ENVIRONMENTAL PRODUCT DECLARATION

Lafarge Stoney Creek Slag Cement Plant

HOLCIM

About this EPD

This is a cradle-to-gate environmental product declaration for slag cement as produced at Lafarge's Stoney Creek, ON plant. The Life Cycle Assessment (LCA) was prepared according to ISO 14025:2006, ISO 21930:2017 (the core PCR) and the NSF product category rules for slag cement (subcategory PCR) and ASTM International's EPD program operator rules. This EPD is intended for business-to-business (B-to-B) audiences.

General Summary

EPD Commissioner and Owner	**Lafarge Canada** 6509 Airport Road Mississauga, Ontario L4V 1S7 www.lafarge.ca
	Lafarge, a member of LafargeHolcim, provided both LCI and meta-data for slag granulation and slag cement manufacturing for the reference year 2020. The owner of the declaration is liable for the underlying information and evidence. *For any explanatory material, regarding this EPD, please contact Marie-Andree Guindon (marie-andree.guindon@lafarge.com).*
Product Group and Name	*Slag Cement, UN CPC 3744, UNSPSC Code 30111601*
Product Definition	***Slag Cement:*** *Slag cement, UNSD CPC 3744 and UNSPSC Code 30111601, is defined as granulated blast-furnace slag that has been ground to cement fineness, with or without additions, and is a hydraulic cement [2].*
Product Category Rules (PCR)	NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Slag Cement, v2.0, December 2020 [2].
Date of Issue & Validity Period	26.04.2023 – 5 years
Declared Unit	1 metric ton of slag cement

EPD and Project Report Information

Program Operator	ASTM International
Declaration Number	EPD 455
Declaration Type	Cradle-to-gate (modules A1 to A3). Facility and product-specific.
Applicable Countries	Canada and United States
Product Applicability	Slag cement is a supplementary cementitious material (SCM) typically used in concretes and mortars to replace a portion of the portland cement in, and augment the performance of, concrete and mortars.
Content of the Declaration	This declaration follows Section 9; Content of an EPD, NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Slag Cement, v2.0, December 2020 [2].
This EPD was independently verified by ASTM in accordance with ISO 14025 and the reference PCR: Internal External X	Tim Brooke ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken PA 19428-2959, USA cert@astm.org
Notes	The EPD results are computed using the N.A. version 3.0 of GCCA Industry EPD tool for Cement and Concrete (https://concrete-epd-tool.org)
LCA report and EPD Prepared by:	James Salazar and Hannah Renaud Athena Sustainable Materials Institute 280 Albert Street, Suite 404 Ottawa, Ontario, Canada K1P 5G8 info@athenasmi.org

This EPD verified in accordance with ISO 14025, ISO 14040/44, and the reference PCR.

PCR Information

Program Operator	NSF International
Reference PCR	Product Category Rules for Preparing an Environmental Product Declaration for Slag Cement, v2.0, December 2020 [2].
PCR review was conducted by:	Thomas P. Gloria, PhD (Chair), Industrial Ecology Consultants, t.gloria@industrial-ecology.com Mr. Jack Geibig, EcoForm Mr. Bill Stough, Sustainable Research Group

Lafarge Cement & Production Facility

Lafarge is a member of LafargeHolcim, the global leader in building materials and solutions. As the largest provider of diversified construction materials in Canada Lafarge's ambition is to lead the industry in reducing carbon emissions and shifting towards low-carbon construction.

In Canada, LafargeHolcim companies include 400 across Canada and employ 6,000 people. Our customers rely on us to help them design and build better communities with innovative solutions that deliver structural integrity and eco-efficiency.

Facility Name: Lafarge Stoney Creek Slag Cement Plant,
360 Jones Rd, Stoney Creek, ON L8E 5N2

Product Description

Slag cement, UN CPC 3744, is defined in ASTM C125 as granulated blast-furnace slag that has been ground to cement fineness, with or without additions, and that is a hydraulic cement [2]. Slag cement is a supplementary cementitious material (SCM). Iron blast furnace slag (BFS) is a waste material of pig iron production and as such is categorized as a "recovered material" [2]. To transform iron BFS, so it can be used as a SCM in concrete and mortars, it is first rapidly quenched with water to form granules known as Granulated Blast Furnace Slag (GBFS). It then undergoes dewatering, crushing of oversized material only (if applicable), and storage at the granulating facilities. GBFS is then shipped to the grinding facilities where it undergoes dewatering/drying (if applicable), iron removal from slag granules (if applicable), crushing (if applicable), grinding, and packaging (if applicable). The slag cement is then stored onsite.

