Environmental Product Declaration

Environmental Product Declaration for packaged cement blends products produced by US Concrete Products at their Baltimore facility

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers packaged cement blends products produced by US Concrete Products. Declared unit: 1 kg of dry blended and bagged product with packaging
Declaration Owner:	US Concrete Products
	200 Frankfurst Ave
	Baltimore, MD
	www.uscproducts.com
Program Operator:	Labeling Sustainability
	11670 W Sunset Blvd.
	Los Angeles, CA 90049
	www.labelingsustainability.com
Product Category Rule:	ISO 21930:2017 Sustainability in buildings and civil engineering works Core rules for environmental product declarations of construction products and services.
	PCR Program Operator: International Organization for Standardization
	PCR review was conducted by: Technical Committee: ISO/TC 59/SC 17 Sustainability in buildings and civil engineering works
Independent LCA Reviewer and EPD Verifier:	This declaration was independently verified in accordance with ISO 14025:2006.
	Independent verification of the declaration, according to ISO 14025:2006
	Internal ☐ ; External ☐ X
	Third Party Verifier
	Geoffrey Guest, Certified 3rd Party Verifier under the Labeling Sustainability Program (www.labelingsustainability.com), CSA Group (www.csaregistries.ca),
Date of Issue:	20 September 2024
Period of Validity:	5 years; valid until 20 September 2029
EPD Number:	0e12c55f-dae8-4d90-8e5b-f647b04705e2

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COMPANY DESCRIPTION

US Concrete Products is a leader in the concrete repair industry, offering engineered prepackaged concrete products for anything from garage repair, highway patching, facade repair, and more. Best in class manufacturing capabilities enable USCP to provide customers with single-component materials to solve any concrete repair problem. The team at USCP is dedicated to developing products that best fit customer needs, which has resulted in an expansive portfolio of product solutions.

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 Packaged Cement Blends published by the International Standards Organization (ISO) 21930:2017 Sustainability in buildings and civil works - Core rules for EPDs of construction products and services; 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 US Concrete Products 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 US Concrete Products 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 US Concrete Products' license to operate in the community. The intended audience for this LCA report is US Concrete Products' 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

Packaged cementitious materials are manufactured by drying bulk-delivered aggregates, combining the dried sand and/or gravel with cement and admixtures. The bulk aggregates and cements are blended with the admixtures and then packaged into either small or bulk bags, then placed on pallets and wrapped with shrink wrap

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.

PACKAGED CEMENT BLENDS DESIGN SUMMARY

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

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

Prod#	Unique name/ID	Short description	Product type	Unit	Density, dry kg/Unit	ProductGroup
1	Deck Mix AE 80lb bag	Single component air entrained concrete mix for concrete repair applications	Full Depth	kg	1.00	US Concrete Products
2	Deck Mix AE 4000 80lb bag	Single component air entrained concrete mix for concrete repair applications formulated for 4000psi ultimate strength	Full Depth	kg	1.00	US Concrete Products
3	Deck Mix UW 80lb bag	Single component air entrained concrete mix for underwater concrete repair applications	Full Depth	kg	1.00	US Concrete Products
4	Deck Mix Advanced 80lb bag	Single component air entrained concrete mix for high density and sulfate resistance concrete repair applications	Full Depth	kg	1.00	US Concrete Products
5	Deck Mix AE w/ Fibers 80lb bag	Single component air entrained concrete mix with polypropylene fibers for concrete repair applications	Full Depth	kg	1.00	US Concrete Products
6	Deck Mix PM 80lb bag	Single component air entrained concrete mix with integral polymer for concrete repair applications	Full Depth	kg	1.00	US Concrete Products
7	Deck Mix FP 50lb bag	Self compacting pumpable micro concrete for form and pump applications	Full Depth	kg	1.00	US Concrete Products
8	Deck Mix FP PM 50lb bag	Self compacting pumpable polymer modified micro concrete	Full Depth	kg	1.00	US Concrete Products

		for form and pump applications				
9	Deck Mix LW 50lb bag	Lightweight concrete to be extended with expanded shale aggregate	Full Depth	kg	1.00	US Concrete Products
10	Deck Mix SCC 80lb bag	Self consolidating concrete including pea gravel for concrete repair or other form and pour applications	Full Depth	kg	1.00	US Concrete Products
11	Deck Mix SCC PM 80lb bag	Polymer modified self consolidating concrete including pea gravel for concrete repair or other form and pour applications	Full Depth	kg	1.00	US Concrete Products
12	Deck Pro 7100 50lb bag	Repair mortar formulated for vertical or overhead application, including application by low pressure spray	Full Depth	kg	1.00	US Concrete Products
13	Deck Pro 7101 50lb bag	Repair mortar formulated with fibers for vertical or overhead application, including application by low pressure spray	Full Depth	kg	1.00	US Concrete Products
14	US Anchor Grout 50lb bag	Non shrink grout formulated for the grouting of anchor bolts	Grouts	kg	1.00	US Concrete Products
15	US Cable Grout 50lb bag	Non shrink grout formulated for the grouting of PT cables	Grouts	kg	1.00	US Concrete Products
16	US Grout 715 80lb bag	Non shrink, pumpable, flowable grout with high early strengths	Grouts	kg	1.00	US Concrete Products
17	HP Grout 15 55lb bag	Non shrink, pumpable, flowable, fast setting grout	Grouts	kg	1.00	US Concrete Products
18	US Construction Grout 80lb bag	Non shrink grout for use in void filling applications	Grouts	kg	1.00	US Concrete Products
19	US Underwater Grout 50lb bag	Non shrink grout for use in underwater void filling applications such as jacketing	Grouts	kg	1.00	US Concrete Products
20	HP Underwater Grout 80lb bag	Non shrink, fast setting grout for use in underwater void filling	Grouts	kg	1.00	US Concrete Products

