

AMRIZE SOUTH CHICAGO SLAG CEMENT PLANT

ENVIRONMENTAL PRODUCT DECLARATION



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ABOUT THIS EPD

This cradle-to-gate environmental product declaration for slag cement as produced at Amrize Cement's South Chicago's plant. The life cycle assessment 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 environmental product declaration (EPD) is intended for business-to-business audiences.

GENERAL SUMMARY

EPD Commissioner and Owner



Amrize Cement Inc.
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Chicago, IL 60631
Phone: 626-852-6200
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Amrize provided both LCI and meta-data for slag granulation and slag cement manufacture for reference year 2019. The owner of the declaration is liable for the underlying information and evidence.

For any explanatory material, regarding this EPD, please contact Sonia Gagnon (sonia.gagnon@amrize.com).

Product Group and Name	Slag Cement, UNSD CPC 3744, UNSPSC Code 30111601
Product Definition	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	31.03.2022 – 5 years
Declared Unit	1 metric ton of slag cement

EPD AND PROJECT REPORT INFORMATION

Program Operator	ASTM International
Declaration Number	EPD 298
Declaration Type	Cradle-to-gate (modules A1 to A3). Facility and product-specific
Applicable Countries	United States and Canada
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
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The Project Report

A Cradle-to-Gate Life Cycle Assessment of Slag Cement produced by Amrize Cement Inc., March 2022.

LCA report and EPD Prepared by:



Athena
Sustainable Materials
Institute

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The EPD project report was independently verified by in accordance with ISO 14025, ISO 14040/44, and the reference PCR:

Thomas P. Gloria, Ph. D.
Industrial Ecology Consultants
35 Bracebridge Rd.
Newton, MA

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,
Mr. Jack Geibig, EcoForm
Mr. Bill Stough, Sustainable Research Group

AMRIZE & PRODUCTION FACILITY

Facility Name:

Amrize South Chicago Plant
2150 East 130th Street, Chicago, IL 60633

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	Quantity (%)
Slag Granules	99.9%
Grinding Aids	<0.1%
Total	100%

Applicable Standards:

As an SCM in concrete:

- 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*

As a constituent of blended cement

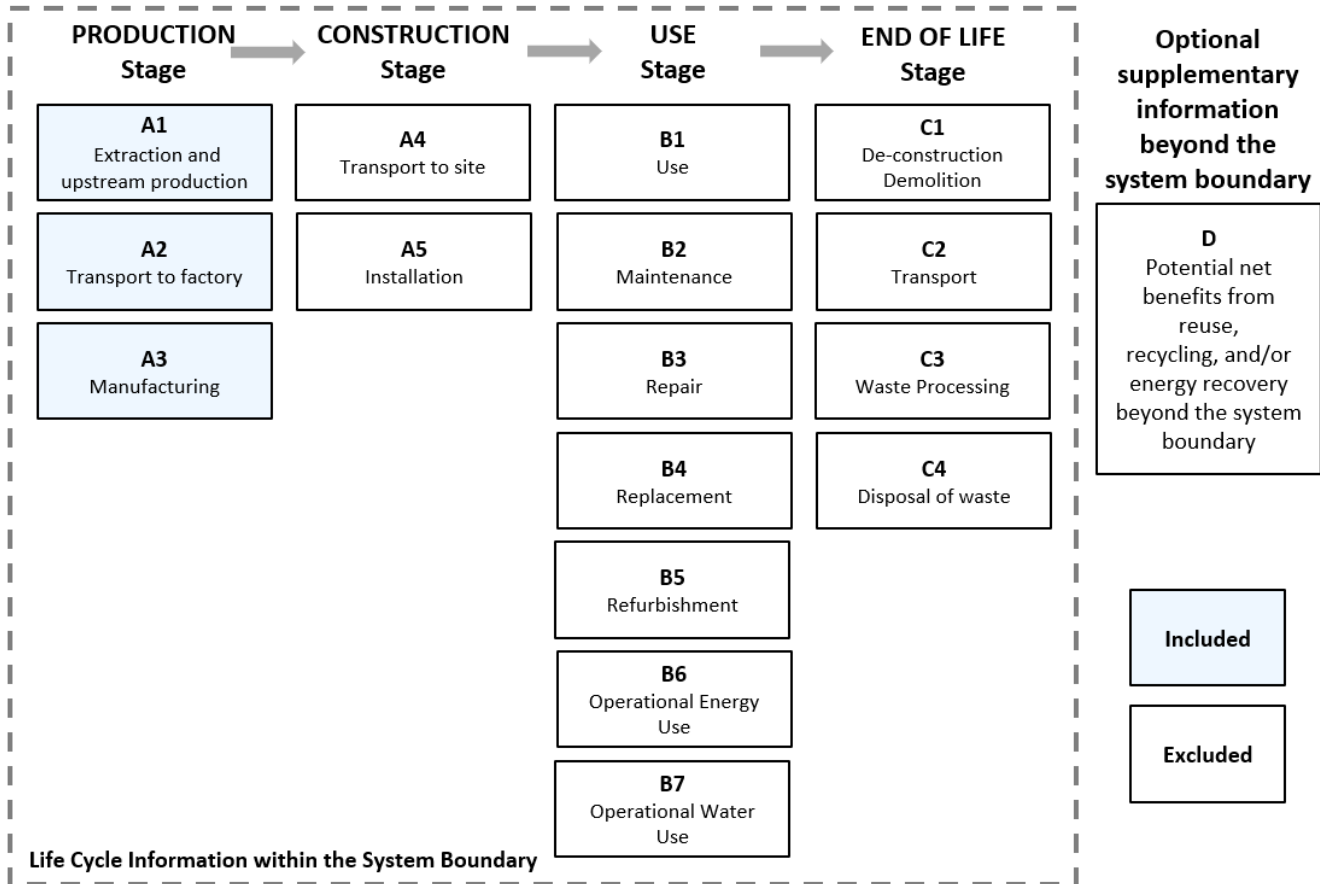
- ASTM C595/C595M, *Standard Specification for Blended Hydraulic Cements*
- AASHTO M 240M/M 240, *Standard Specification for Blended Hydraulic Cements*
- ASTM C219, *Standard Terminology Relating to Hydraulic Cement*.