Products and Standards

Inputs	**General Use (GU)** CSA A3001
Slag Granules	99.9%
Grinding Aids	<0.1%
Total	100%

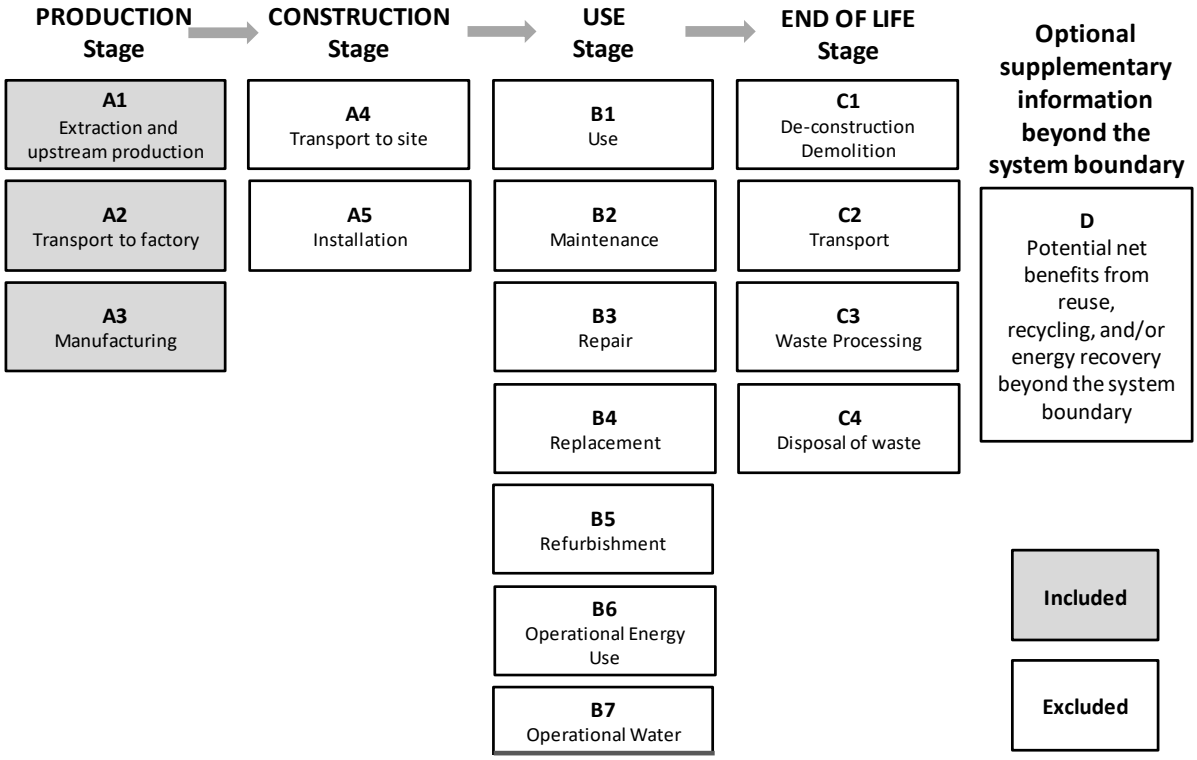
Applicable Standards:
ASTM C989/C989M, Standard Specification for Slag Cement for Use in Concrete and Mortars
AASHTO M 302, Standard Specification for Slag Cement for Use in Concrete and Mortars
CSA A3001, Cementitious Materials for Use in Concrete
ASTM C125 Standard Terminology Relating to Concrete and Concrete Aggregates

Declared Unit

The declared unit is one metric tonne (1000kg) of slag cement.

System Boundary

This EPD is a cradle-to-gate EPD covering the production stage (A1-A3) as depicted in the figure below. The production stage includes extraction and recovery of raw materials (cradle) through the manufacture of slag cement ready for shipment (gate). Downstream activity stages - Construction, Use, End-of-life, and Optional supplementary information beyond the system boundary - are excluded from the system boundary.