		applications such as jacketing				
21	Gunite 2020 50lb bag	Low dust dry process shotcrete, to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
22	Gunite 2020 80lb bag	Low dust dry process shotcrete, to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
23	Gunite 2024 50lb bag	Low dust dry process shotcrete with high early strengths, to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
24	Gunite 2020WP 50lb bag	Low dust dry process shotcrete with crystaline waterproofing, to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
25	Gunite 7000W 50lb bag	Wet process shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
26	Gunite 7000W 80lb bag	Wet process shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
27	Gunite 7001W 50lb bag	Wet process, fiber reinforced shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
28	Gunite 7001W 80lb bag	Wet process, fiber reinforced shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
29	Gunite 7000D 50lb bag	Dry process shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
30	Gunite 7000D 80lb bag	Dry process shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
31	Gunite 7001D 50lb bag	Dry process, fiber reinforced shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
32	Gunite 7001D 80lb bag	Dry process, fiber reinforced shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
33	Gunite 7041 80lb bag	Wet process, fiber reinforced shotcrete to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
34	Gunite 7424 50lb bag	Dry process, fiber reinforced shotcrete to be applied pneumatically in mining applications	Shotcretes	kg	1.00	US Concrete Products
35	Gunite Advanced 80lb bag	Dry process, fiber reinforced shotcrete with high sulfate resistance to be applied pneumatically	Shotcretes	kg	1.00	US Concrete Products
36	HP Concrete 60lb bag	Fast setting, single component air entrained	Fast Setting	kg	1.00	US Concrete Products

		concrete mix for concrete repair applications				
37	HP Concrete with Fibers 60lb bag	Fast setting, single component air entrained concrete mix reinforced with fibers for concrete repair applications	Fast Setting	kg	1.00	US Concrete Products
38	HP DOT Grade Repair Mortar 55lb bag	Fast setting, single component repair mortar for concrete repair applications	Fast Setting	kg	1.00	US Concrete Products
39	HP Cement 50lb bag	Fast setting specialty cement featuring low shrinkage and high early strengths	Fast Setting	kg	1.00	US Concrete Products
40	HP Cement 2000lb bag	Fast setting specialty cement featuring low shrinkage and high early strengths	Fast Setting	kg	1.00	US Concrete Products
41	HP LP Cement 50lb bag	Fast setting low permeability specialty cement featuring low shrinkage and high early strengths	Fast Setting	kg	1.00	US Concrete Products
42	HP LP Cement 2000lb bag	Fast setting low permeability specialty cement featuring low shrinkage and high early strengths	Fast Setting	kg	1.00	US Concrete Products
43	HP Multi-Purpose Repair Mortar 55lb bag	Fast setting, single component repair mortar for a variety of applications including vertical and overhead repair	Fast Setting	kg	1.00	US Concrete Products
44	HP Hydraulic Cement 50lb bag	Fast setting specialty cement featuring low shrinkage and high early strengths for small applications	Fast Setting	kg	1.00	US Concrete Products
45	US Thin Patch 50lb bag	Repair mortar formulated with fibers for vertica, horizontal or overhead application. Dense material that allows for shallow patches	Repair Mortars	kg	1.00	US Concrete Products
46	US Thin Patch V/O 50lb bag	Fast setting, single component repair mortar for vertical and overhead repair	Repair Mortars	kg	1.00	US Concrete Products

47	US Thin Patch V/O w/ Fibers 50lb bag	Fast setting, single component repair mortar reinforced with polypropylene fibers for vertical and overhead repair	Repair Mortars	kg	1.00	US Concrete Products
48	US Floor Level 50lb bag	Self leveling underlayment that can be used to created a smooth level surface prior to floor installation	Repair Mortars	kg	1.00	US Concrete Products

PACKAGED CEMENT BLENDS DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each flooring design considered. Please note that the presented breakdown has been randomly altered by +/-10% and is therefore only an approximation; this manipulation is to ensure confidentiality.

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
Concrete Sand(sand)	Sand	100%	0%	0%	2%
Type IL Cement	Cement, Portland	100%	0%	0%	2%
Type III Cement	Cement, Portland	100%	0%	0%	2%
Crushed Stone (limestone)	Limestone, unprocessed	100%	0%	0%	2%
Pea Gravel (limestone)	Limestone, unprocessed	100%	0%	0%	2%
Mason Sand	Limestone, unprocessed	100%	0%	0%	2%
Fly Ash	Fly ash and scrubber sludge	100%	0%	0%	2%
Crystalline silica	Silica sand	100%	0%	0%	2%
silica dust	Silica dust	100%	0%	0%	2%
Barium Sulfate	Barium sulfide	100%	0%	0%	2%
Silica Fume	Silica fume, densified	100%	0%	0%	2%
Calcium Sulfate	Cement, Portland fly ash cement 21-35%	100%	0%	0%	2%

Calcium carbonate	Calcium carbonate, precipitated	100%	0%	0%	2%
Naphthalene sulfonic acid, formaldehyde polymer, sodium salt	Naphthalene sulfonic acid	100%	0%	0%	2%
CSA Cement	Cement, Portland fly ash cement 21-35%	100%	0%	0%	2%
Fast Rock CSA	Cement, Portland fly ash cement 21-35%	100%	0%	0%	2%

