rapid Set, 50 lb Pail	High performance, very rapid hardening CSA-based cement	Rapid Hardening	kg	1.00	1.00	Rapid Hardening
7	Rapid Set, 88 lb bag	High performance, very rapid hardening CSA-based cement	Rapid Hardening	kg	1.00	1.00	Rapid Hardening

CEMENT DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each cement product design considered.

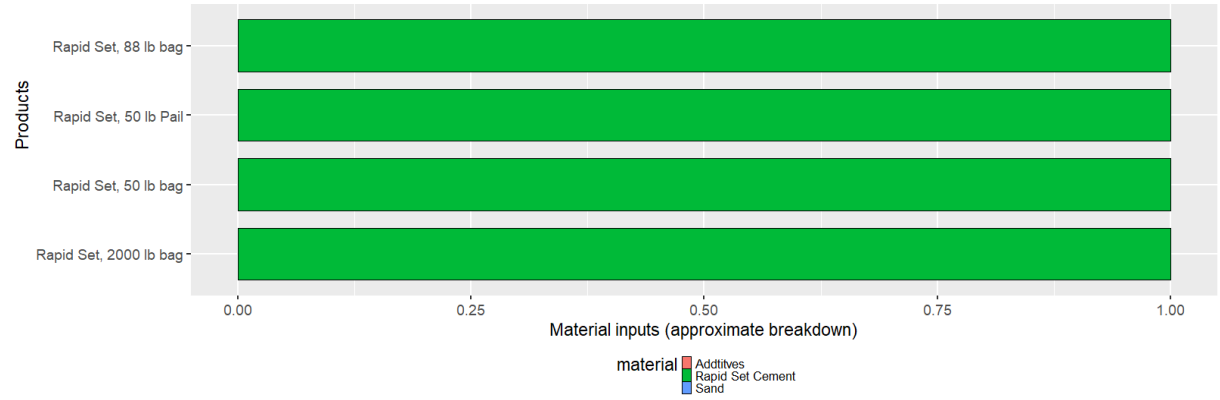

Figure 4: **Material composition – per 1 kg of blended and bagged product with packaging**

A1 RAW MATERIAL RECYCLED CONTENT AND MATERIAL LOSSES

The following table provides a list of the raw material inputs (module A1) across all products considered, their recyclability content and assumed material losses.

Table 2: **Module A1 raw material inputs, the recyclability content and assumed material losses (dry basis)**

product.name	mix.category	primary.content	post.industrial.content	post.consumer.content	material.losses
Fly Ash	fly ash and scrubber sludge	0%	0%	100%	2%
Pet Fiber	fibre, polyester	0%	100%	0%	2%
Rubber	acrylonitrile -butadiene-styrene copolymer	0%	100%	0%	2%

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-gate system boundary considered in this study (ND= Not Defined)

Life Cycle Impacts

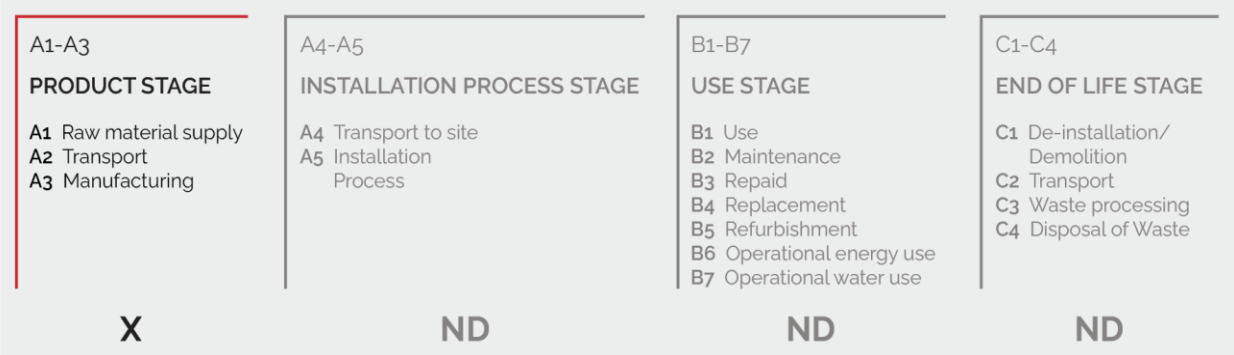

Figure 2: **General life cycle phases for consideration in a construction works system**

This is a Cradle-to-gate life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.

As according to the PCR, the following figure illustrates the general activities and input requirements for producing cement products and is not necessarily exhaustive.