Items *excluded* from the system boundary include:

- Production, manufacture, and construction of manufacturing capital goods and infrastructure
- Production and manufacture of production equipment, delivery vehicles, and laboratory equipment
- Personnel-related activities (travel, furniture, and office supplies)
- Energy and water use related to company management and sales activities that may be located either within the factory site or at another location

Cut-off Criteria

The cut-off criteria as per NSF PCR, Section 7.1.8 [2] and ISO 21930, 7.1.8 [3] were followed. Per ISO 21930, all input/output data required were collected and included in the LCI modelling. No substances with hazardous and toxic properties that pose a concern for human health and/or the environment were identified in the framework of this EPD. Any plant specific data gaps for the reference year 2020 (e.g., amount of lubricants) were filled in with industry data (secondary data).

Data Collection

Gate-to-gate input/output flow data were collected for the following processes for the reference year 2020:

- Stoney Creek Slag Cement Manufacture.

Allocation Rules

Allocation follows the requirements and guidance of ISO 14044 Clause 4.3.4 [5], NSF PCR [2], and ISO 21930 section 7.2 [3]. The sub-category PCR recognizes iron blast furnace slag as a recovered material and thus the environmental impacts allocated to raw slag are limited to the treatment and transportation required to use as a material input. “Mass” was used as the physical parameter for allocating flows between slag cement and other co-products to calculate the input energy flows (e.g., electricity, natural gas, diesel), packaging materials, freshwater consumption, process emissions to air, water and land and waste flows (if applicable). LCI modeling did consider the plant specific manufacturing yield.

Data Quality Requirements and Assessment

Data Quality Requirements	Description
Technology Coverage	Data represents the prevailing technology in use at the Stoney Creek facility. Whenever available, for all upstream and core material and processes, North American typical or average industry LCI datasets were utilized. Technological representativeness is characterized as “high”.
Geographic Coverage	The geographic region considered is Canada. The electricity was modeled based on the Ontario provincial grid mix. *Geographical representativeness is characterized as "high".*
Time Coverage	Activity (primary) data are representative of 2020 calendar year (12 months). -Stoney Creek slag granulation and manufacturing - In-bound/out-bound transportation data - primary data collected for granulation and slag cement manufacturing plant. - Generic data: the most appropriate LCI datasets were used as found in the ecoinvent v.3.6 database for US and global, December 2020 and US LCI Database. *Temporal representativeness is characterized as “high”.*
Completeness	All relevant, specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to complete production profile for Stoney Creek slag cement.

Consistency	All relevant, specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to complete production profile for Stoney Creek slag cement. The relevant background materials and processes were taken from the US LCI Database, ecoinvent v 3.5 LCI database for US, and modeled in Athena LCA Software (2022). The completeness of the cradle-to-gate process chain in terms of process steps is rigorously assessed across product system.
Reproducibility	Internal reproducibility is possible since the data and the models are stored and available in Stoney Creek LCI database developed in Athena LCA Software, 2022. A high level of transparency is provided throughout the report as the LCI profile is presented for each of the declared products as well as major upstream inputs. Key primary (manufacturer specific) and secondary (generic) LCI data sources are also summarized in the background report. External reproducibility is not possible as the background report is confidential.
Transparency	Activity and LCI datasets are disclosed in the project report, including all data sources.

Life Cycle Impact Assessment Results: Stoney Creek, ON Slag Cement

This section summarizes the product stage life cycle impact assessment (LCIA) results including resource use and waste generated metrics based on the cradle-to-gate life cycle inventory inputs and outputs analysis. The results are calculated based on 1 metric ton of slag cement as produced at the Stoney creek, ON plant. It should be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks [4], [5]. Further, a number of LCA impact categories and inventory items are still emerging or under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting results for these categories – identified with an "*" [2].

EPDs based on cradle-to-gate and cradle-to-gate with options information modules shall not be compared. Further, EPDs based on a declared unit shall not be used for comparisons [2]. Environmental declarations from different programs may not be comparable [7]. EPDs are comparable only if they comply with ISO 21930, use the same, sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works [3].