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-grave system boundary considered in this study:

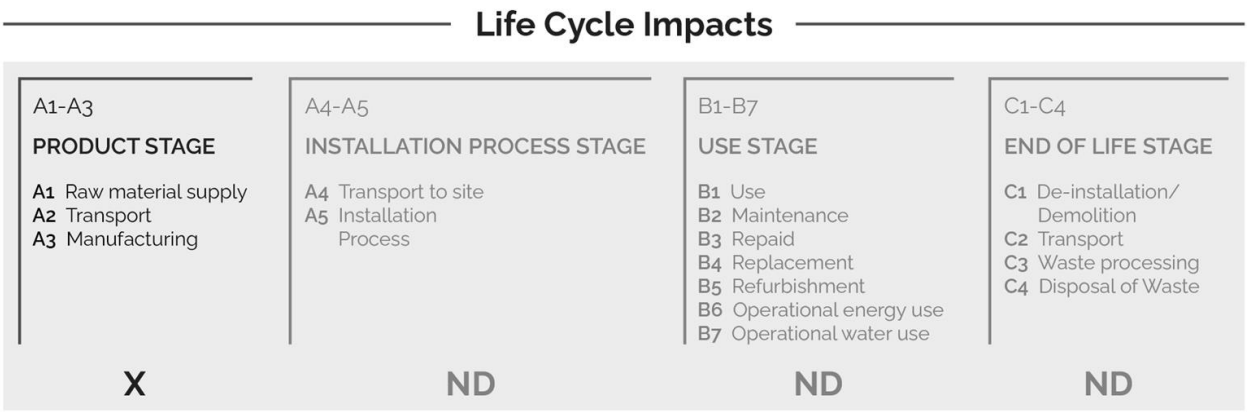

Figure 1: **General life cycle phases for consideration in a construction works system.**

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.

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

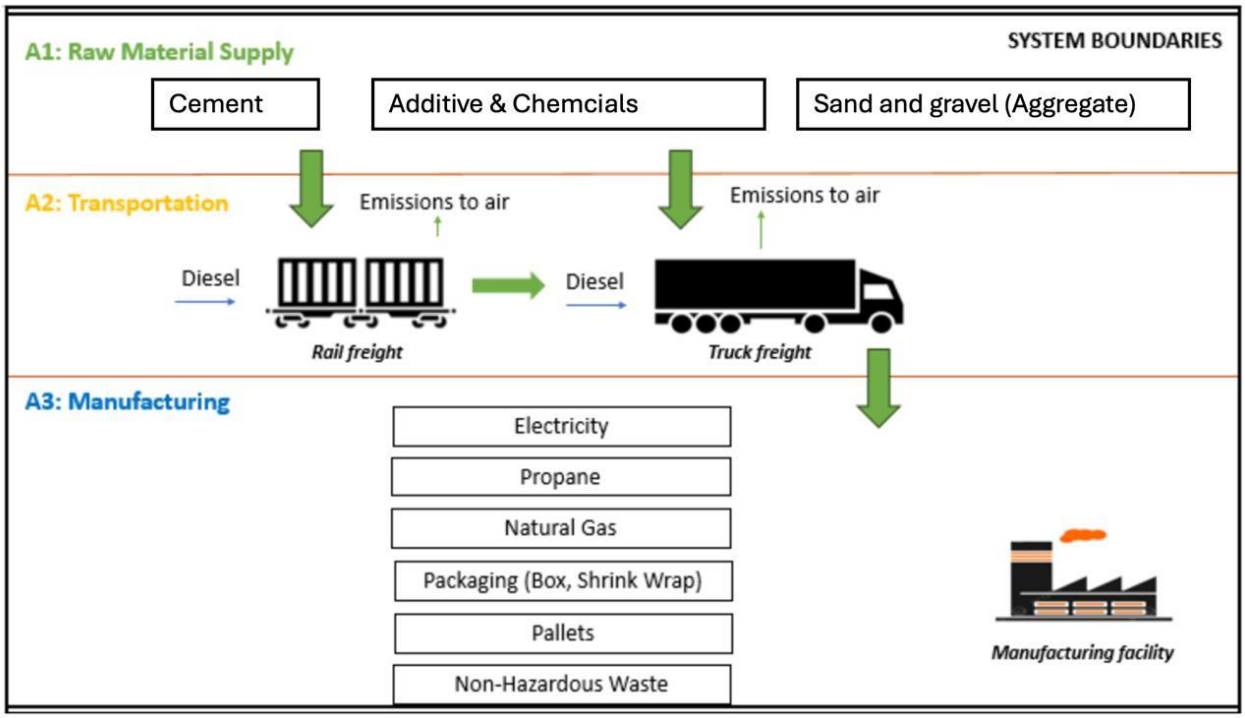

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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, earth-moving equipment, and laboratory equipment.
- Personnel-related activities (travel, furniture, office supplies);
- Energy use is related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by US Concrete Products, is located at their Baltimore facility in Mid-Atlantic. All operating data is formulated using the actual data from US Concrete Products 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 v3.10 database and a local EPD database in combination with primary data from US Concrete Products 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.