DECLARED UNIT

The declared unit is one metric ton (1000 kg) 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. The South Chicago slag grinding plant sources its granulated slag input from a facility it operates in East Chicago adjacent to a steel mill. This EPD also includes, and is based on, life cycle inventory data collected from the East Chicago granulation facility.



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 2019 (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 2019:

- East Chicago granulation and South Chicago 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 both the East Chicago granulation facility and the South Chicago grinding facility. Whenever available, for all upstream and core material and processes, North American typical or average industry LCI datasets were utilized. <i>Technological representativeness is characterized as "high".</i>
Geographic Coverage	The geographic region considered is U.S. <i>Geographical representativeness is characterized as "high".</i>
Time Coverage	Activity (primary) data are representative of 2019 calendar year (12 months). - East Chicago slag granulation, - South Chicago slag cement 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.3.5 database for US and global, 2018 and US LCI Database. US LCI database (empty/missing LCI datasets) are substituted with ecoinvent v3.5 LCI datasets. <i>Temporal representativeness is characterized as "high".</i>
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 South Chicago slag cement. The relevant background materials and processes were taken from the US LCI Database (adjusted for known data placeholders), ecoinvent v 3.5 LCI database for US, and modeled in SimaPro software v.9.2.0.2, 2022. The completeness of the cradle-to-gate process chain in terms of process steps is rigorously assessed for all cement product systems
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 South Chicago 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 SimaPro software v.9.2.0.2, 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 <i>Amrize_Athena LCI database</i> developed in SimaPro, 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.
Uncertainty	A <i>sensitivity check</i> was conducted to assess the reliability of the EPD results and conclusions by determining how they are affected by uncertainties in the data or assumptions on calculation of LCIA and energy indicator results.

LIFE CYCLE IMPACT ASSESSMENT RESULTS: SOUTH CHICAGO 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 South Chicago, IL 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: South Chicago, IL – per Metric Ton