Production Stage EPD Results: Stoney Creek, ON– per Metric Tonne

Impact category and inventory indicators	Unit	A1, Extraction and upstream production	A2, Transport to factory	A3, Manufacturing	Total
Global warming potential, GWP 100, AR5	kg CO2	1.80	8.98	38.74	49.52
Ozone depletion potential, ODP	kg CFC-	2.91E-07	3.53E-10	1.29E-06	1.58E-06
Smog formation potential, SFP	kg O3	0.19	4.41	1.00	5.60
Acidification potential, AP	kg SO2	0.01	0.16	0.27	0.44
Eutrophication potential, EP	kg N eq	2.91E-03	0.01	0.03	0.04
Abiotic depletion potential for non-fossil mineral resources, ADP elements*	kg Sb eq	1.70E-06	0.00E+00	5.78E-05	5.95E-05
Abiotic depletion potential for fossil resources, ADP fossil	MJ LHV	3.11	119.45	578.80	701.36
Renewable primary resources used as an energy carrier (fuel), RPRE*	MJ LHV	3.01	0.00	131.87	134.88
Renewable primary resources with energy content used as material, RPRM *	MJ LHV	0.00	0.00	0.00	0.00
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*	MJ LHV	28.06	126.64	1652.72	1807.42
Non-renewable primary resources with energy content used as material, NRPRM	MJ LHV	0.00	0.00	0.00	0.00
Secondary materials, SM *	kg	0.00	0.00	0.00	0.00
Renewable secondary fuels, RSF *	MJ LHV	0.00	0.00	0.00	0.00
Non-renewable secondary fuels, NRSF *	MJ LHV	15.73	0.00	0.00	15.73
Recovered energy, RE *	MJ LHV	0.00	0.00	0.00	0.00
Consumption of freshwater, FW	m3	0.00	0.00	0.00	0.00
Hazardous waste disposed, HWD *	kg	2.91E-03	0.00	0.00	2.91E-03
Non-hazardous waste disposed, NHWD*	kg	3.01E-05	0.00	0.00	3.01E-05
High-level radioactive waste, conditioned, to final repository, HLRW *	m3	6.91E-09	0.00	4.01E-06	4.01E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW *	m3	1.10E-07	0.00	2.85E-06	2.96E-06
Components for re-use, CRU *	kg	0.00	0.00	0.00	0.00
Materials for recycling, MR *	kg	0.00	0.00	0.00	0.00
Materials for energy recovery, MER *	kg	0.00	0.00	0.00	0.00
Recovered energy exported from the product system, EE *	MJ LHV	0.00	0.00	0.00	0.00
Additional Inventory Parameters for Transparency					
Emissions from calcination	kg CO_2 eq	0.00	0.00	0.00	0.00
Biogenic CO2, reporting the removals and emissions of biogenic carbon within	kg CO_2 eq	0.00	0.00	0.00	0.00

Table Notes:
1) (x) Not all LCA datasets for upstream materials include these impact categories and thus results may be incomplete.
2) (*) Use caution when interpreting results for these categories.

LCA Interpretation

The Manufacturing module (A3) drives most of the potential environmental impacts. Manufacturing impacts are primarily driven by energy use (electricity and thermal fuels) used during the drying and grinding of slag granules. Raw material extraction (A1) is a minor contributor to the overall EPD results. Transportation (A2) contributes significantly to overall smog formation and acidification impacts (>10%) but otherwise is a minor contributor to the overall environmental footprint.

References

1. 1. ASTM C989/ C989M, Standard Specification for Slag Cement for Use in Concrete and Mortars.
2. 2. NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Slag Cement, v2.0, December 2020.
3. 3. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
4. 4. ISO 14040:2006/Amd 1:2020 Environmental management - Life cycle assessment - Principles and framework.
5. 5. ISO 14044:2006/Amd1:2017/Amd2:2020 Environmental management - Life cycle assessment - Requirements and guidelines.
6. 6. NSF International, Product Category Rule Environmental Product Declarations, PCR for Concrete, February 2020.
7. 7. ISO 14025:2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
8. 8. ISO 14021:2016 Environmental labels and declarations -- Self-declared environmental claims (Type II environmental labelling).
9. 9. ASTM. (2020). General Program Instructions, Version: 8.0. ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs).
10. 10. PRé 2019.SimaPro LCA Software v9.2.0.2, 2022. https://simapro.com/, accessed 08-2020.
11. 11. ACLCA 2019, Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. The American Centre for Life Cycle Assessment. May, 2019. https://aclca.org/aclca-iso-21930-guidance/, accessed 02-2022.