In addition, as according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 building/capital goods and infrastructure;
- Production and manufacture of steel production equipment, steel delivery vehicles, earthmoving equipment, and laboratory equipment;
- Personnel-related activities (travel, furniture, office supplies);
- Energy use related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by CTS Cement Manufacturing Corporation, is located at their CTS Cement Mfg. Corp. MO Plant facility in Missouri, USA. All operating data is formulated using the actual data from CTS Cement Manufacturing Corporation's plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

This life cycle inventory was organized in a spreadsheet and was then input into an RStudio environment where pre-calculated LCIA results for relevant products/activities stemming from the ecoinvent v3.8 database and a local EPD database in combination with primary data from CTS Cement Manufacturing Corporation were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA

report. A parameter uncertainty analysis was also performed where key statistical results (e.g. min/mean/max etc.) are provided in the detailed LCA report.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

DATA SOURCES AND DATA QUALITY ASSESSMENT

No recovered on-site energy occurs at this facility.

No re-used or recycled material for utilization on-site or off-site was reported at this facility.

The following statements explain how the above facility requirements/generation were derived:

Raw material transport: CTS Cement provided all the raw material data for the reference year 2022. Raw material transportation is based on the actual distance from the manufacturer. The transportation was reported using CTS primary data that consisted of the actual distance, mode of transport, and location in the city, state, and country. The provision of raw materials relies on two modes of transportation: truck freight and ship freight.

Electricity: The reported electricity consumption is based on the CTS Cement primary information from utility bills for the reporting period. Twelve consecutive months were used, from January 2022 through December 2022. The products covered in this EPD consist of 99% of the overall product volume; therefore, all electricity was allocated based on that 99% figure.

Process/space heating: The reported propane consumption value is based on the CTS primary information from utility bills for the reporting period.

Fuel required for machinery: No on-site machinery fuel used.

Waste generation: Waste generation values are directly reported from the CTS operations for non-hazardous waste. No other waste is generated on-site at the facility. Transportation defaults were used because the driver's route and ultimate final destination are unknown. Therefore, the exact mileage could not be confirmed by the waste hauler. Transportation for waste in the end-of-life modules also uses default distances set by the PCR.

Recovered energy: No on-site energy is recovered on site.

Recycled/reused material/components: Due to lack of data, default loss factors of 5% were assumed. The PCR states " A3 shall include an assumption of 5% material loss unless product-specific data is available and transparently reported in the project LCA report underlying the EPD;"

Module A1 material losses: Direct emissions were modeled with best available ecoinvent processes (see LCI list).

Direct A3 emissions accounting: NA

The following tables depict a list of assumed life cycle inventory utilized in the LCA modeling to generate the impact results across the life cycle modules in scope. An assessment of the quality of each LCI activities utilized from various sources is also provided.

Table 5: **LCI inputs assumed for module A3** ***Data Quality Assessment- 0= Poor, 1=Fair, 2=Good, and 3= very good.***

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Cardboard box	corrugated board box production/corrugated board box/RoW/kg	ecoinvent v3.8	California	v3.8 in 2021	2	3	2	3	3
Drum lid (Steel)	steel production, converter, low-alloyed/steel, low-alloyed/RoW/kg	ecoinvent v3.8	Wisconsin	v3.8 in 2021	2	3	2	3	3
Electricity	market for electricity, medium voltage/electricity, medium voltage/US-SERC/kWh	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
Fibreboard drum	plywood production/wood chips, dry, measured as dry mass/RoW/kg	ecoinvent v3.8	Wisconsin	v3.8 in 2021	2	3	2	3	3
Non-hazardous waste	process-specific burdens, residual material landfill/process-specific burdens, residual material landfill/RoW/kg	ecoinvent v3.8	Missouri	v3.8 in 2021	1	3	1	3	3
Pail	extrusion, plastic pipes/extrusion, plastic pipes/RoW/kg	ecoinvent v3.8	Missouri	v3.8 in 2021	2	3	2	3	3
Pallets	EUR-flat pallet production/EUR-flat pallet/RoW/unit	ecoinvent v3.8	Missouri	v3.8 in 2021	2	3	2	3	3
Plastic bag	extrusion, plastic film/extrusion, plastic film/RoW/kg	ecoinvent v3.8	California	v3.8 in 2021	2	3	2	3	3
Plastic wrap	packaging film production, low density polyethylene/packaging film, low density polyethylene/RoW/kg	ecoinvent v3.8	Missouri	v3.8 in 2021	2	3	2	3	3
Propane	natural gas production/propane/RoW/kg	ecoinvent v3.8	Missouri	v3.8 in 2021	2	3	2	3	3
Supersack	textile production, nonwoven polypropylene, spunbond/textile, nonwoven polypropylene/RoW/kg	ecoinvent v3.8	Missouri	v3.8 in 2021	2	3	2	3	3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. Most relevant background materials and processes were taken from ecoinvent v3.6 LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency: To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product, and co-products outputs, returned and recovered materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.6 database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a machine-readable project file for all foreground and background processes, and in Labeling Sustainability proprietary LCA calculator* for all production facility and product-specific calculations. A considerable level of transparency is provided throughout the detailed LCA report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

Label Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for product designs. The tool auto-calculates results by scaling base-unit Technosphere inputs (i.e., 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes' primary collected data from 2022-01-01 to 2022-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.6 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators (see tables below).