Table 3: **Reused or recycled components/materials at the A3 facility site**

Component/material for re-use/recycling	Value	Units	Re-used/recycled on-site or off-site
Pallets	85,050.54	kg	On-site

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

Raw material transport: Baltimore provided all the raw material data for the reference year 2023. Raw material transportation is based on the actual distance from the manufacturer. The transportation was reported using Baltimore primary data that consisted of the actual distance, mode of transport, and location in the city, state, and country. Packaged cementitious materials are manufactured by drying bulk-delivered aggregates, combining the dried sand and/or gravel with cement and admixtures. The bulk aggregates and cements are blended with the admixtures and then packaged into either small or bulk bags, then placed on pallets and wrapped with shrink wrap. The provision of raw materials relies on two modes of transportation: barge freight and truck freight.

Electricity: Electricity consumption values are for Baltimore. These values were directly reported from plant records.80% of the energy goes to packaging, 20% to dryer operations.

Process/space heating: The reported natural gas consumption value is based on the Baltimore plant primary information from utility bills for the reporting period.

Fuel required for machinery: Machinery-related fuel requirements were determined from direct Baltimore plant information.

Waste generation: Waste generation values are directly reported from the Baltimore 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 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: No recycling is assumed based on information in this cradle-to-gate study. pallets are reused on site.

Module A1 material losses: Due to lack of data, default loss factors of 2% were assumed.

Direct A3 emissions accounting: Direct emissions were modeled with the best available ecoinvent processes (see LCI list).

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 4: **LCI inputs assumed for module A1 (i.e., raw material supply)**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Crystalline silica	silica sand production/silica sand/RoW/kg	ecoinvent v3.10 in 2024	Wyoming	2024	2	3	2	3	3
Pea Gravel (limestone)	limestone quarry operation/limestone, unprocessed/RoW/kg	ecoinvent v3.10 in 2024	Maryland	2024	2	3	2	3	3
Barium Sulfate	barium sulfide production/barium sulfide/GLO/kg	ecoinvent v3.10 in 2024	Maryland	2024	2	3	2	3	3
Naphthalene sulfonic acid, formaldehyde polymer, sodium salt	naphthalene sulfonic acid production/naphthalene sulfonic acid/RoW/kg	ecoinvent v3.10 in 2024	Maryland	2024	2	3	2	3	3
Silica Fume	silica fume, densified, Recycled Content cut-off/silica fume, densified/GLO/kg	ecoinvent v3.10 in 2024	West Virginia, Mississipi	2024	2	3	2	3	3
Concrete Sand(sand)	sand quarry operation, extraction from river bed/sand/BR/kg	ecoinvent v3.10 in 2024	Maryland	2024	2	3	2	3	3
Calcium carbonate	calcium carbonate production, precipitated/calcium carbonate, precipitated/RoW/kg	ecoinvent v3.10 in 2024	Pennsylvania	2024	2	3	2	3	3
Fast Rock CSA	Fast Rock CTS	Program Operator: Labeling	Pennsylvania	07 Dece	2	3	2	3	3

		Sustainability- EPD ID: 8631a981-7ab4-4c84-b552-5243e37f9648		mber 2022					
Calcium Sulfate	Mine B Co-Product-CTS.Cement	Program Operator: Labeling Sustainability- EPD ID: 8631a981-7ab4-4c84-b552-5243e37f9648	Texas	07 December 2022	2	3	2	3	3
Fly Ash	Waste input produced off-site	See A3 inputs	Georgia	See A3 inputs	2	A3	2	A3	A3
Type IL Cement	Production of cement, general use cement Type IL/Type IL/US/kilogram	ecoinvent v3.10 in 2024	Maryland	2024	2	3	2	3	3
Type III Cement	Production of cement, general use high strength cement Type III/Type III/US/kilogram	ecoinvent v3.10 in 2024	Maryland	2024	2	3	2	3	3
CSA Cement	Rapidset CTS	Program Operator: Labeling Sustainability- EPD ID: 8631a981-7ab4-4c84-b552-5243e37f9648	Pennsylvania	07 December 2022	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. The majority of relevant background materials and processes were taken from ecoinvent v3.10 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 Packaged Cement Blends materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.10 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 levels 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's proprietary Packaged Cement Blends 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.

*Labeling Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Packaged Cement Blends 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 v3.10 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 5: **Life cycle impact categories and life cycle inventory metrics**

ID	LCIA.indicators	Abbreviations	Units
1	Climate change: global warming potential (GWP100)	GWP100	kg CO2-eq
2	Ozone depletion: ozone depletion potential (ODP)	ODP	kg CFC-11-eq
3	Acidification: acidification potential (AP)	AP	kg SO2-eq
4	Eutrophication: eutrophication potential	EP	kg N-eq
5	Smog formation potential	SFP	kg O3-eq
6	Energy resources: non-renewable: abiotic depletion potential (ADP): fossil fuels	ADPfossil	MJ
Inventory metrics			
7	Inventory indicators ISO21930: Cumulative Energy Demand - renewable energy resources	RPRE	MJ
8	Inventory indicators ISO21930: Renewable primary resources with energy content used as material (i.e., PERM)	PRM	MJ
9	Inventory indicators ISO21930: Cumulative Energy Demand - non-renewable energy resources	NRPRE	MJ
10	Inventory indicators ISO21930: Non-renewable primary resources with energy content used as material (i.e., PENRM)	NRPRM	kg
11	Inventory indicators ISO21930: use of secondary material	SM	MJ
12	Inventory indicators ISO21930: use of renewable secondary fuels	RSF	MJ
13	Inventory indicators ISO21930: recovered energy	RE	MJ
14	Inventory indicators ISO21930: use of net fresh water	FW	m3
15	Inventory indicators ISO21930: hazardous waste disposed	HWD	kg
16	Inventory indicators ISO21930: non-hazardous waste disposed	NHWD	kg
17	Inventory indicators ISO21930: high-level radioactive waste disposed	HLRW	kg
18	Inventory indicators ISO21930: intermediate and low-level radioactive waste disposed	ILLRW	kg
19	Inventory indicators ISO21930: materials for recycling	MR	kg
20	Inventory indicators ISO21930: materials for energy recovery	MER	kg
21	Inventory indicators ISO21930: exported energy - electricity	EEel	MJ
22	Inventory indicators ISO21930: exported energy - heat	EEheat	MJ

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

The following table reports the total LCA results for each product produced at the given packaged cement blends facility on a per 1 kg of dry blended and bagged product with packaging basis.

Table 6: **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 dry blended and bagged product with packaging basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	GWP100	ODP	AP	EP	SFP	ADPfossil
Unit	kg CO2-eq	kg CFC-11-eq	kg SO2-eq	kg N-eq	kg O3-eq	MJ
Minimum	0.138	9.19e-07	0.000289	0.000197	0.0322	5.53
Maximum	0.805	6.29e-06	0.00129	0.00125	0.199	36
Mean	0.286	1.99e-06	0.000508	0.000425	0.0653	11.6
Median	0.213	1.5e-06	0.000404	0.000312	0.05	8.78
Deck Mix AE 80lb bag	0.211	1.5e-06	4e-04	0.000311	0.0502	8.84
Deck Mix AE 4000 80lb bag	0.138	9.19e-07	0.000289	0.000197	0.0322	5.53
Deck Mix UW 80lb bag	0.215	1.45e-06	0.000407	0.000311	0.049	8.7

Deck Mix Advanced 80lb bag	0.211	1.42e-06	0.000401	0.000306	0.048	8.52
Deck Mix AE w/ Fibers 80lb bag	0.211	1.5e-06	4e-04	0.000311	0.0502	8.83
Deck Mix PM 80lb bag	0.211	1.5e-06	0.000401	0.000312	0.0502	8.83
Deck Mix FP 50lb bag	0.211	1.45e-06	0.000395	0.000315	0.0487	8.65
Deck Mix FP PM 50lb bag	0.211	1.45e-06	0.000395	0.000315	0.0486	8.65
Deck Mix LW 50lb bag	0.244	1.77e-06	0.000447	0.000371	0.0584	10.4
Deck Mix SCC 80lb bag	0.215	1.45e-06	0.000408	0.000312	0.0491	8.71
Deck Mix SCC PM 80lb bag	0.215	1.45e-06	0.000408	0.000312	0.049	8.7
Deck Pro 7100 50lb bag	0.259	1.96e-06	0.000468	4e-04	0.0639	11.3
Deck Pro 7101 50lb bag	0.26	1.96e-06	0.000468	4e-04	0.0639	11.3
US Anchor Grout 50lb bag	0.805	6.29e-06	0.00129	0.00125	0.199	36
US Cable Grout 50lb bag	0.805	6.29e-06	0.00129	0.00125	0.199	36
US Grout 715 80lb bag	0.336	2.53e-06	0.000601	0.000533	0.082	14.6
HP Grout 15 55lb bag	0.248	1.76e-06	0.000449	0.00038	0.0578	10.3
US Construction Grout 80lb bag	0.332	2.5e-06	0.000596	0.000527	0.0811	14.4
US Underwater Grout 50lb bag	0.303	2.26e-06	0.000555	0.000484	0.0737	13.1
HP Underwater Grout 80lb bag	0.218	1.53e-06	0.000406	0.000335	0.0508	8.96
Gunite 2020 50lb bag	0.202	1.46e-06	0.000383	0.000304	0.0487	8.54
Gunite 2020 80lb bag	0.202	1.46e-06	0.000383	0.000304	0.0487	8.55
Gunite 2024 50lb bag	0.202	1.46e-06	0.000383	0.000304	0.0487	8.54
Gunite 2020WP 50lb bag	0.202	1.46e-06	0.000383	0.000304	0.0487	8.54
Gunite 7000W 50lb bag	0.202	1.47e-06	0.000383	0.000306	0.0491	8.6
Gunite 7000W 80lb bag	0.202	1.47e-06	0.000383	0.000307	0.0491	8.61
Gunite 7001W 50lb bag	0.2	1.47e-06	0.000378	0.000306	0.049	8.57
Gunite 7001W 80lb bag	0.2	1.47e-06	0.000378	0.000306	0.049	8.57
Gunite 7000D 50lb bag	0.204	1.48e-06	0.000385	0.000307	0.0493	8.65
Gunite 7000D 80lb bag	0.204	1.48e-06	0.000386	0.000308	0.0493	8.65
Gunite 7001D 50lb bag	0.207	1.5e-06	0.00039	0.000312	0.05	8.78
Gunite 7001D 80lb bag	0.207	1.5e-06	0.00039	0.000312	0.05	8.78
Gunite 7041 80lb bag	0.173	1.25e-06	0.000339	0.000262	0.0422	7.33
Gunite 7424 50lb bag	0.224	1.59e-06	0.000413	0.000337	0.0513	8.8
Gunite Advanced 80lb bag	0.211	1.42e-06	0.000401	0.000306	0.048	8.52
HP Concrete 60lb bag	0.178	1.02e-06	0.000342	0.000239	0.0348	6.03
HP Concrete with Fibers 60lb bag	0.164	9.39e-07	0.000323	0.000218	0.0333	5.89
HP DOT Grade Repair Mortar 55lb bag	0.255	1.54e-06	0.000456	0.000353	0.0521	9.45
HP Cement 50lb bag	0.746	5.03e-06	0.00117	0.00109	0.157	28.1
HP Cement 2000lb bag	0.742	5.03e-06	0.00117	0.00109	0.157	28.1

HP LP Cement 50lb bag	0.565	3.79e-06	0.000893	0.000825	0.119	21.3
HP LP Cement 2000lb bag	0.564	3.79e-06	0.000893	0.000824	0.119	21.2
HP Multi-Purpose Repair Mortar 55lb bag	0.263	1.33e-06	0.000536	0.000367	0.0475	8.69
HP Hydraulic Cement 50lb bag	0.363	1.52e-06	0.00059	0.000432	0.0523	9.97
US Thin Patch 50lb bag	0.274	2.07e-06	0.000489	0.000422	0.0676	12
US Thin Patch V/O 50lb bag	0.273	1.82e-06	0.00048	0.000395	0.0603	10.8
US Thin Patch V/O w/ Fibers 50lb bag	0.273	1.82e-06	0.00048	0.000395	0.0603	10.8
US Floor Level 50lb bag	0.173	1.09e-06	0.000327	0.000247	0.0374	6.63

b) Resource Inventory Metrics:

Indicator/LCI Metric	**RPRE**	**PRM**	**NRPRE**	**NRPRM**	**SM**	**RSF**	**RE**	**FW**
Unit	**MJ**	**MJ**	**MJ**	**kg**	**MJ**	**MJ**	**MJ**	**m3**
Minimum	1.4	0.000684	1.42	4.48e-05	0.0149	0.000222	0.004	0.0029
Maximum	143	13	9.67	7.91	2.27	0.0014	1.03	0.0191
Mean	13.3	0.944	3.03	0.577	0.204	0.000496	0.0828	0.00621
Median	2.28	0.000913	2.3	5.97e-05	0.0438	0.000343	0.0065	0.00464
Deck Mix AE 80lb bag	2.28	0.000913	2.31	5.97e-05	0.0243	0.000343	0.00649	0.00463
Deck Mix AE 4000 80lb bag	1.4	0.000913	1.42	5.97e-05	0.0149	0.000222	0.004	0.0029
Deck Mix UW 80lb bag	2.21	0.000913	2.24	5.97e-05	0.0236	0.000334	0.00631	0.0045
Deck Mix Advanced 80lb bag	2.16	0.000912	2.18	5.96e-05	0.0432	0.000327	0.00618	0.00441
Deck Mix AE w/ Fibers 80lb bag	2.28	0.000913	2.31	5.97e-05	0.0243	0.000343	0.00648	0.00463
Deck Mix PM 80lb bag	2.28	0.00146	2.31	9.56e-05	0.0243	0.00036	0.00648	0.00463
Deck Mix FP 50lb bag	2.22	0.000783	2.24	5.12e-05	0.0236	0.000331	0.00634	0.00456
Deck Mix FP PM 50lb bag	2.21	0.000996	2.24	6.52e-05	0.0236	0.000338	0.00634	0.00455
Deck Mix LW 50lb bag	2.7	0.000685	2.73	4.48e-05	0.0287	0.000394	0.00769	0.00554
Deck Mix SCC 80lb bag	2.21	0.000913	2.24	5.97e-05	0.0236	0.000334	0.00632	0.0045
Deck Mix SCC PM 80lb bag	2.21	0.00133	2.24	8.69e-05	0.0236	0.000347	0.00631	0.0045
Deck Pro 7100 50lb bag	2.98	0.000919	3.01	6.01e-05	0.0433	0.00044	0.00846	0.00608
Deck Pro 7101 50lb bag	2.98	0.00109	3.01	7.16e-05	0.0442	0.000445	0.00846	0.00608

US Anchor Grout 50lb bag	9.57	0.000689	9.67	4.51e-05	0.123	0.00134	0.0271	0.0191
US Cable Grout 50lb bag	9.57	0.000689	9.67	4.51e-05	0.123	0.00134	0.0271	0.0191
US Grout 715 80lb bag	3.88	0.00222	3.89	0.0334	0.0411	0.000561	0.0111	0.00789
HP Grout 15 55lb bag	3.05	0.0176	2.71	0.0373	0.0311	0.000409	0.00913	0.00556
US Construction Grout 80lb bag	3.8	0.000913	3.85	0.0327	0.0404	0.000553	0.0108	0.0078
US Underwater Grout 50lb bag	3.44	0.000689	3.48	0.0384	0.0366	0.000496	0.0098	0.0071
HP Underwater Grout 80lb bag	2.65	0.0154	2.36	0.0359	0.0271	0.000366	0.00794	0.00488
Gunite 2020 50lb bag	2.22	0.000685	2.25	4.48e-05	0.0483	0.000328	0.00633	0.00457
Gunite 2020 80lb bag	2.22	0.000912	2.25	5.96e-05	0.0483	0.000335	0.00633	0.00457
Gunite 2024 50lb bag	2.22	0.000684	2.25	4.48e-05	0.0483	0.000328	0.00633	0.00457
Gunite 2020WP 50lb bag	2.22	0.000685	2.25	4.48e-05	0.0483	0.000328	0.00632	0.00457
Gunite 7000W 50lb bag	2.24	0.000689	2.27	4.51e-05	0.0444	0.000331	0.00639	0.00462
Gunite 7000W 80lb bag	2.25	0.000913	2.27	5.97e-05	0.0444	0.000339	0.00639	0.00462
Gunite 7001W 50lb bag	2.24	0.000685	2.27	4.48e-05	0.0444	0.000331	0.00639	0.00464
Gunite 7001W 80lb bag	2.25	0.000913	2.27	5.97e-05	0.0444	0.000339	0.00639	0.00464
Gunite 7000D 50lb bag	2.25	0.000689	2.28	4.51e-05	0.0428	0.000333	0.00641	0.00463
Gunite 7000D 80lb bag	2.25	0.000912	2.28	5.96e-05	0.0428	0.00034	0.00641	0.00463
Gunite 7001D 50lb bag	2.29	0.000685	2.31	4.48e-05	0.0431	0.000337	0.00651	0.0047
Gunite 7001D 80lb bag	2.29	0.000913	2.31	5.97e-05	0.0434	0.000345	0.00651	0.0047
Gunite 7041 80lb bag	1.91	0.000913	1.93	5.97e-05	0.036	0.000292	0.00543	0.00396
Gunite 7424 50lb bag	2.27	0.000685	2.27	4.48e-05	0.0451	0.000332	0.00644	0.00473
Gunite Advanced 80lb bag	2.16	0.000912	2.18	5.96e-05	0.0446	0.000327	0.00618	0.00441
HP Concrete 60lb bag	23.4	2.02	1.48	1.23	0.367	0.000339	0.163	0.00323
HP Concrete with Fibers 60lb bag	23.3	2.02	1.47	1.22	0.366	0.000338	0.163	0.00314
HP DOT Grade Repair Mortar 55lb bag	51.4	4.53	2.42	2.75	0.811	0.000606	0.363	0.00523

HP Cement 50lb bag	78.6	6.56	7.26	3.99	1.22	0.0014	0.538	0.0152
HP Cement 2000lb bag	78.6	6.56	7.26	3.98	1.22	0.0014	0.537	0.0152
HP LP Cement 50lb bag	6.18	0.035	5.43	0.0196	0.0639	0.000803	0.0185	0.0111
HP LP Cement 2000lb bag	6.15	0.0337	5.43	0.0188	0.0636	0.000808	0.0184	0.0111
HP Multi-Purpose Repair Mortar 55lb bag	57.2	5.1	2.11	3.1	0.906	0.000592	0.407	0.00472
HP Hydraulic Cement 50lb bag	143	13	2.33	7.91	2.27	0.00107	1.03	0.00571
US Thin Patch 50lb bag	3.16	0.000689	3.19	4.51e-05	0.0427	0.000457	0.00897	0.00644
US Thin Patch V/O 50lb bag	32	2.69	2.83	1.64	0.499	0.000564	0.22	0.00592
US Thin Patch V/O w/ Fibers 50lb bag	32	2.69	2.83	1.63	0.499	0.000564	0.22	0.00592
US Floor Level 50lb bag	1.92	0.0122	1.69	0.00658	0.0196	0.000265	0.00581	0.0035

c) Waste/output Inventory Metrics:

Indicator/LCI Metric	**HWD**	**NHWD**	**HLRW**	**ILLRW**	**MR**	**MER**	**EEel**	**EEheat**
Unit	**kg**	**kg**	**kg**	**kg**	**kg**	**kg**	**MJ**	**MJ**
Minimum	0.0516	1.02	1.56e-06	3.75e-06	0.000195	7.81e-07	0.002	0.00197
Maximum	0.351	6.96	1.06e-05	2.55e-05	0.00133	0.628	1.79	0.0133
Mean	0.11	2.19	3.46e-06	8.16e-06	0.000435	0.046	0.134	0.00425
Median	0.083	1.65	2.54e-06	6.09e-06	0.000317	1.27e-06	0.00326	0.00319
Deck Mix AE 80lb bag	0.0838	1.66	2.54e-06	6.09e-06	0.000317	1.26e-06	0.00324	0.00319
Deck Mix AE 4000 80lb bag	0.0516	1.02	1.56e-06	3.75e-06	0.000195	7.81e-07	0.002	0.00197
Deck Mix UW 80lb bag	0.0814	1.61	2.47e-06	5.92e-06	0.000308	1.23e-06	0.00315	0.00311
Deck Mix Advanced 80lb bag	0.0796	1.58	2.41e-06	5.79e-06	0.000301	1.21e-06	0.00308	0.00305
Deck Mix AE w/ Fibers 80lb bag	0.0838	1.66	2.54e-06	6.09e-06	0.000317	1.26e-06	0.00324	0.00319
Deck Mix PM 80lb bag	0.0838	1.66	2.54e-06	6.09e-06	0.000317	1.27e-06	0.00324	0.00319
Deck Mix FP 50lb bag	0.0817	1.62	2.48e-06	5.94e-06	0.000309	1.24e-06	0.00316	0.00313

Deck Mix FP PM 50lb bag	0.0816	1.62	2.48e-06	5.94e-06	0.000309	1.24e-06	0.00316	0.00313
Deck Mix LW 50lb bag	0.0992	1.97	3.01e-06	7.21e-06	0.000375	1.5e-06	0.00384	0.00379
Deck Mix SCC 80lb bag	0.0815	1.61	2.47e-06	5.93e-06	0.000308	1.23e-06	0.00315	0.00311
Deck Mix SCC PM 80lb bag	0.0814	1.61	2.47e-06	5.92e-06	0.000308	1.23e-06	0.00315	0.00311
Deck Pro 7100 50lb bag	0.109	2.17	3.31e-06	7.95e-06	0.000413	1.64e-06	0.00423	0.00416
Deck Pro 7101 50lb bag	0.109	2.17	3.31e-06	7.95e-06	0.000413	1.64e-06	0.00423	0.00416
US Anchor Grout 50lb bag	0.351	6.96	1.06e-05	2.55e-05	0.00133	5.26e-06	0.0136	0.0133
US Cable Grout 50lb bag	0.351	6.96	1.06e-05	2.55e-05	0.00133	5.26e-06	0.0136	0.0133
US Grout 715 80lb bag	0.142	2.81	4.29e-06	1.03e-05	0.000535	0.000312	0.00565	0.00538
HP Grout 15 55lb bag	0.0988	1.96	3e-06	7.2e-06	0.000377	0.00415	0.0062	0.00376
US Construction Grout 80lb bag	0.14	2.78	4.24e-06	1.02e-05	0.000528	2.1e-06	0.00541	0.00532
US Underwater Grout 50lb bag	0.127	2.52	3.84e-06	9.21e-06	0.000478	1.9e-06	0.0049	0.00482
HP Underwater Grout 80lb bag	0.0862	1.71	2.62e-06	6.28e-06	0.000329	0.00355	0.00537	0.00328
Gunite 2020 50lb bag	0.0817	1.62	2.48e-06	5.94e-06	0.000308	1.23e-06	0.00316	0.00311
Gunite 2020 80lb bag	0.0817	1.62	2.48e-06	5.94e-06	0.000309	1.23e-06	0.00316	0.00311
Gunite 2024 50lb bag	0.0817	1.62	2.48e-06	5.94e-06	0.000309	1.23e-06	0.00316	0.00311
Gunite 2020WP 50lb bag	0.0817	1.62	2.48e-06	5.94e-06	0.000308	1.23e-06	0.00316	0.00311
Gunite 7000W 50lb bag	0.0825	1.63	2.5e-06	6e-06	0.000312	1.24e-06	0.00319	0.00314
Gunite 7000W 80lb bag	0.0825	1.64	2.5e-06	6e-06	0.000312	1.24e-06	0.00319	0.00314
Gunite 7001W 50lb bag	0.0825	1.64	2.5e-06	6e-06	0.000312	1.24e-06	0.00319	0.00314
Gunite 7001W 80lb bag	0.0825	1.64	2.5e-06	6e-06	0.000312	1.24e-06	0.00319	0.00314
Gunite 7000D 50lb bag	0.0828	1.64	2.51e-06	6.02e-06	0.000313	1.25e-06	0.0032	0.00315
Gunite 7000D 80lb bag	0.0828	1.64	2.51e-06	6.02e-06	0.000313	1.25e-06	0.0032	0.00315
Gunite 7001D 50lb bag	0.0841	1.67	2.55e-06	6.11e-06	0.000318	1.27e-06	0.00325	0.0032
Gunite 7001D 80lb bag	0.0841	1.67	2.55e-06	6.11e-06	0.000318	1.27e-06	0.00325	0.0032

Gunite 7041 80lb bag	0.0701	1.39	2.13e-06	5.1e-06	0.000265	1.06e-06	0.00271	0.00267
Gunite 7424 50lb bag	0.0832	1.68	2.52e-06	6.06e-06	0.000323	1.25e-06	0.00326	0.00324
Gunite Advanced 80lb bag	0.0796	1.58	2.41e-06	5.79e-06	0.000301	1.21e-06	0.00308	0.00305
HP Concrete 60lb bag	0.0537	1.08	1.89e-06	4.22e-06	0.000241	0.0974	0.28	0.00216
HP Concrete with Fibers 60lb bag	0.053	1.05	1.87e-06	4.16e-06	0.000233	0.0973	0.279	0.00209
HP DOT Grade Repair Mortar 55lb bag	0.0869	1.72	3.22e-06	6.99e-06	4e-04	0.218	0.626	0.00346
HP Cement 50lb bag	0.264	5.33	8.87e-06	2.02e-05	0.00113	0.317	0.913	0.0105
HP Cement 2000lb bag	0.264	5.33	8.87e-06	2.02e-05	0.00113	0.316	0.913	0.0105
HP LP Cement 50lb bag	0.199	4.03	6.07e-06	1.46e-05	0.000785	0.00845	0.0127	0.00781
HP LP Cement 2000lb bag	0.199	4.02	6.06e-06	1.46e-05	0.000784	0.00807	0.0125	0.00781
HP Multi-Purpose Repair Mortar 55lb bag	0.0765	1.51	2.99e-06	6.34e-06	0.000369	0.245	0.705	0.00316
HP Hydraulic Cement 50lb bag	0.0823	1.65	4.17e-06	7.91e-06	0.000526	0.628	1.79	0.00365
US Thin Patch 50lb bag	0.116	2.3	3.51e-06	8.42e-06	0.000438	1.74e-06	0.00448	0.00441
US Thin Patch V/O 50lb bag	0.102	2.02	3.46e-06	7.83e-06	0.00043	0.13	0.374	0.00398
US Thin Patch V/O w/ Fibers 50lb bag	0.102	2.03	3.46e-06	7.84e-06	0.00043	0.13	0.374	0.00399
US Floor Level 50lb bag	0.0616	1.22	1.88e-06	4.5e-06	0.000236	0.00282	0.004	0.00237

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