Impact category and inventory indicators	Unit	A1, Extraction and upstream production	A2, Transport to factory	A3, Manufacturing	Total
Global warming potential, GWP 100 ¹⁾ , AR5	kg CO ₂ eq	3	3.9	88.4	95
Ozone depletion potential, ODP ²⁾	kg CFC-11 eq	5.5E-07	1.6E-10	1.1E-05	1.1E-05
Smog formation potential, SFP ²⁾	kg O ₃ eq	0.4	1.2	2.1	3.6
Acidification potential, AP ²⁾	kg SO ₂ eq	0.01	0.04	0.23	0.28
Eutrophication potential, EP ²⁾	kg N eq	0.00	2.7E-03	2.4E-01	0.25
Abiotic depletion potential for non-fossil mineral resources, ADP elements ^{3)*}	kg Sb eq	1.6E-06	0.0E+00	1.0E-04	1.0E-04
Abiotic depletion potential for fossil resources, ADP fossil ²⁾	MJ surplus LHV	5	8	116	129
Renewable primary resources used as an energy carrier (fuel), RPR _E ^{*)}	MJ LHV	0.1	0.0	42.6	42.7
Renewable primary resources with energy content used as material, RPR _M ^{4) *)}	MJ LHV	0	0	0	0
Non-renewable primary resources used as an energy carrier (fuel), NRPR _E ^{*)}	MJ LHV	36	53	1,469	1,558
Non-renewable primary resources with energy content used as material, NRPR _M ^{4) *)}	MJ LHV	0	0	0	0
Secondary materials, SM ^{4) *)}	kg	1137	0	0	1,137
Renewable secondary fuels, RSF ^{4) *)}	MJ LHV	0	0	0	0
Non-renewable secondary fuels, NRSF ^{4) *)}	MJ LHV	0	0	0	0
Recovered energy, RE ^{4) *)}	MJ LHV	0	0	0	0
Consumption of freshwater, FW ⁴⁾	m ³	3.8E-03	0	1.1E-03	4.8E-03
Hazardous waste disposed, HWD ^{4) *)}	kg	3.2E-03	0	0	3.2E-03

Non-hazardous waste disposed, NHWD ⁴⁾ *)	kg	0	0	1.5E-01	1.5E-01
High-level radioactive waste, conditioned, to final repository, HLRW ⁴⁾ *)	m ³	2.5E-10	0	2.2E-07	2.2E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW ⁴⁾ *)	m ³	1.9E-07	0	3.1E-06	3.3E-06
Components for re-use, CRU ⁴⁾ *)	kg	0	0	0	0
Materials for recycling, MR ⁴⁾ *)	kg	0	0	0.18	0.18
Materials for energy recovery, MER ⁴⁾ *)	kg	0	0	0	0
Recovered energy exported from the product system, EE ⁴⁾ *)	MJ LHV	0	0	0	0

Additional Inventory Parameters for Transparency

Emissions from calcination	kg CO ₂ eq	0	0	0	0
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Table Notes:

¹⁾ Calculated as per U.S EPA TRACI v2.1, with IPCC 2013 (AR 5), SimaPro v 9.2.0.2 2022 [10].

GWP 100, excludes biogenic CO₂ removals and emissions associated with biobased products; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5), TRACI v2.1 with AR5, v1.05 [10].

²⁾ Calculated as per U.S EPA TRACI v2.1, SimaPro v 9.2.0.2 2022 [10].

³⁾ ADP elements is calculated as per CML-IA Baseline V3.05, SimaPro v 9.2.0.2 [10].

⁴⁾ Calculated as per ACLCA ISO 21930 Guidance [11].

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.

ADDITIONAL ENVIRONMENTAL INFORMATION

Environmental Protection and Equipment

Amrize manufacturing facilities comply with the U.S. environmental protection requirements, monitor and report the emissions to air during the manufacturing process as per the following:

- EPCRA Section 313 Toxic Release Inventory reporting (U.S) <https://www.epa.gov/toxics-release-inventory-tri-program>, accessed 02-2022.

The South Chicago facility is both ISO 9001 and 14001 certified. Pollution abatement equipment used at Amrize Cement's South Chicago plant consist of high temperature baghouses, cartridge filters, bin vents and water sprinklers to control particulate matter and dust generation.

LIMITATIONS AND DISCLAIMER

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of products using EPD or ED information shall be based on the product's use and impacts at the building or construction works level, and therefore EPDs and EDs may not be used for comparability purposes when not considering the whole building life cycle. EPD and ED comparability is only possible when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences in results upstream or downstream of the life cycle stages declared.

The environmental impact results of products in this document are based on a declared unit and therefore do not provide sufficient information to establish comparisons. The results shall not be used for comparisons without knowledge of how the physical properties of the product impact the precise function at the construction level. The environmental impact results shall be converted to a functional unit basis before any comparison is attempted.

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REFERENCES

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