Table 8: **Life cycle impact categories and life cycle inventory metrics**

ID	LCIA.indicators	Abbreviations	Units
1	environmental impact: acidification	AP	kg SO2eq
2	environmental impact: ecotoxicity	ETP	kg 2,4-D-.
3	environmental impact: global warming	GWP	kg CO2-Eq
4	environmental impact: ozone depletion	ODP	kg CFC-11.
5	environmental impact: photochemical oxidation	PCOP	kg O3eq
6	Abiotic Depletion-elements	ADPe	kg Sbeq
7	Abiotic Depletion-fossil fuels	ADPf	kg Sbeq
Inventory metrics			
8	Total primary energy	TPE	MJ-Eq
9	Non-Renewable Resources	NRR	kg
10	Renewable energy	RE	MJ-Eq
11	environmental impact: land filling, bulk waste	LFW	kg waste
12	environmental impact: land filling, hazardous waste	LFHW	kg waste
13	water depletion: WDP	WDP	m3 water-.

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.

- Renewable primary energy resources as energy (fuel);
- Renewable primary resources as material;
- Non-renewable primary resources as energy (fuel);
- Non-renewable primary resources as material;
- Secondary Materials;
- Renewable secondary fuels;
- Non-renewable secondary fuels;

- Recovered energy;
- Abiotic depletion potential for non-fossil mineral resources.
- Land use related impacts, for example on biodiversity and/or soil fertility;
- Toxicological aspects;
- Emissions from land use change [GWP 100 (land-use change)];
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- High-level radioactive waste;
- Intermediate and low-level radioactive waste;
- Components for reuse;
- Materials for recycling;
- Materials for energy recovery;
- Recovered energy exported from the product system.

TOTAL IMPACT SUMMARY

Interpretation

The primary environmental impact of bagged cement products is overwhelmingly attributed to specific key components. Rapid Set Cement is the major contributor for both the "Rapid Set" and "DOT Cement" products, accounting for more than 95% of the total impact. In the case of "Komponent," the product named Komponent itself is responsible for over 96% of the impact. Therefore, mitigation strategies should primarily focus on these components, exploring alternatives or more sustainable methods in their production and use to reduce overall environmental impact significantly.

The following table reports the total LCA results for each product produced at the given cement facility on a per 1 kg of blended and bagged product with packaging. This EPD was created using industry-average data for upstream materials.

Table 9: **Total life cycle (across modules in scope) impact results for All declared products, assuming the geometric mean point values on a per 1 kg of blended and bagged product with packaging basis**

Midpoint Impact Categories

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
DOT Cement, 2000 lb bag	0.0621	6.08e-05	0.714	2.95e-08	0.000485	1.37e-05	3.23
DOT Cement, 50 lb bag	0.0621	6.09e-05	0.714	2.96e-08	0.000485	1.37e-05	3.24
Komponent, 50 lb bag	0.0458	4.33e-05	0.49	2.17e-08	0.000373	1.53e-05	2.41
Rapid Set, 2000 lb bag	0.0615	5.8e-05	0.713	2.82e-08	0.000475	1.37e-05	3.23
Rapid Set, 50 lb bag	0.06	5.73e-05	0.706	2.84e-08	0.000461	1.37e-05	2.95
Rapid Set, 50 lb Pail	0.0643	5.93e-05	0.721	2.87e-08	5e-04	1.37e-05	3.13
Rapid Set, 88 lb bag	0.06	5.73e-05	0.706	2.83e-08	0.000461	1.37e-05	2.94

Inventory Metrics

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste
DOT Cement, 2000 lb bag	3.62	0.146	3.46	0.146	3.08e-06	0.000493	0.0726	5.22e-06
DOT Cement, 50 lb bag	3.61	0.143	3.46	0.146	2.91e-06	0.000494	0.0727	5.22e-06
Komponent, 50 lb bag	2.69	0.128	2.56	0.103	2.44e-06	0.000424	0.0512	3.71e-06
Rapid Set, 2000 lb bag	3.59	0.142	3.46	0.145	2.6e-06	0.000501	0.0697	5.07e-06
Rapid Set, 50 lb bag	3.29	0.138	3.18	0.138	2.77e-06	0.000473	0.0708	5.09e-06
Rapid Set, 50 lb Pail	3.5	0.18	3.32	0.146	5.23e-06	0.000532	0.0712	5.14e-06
Rapid Set, 88 lb bag	3.3	0.152	3.16	0.138	4.04e-06	0.000472	0.0705	5.08e-06

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

REFERENCES

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)
- 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
- ISO 14067:2018 Greenhouse Gases – Carbon Footprint of Products – Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations – Product Category Rules for concrete and concrete elements.
- EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

Other References:

- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b.
- US EPA (2020) Advancing Sustainable Materials Management: 2018 Fact Sheet, https://www.epa.gov/sites/production/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf