



Ready Mixed Concrete

Nashville Airport Plant, TN

Environmental Product Declaration

Date of Issue: 3/25/2022

Date of Expiration: 3/25/2027

PRODUCT CATEGORY RULE

NSF International. PCR for Concrete, v2.1, August 2021.


FUNCTIONAL UNIT

1 m³ of concrete



**Certified
Environmental
Product Declaration**
www.nsf.org

Program Operator Information

Program Operator	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org		
Manufacturer Name and Address	Irving Materials, Inc. 141 Bush Road, Nashville, TN, 3721		
Facility Under Study	Nashville Airport Plant		
Declaration Number	EPD10698		
Product and Declared Unit	1 m ³ of ready-mixed concrete		
Reference PCR and Version Number	Core PCR: ISO 21930:2017 Sustainability in Building Construction – Environmental Declaration of Building Products Sub-category PCR: NSF International. PCR for Concrete, v2.1, August 2021		
Product's intended Application and Use	Concrete in residential, commercial, and public works		
Product RSL	Not Applicable		
Markets of Applicability	United States		
Date of Issue	March 25, 2022 – March 25, 2027		
Period of Validity	5 years from date of issue		
EPD Type	Product Specific		
EPD Scope	Cradle to Gate		
Year of reported manufacturer primary data	2020		
LCA Software and Version Number	Concrete EPD Calculator, v2022.1		
LCI Database and Version Number	Data as specified in PCR		
LCIA Methodology and Version Number	TRACI 2.1		
The sub-category PCR review was conducted by:	Dr. Thomas P. Gloria, PhD Industrial Ecology Consultants t.gloria@industrial-ecology.com		
Independent verification of the declaration and data, according to ISO 14025: 2006, ISO 21930:2017, and the PCR. <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External	 Tony Favilla afavilla@nsf.org  Jack Geibig jgeibig@ecoform.com		
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting		
Limitations: <ul style="list-style-type: none"> Environmental declarations from different programs (ISO 14025) may not be comparable. Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, reference service life, and quantified by the same functional unit, and meeting all the conditions in ISO 14025, Section 6.7.2, can be used to assist purchasers and users in making informed comparisons between products. Full conformance with the PCR for Products allows EPD comparability only 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 results for upstream or downstream of the life cycle stages declared. Additional information on the life cycle assessment can be found by contacting the manufacturer directly: https://www.irvmat.com/contact.html. 			



Declaration of General Information

Company Description

Irving Materials, Inc. is a building materials supplier operating throughout the midwestern and the southern U.S. IMI Concrete is a subsidiary of Irving Materials, Inc., producing ready mix concrete and servicing Indiana, Kentucky, Tennessee, Southwestern Ohio, and Northern Alabama.

Product Description and Intended Use

This Environmental Product Declaration (EPD) is for multiple concrete mixes produced at IMI's Nashville Airport Plant. As the precise mix designs are considered proprietary composition is listed in order of greatest mass per mix.

The below table provides select technical details and the unique mix ID for the mixes under study. No regulated substances of very high concern are present in the mixes assessed.

Mix	Bulk Density [kg/m ³]	Comp Strength @ 28 days (MPa)	Fly Ash %	Slag %	Air Entrained (Y/N)	W/C Ratio	Slump flow	Composition (in order of greatest mass)
4092 w/ Carbon Cure	2310	4000	20%	30%	Y	0.5	4.00 +/- 1.0"	Coarse aggregate (natural), Natural sand, Portland-limestone cement, Batch water, Slag, Fly ash, Water resisting admixtures, Carbon cure, Air entrainers
4192 w/ Carbon Cure	2371	4000	20%	30%	Y	0.5	4.00 +/- 1.0"	Coarse aggregate (natural), Natural sand, Batch water, Portland-limestone cement, Slag, Fly ash, Water resisting admixtures, Carbon cure, Air entrainers
4092 w/o Carbon Cure	2311	4000	20%	30%	Y	0.5	4.00 +/- 1.0"	Coarse aggregate (natural), Natural sand, Portland-limestone cement, Batch water, Slag, Fly ash, Water resisting admixtures, Air entrainers
4192 w/o Carbon Cure	2372	4000	20%	30%	Y	0.5	4.00 +/- 1.0"	Coarse aggregate (natural), Natural sand, Portland-limestone cement, Batch water, Slag, Fly ash, Water resisting admixtures, Air entrainers

Declaration of the Methodological Framework

Type of EPD and Declared Unit

This EPD is a Cradle-to-Gate EPD and includes the sourcing of raw materials, transportation of raw materials to the manufacturing facility, and the manufacturing and packaging of the product.

The declared unit is 1 m³ of concrete.



System Boundary

Production			Construction		Use							End of Life				Benefits & Loads Beyond System Boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw Material Supply	Transport	Manufacturing	Transport to Site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Construction of the facility, maintenance and construction of operational equipment, and any personnel related activity, such as transport, are excluded.

Background Data

The below table summarizes the material LCI data sources utilized.

Category	Material	Dataset	Database	Notes
Aggregates	Coarse aggregate (natural)	Gravel, round {RoW} gravel and sand quarry operation Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Coarse aggregate (crushed)	Gravel, crushed {RoW} production Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Natural sand	Gravel, round {RoW} gravel and sand quarry operation Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Manufactured/crushed sand	Gravel, crushed {RoW} production Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Recycled concrete aggregate	Diesel, combusted in industrial equipment/US	USLCI	Estimated as 0.4 MMBTU/short ton (0.047 MJ/kg), sourced from diesel (US EPA, 2020)
	Lightweight aggregates	Expanded clay {RoW} production Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
Cementitious Materials	Portland cement	EPD, Portland Cement Association (2016)		
	Blended hydraulic cement	EPD, Portland Cement Association (2016)		
	Portland-limestone cement	EPD, Portland Cement Association (2016)		
	Fly ash ¹	n/a		Recovered Material per PCR
	Slag cement	EPD, Slag Cement Association (2015)		

Category	Material	Dataset	Database	Notes
	Silica fume ¹	n/a		Recovered Material per PCR
	Slag ¹	n/a		Recovered Material per PCR
Water	Batch water	Tap water {RoW} market for Cut-off		Replaced with US electricity
Admixtures	Air entrainers	EPD, EFCA (2015)		
	Retarders	EPD, EFCA (2015)		
	Plasticizers and superplasticizers	EPD, EFCA (2015)		
	Hardening accelerators	EPD, EFCA (2015)		
	Set accelerators	EPD, EFCA (2015)		
	Coloring admixtures	Used water reducing admixture EPD as proxy		
	Corrosion inhibitors	Used water reducing admixture EPD as proxy		
	Water resisting admixtures	EPD, EFCA (2015)		
	Carbon cure	Electricity, medium voltage {US} market group for Cut-off, U	Ecoinvent 3.7	Estimated as 200 kWh electricity per metric ton carbon dioxide processed (Haring, 2008)
Fibers	Plastic fibers	Fibre, polyester {RoW} polyester fibre production, finished Cut-off, U	Ecoinvent 3.7	Foreground process replaced with US electricity
	Glass fibers	Glass fibre {RoW} production Cut-off, U	Ecoinvent 3.7	Foreground process replaced with US electricity

¹ The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.

Allocation Procedure and Cut-off Procedure

General principles of allocation for the LCA were based on ISO 14040/44. There are no products other than the synthetic granulates produced as part of the manufacturing processes studied in the LCA. Since there are no co-products, no allocation based on co-products is required.

Of relevancy to the defined system boundary is the method in which recycled materials were handled. Throughout the study, recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of the raw materials from recycled stock are excluded from the system boundary. Hence no impacts arise from secondary materials used as raw materials for the manufacture of synthetic gravel. The study does include the impacts associated with reprocessing and preparation of the recycled materials that are used as raw materials.

Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit.

Results - Declaration of Environmental Indicators Derived from LCA

The environmental indicators required by the PCR are specified by the table below.

Abbreviation	Indicator	Unit
Impact		
GWP	Global warming potential, 100 years, excluding biogenic carbon	kg CO ₂ eq
ODP	Ozone depletion potential	kg CFC 11 eq
EP	Eutrophication potential	kg N eq
AP	Acidification potential	kg SO ₂ eq
SFP	Smog formation potential	kg O ₃ eq
ADP-elements ¹	Abiotic depletion potential for non-fossil resources	kg Sb eq
ADP-fossil	Abiotic depletion potential for fossil resources	MJ, net calorific value
Carbon Emissions		
CCE	Calcination and carbonation emissions	kg CO ₂
Resource Use		
RPR _E ¹	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
RPR _M	Use of renewable primary energy resources used as raw materials	MJ, net calorific value
NRPR _E ¹	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value
NRPR _M	Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value
SM ¹	Use of secondary materials	kg
RSF ¹	Use of renewable secondary fuels	MJ, net calorific value
NRSF ¹	Use of non-renewable secondary fuels	MJ, net calorific value
RE ^{1,3}	Recovered energy	MJ, net calorific value
FW	Net use of fresh water	m ³
Waste Categories		
HWD ¹	Hazardous waste disposed	kg
NHWD	Non-hazardous waste disposed	kg
RWD ^{1,2}	Radioactive waste disposed	kg
<i>HLRW^{1,2}</i>	<i>High-level radioactive waste, conditioned, to final repository</i>	<i>kg</i>
<i>ILLRW^{1,2}</i>	<i>Intermediate- and low-level radioactive waste, conditioned, to final repository</i>	<i>kg</i>
Output Flows		
CRU ¹	Components for reuse	kg
MR	Materials for recycling	kg
MER ¹	Materials for energy recovery	kg
EE	Exported energy	MJ

¹ 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 these categories.

² As many of the specified data sources do not differentiate between high-level and intermediate- and low-level radioactive waste, the two metrics have been summed into a single indicator.

³ Not all LCA datasets for upstream materials include these impact categories and thus results may be incomplete. Use caution when interpreting data in these categories.



Production A1-A3

Production results are presented in the following tables for the mix designs under study.

Product ID:		4092CC	4192CC	4092	4192
Impacts	Unit	A1-A3	A1-A3	A1-A3	A1-A3
GWP	kg CO ₂ eq	181	178	184	182
ODP	kg CFC-11 eq	7.52E-06	7.46E-06	7.68E-06	7.61E-06
AP	kg SO ₂ eq	0.663	0.658	0.674	0.67
EP	kg PO ₄ ³⁻ eq	0.236	0.234	0.241	0.239
POCP	kg C ₂ H ₄ eq	13.4	13.3	13.6	13.6
ADP _E	kg Sb eq	1.42E-04	1.22E-04	1.24E-04	1.23E-04
ADP _F	MJ _{NOV}	131	129	132	131
CCE	kg CO ₂ eq	71.1	69.8	73	71.6

This EPD was calculated using industry average cement data. Cement LCA impacts can vary depending upon manufacturing process, efficiency, and fuel source by as much as 50% for some environmental impact categories. Cement accounts for as much as 77% of the impacts of the concrete mixes included in this EPD and thus manufacturer specific cement impacts could result in variation of as much as 39%.

Product ID:		4092CC	4192CC	4092	4192
Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3
RPR _E	MJ _{NOV}	227	230	226	230
RPR _M	MJ _{NOV}	0.0426	0.0418	0.0437	0.0429
NRPR _E	MJ _{NOV}	697	685	689	691
NRPR _M	MJ _{NOV}	0	0	0	0
SM	kg	181	178	186	183
RSF	MJ _{NOV}	8.03	7.88	8.24	8.09
NRSF	MJ _{NOV}	77.5	76	79.6	78.1
RE ¹	MJ _{NOV}	x	x	x	x
FW	m ³	3.1	3.19	3.09	3.18
HWD	kg	2.39E-03	2.35E-03	2.44E-03	2.41E-03
NHWD	kg	183	185	184	186
RWD	kg	2.26E-03	1.93E-03	1.93E-03	1.93E-03
CRU	kg	x	x	x	x
MR	kg	0.0917	0.09	0.0942	0.0924
MER	kg	0	0	0	0
EE	MJ	0.288	0.283	0.296	0.291

References

- Haring, H.-W. (Ed.), 2008. Industrial Gases Processing. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.
- Population Reference Bureau (PRB), 2016. 2016 World Population Data Sheet. ISSN: 0085-8315.
- ISO 14040: 2006/Amd 1:2020 Environmental Management - Life cycle assessment – Principles and framework.
- ISO 14044: 2006/Amd 2:2020 Environmental Management - Life cycle assessment - Requirements and Guidelines
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
- NSF International. Product Category Rule for Environmental Product Declarations: PCR for Concrete. Valid through February 22, 2024.
- TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Version 2.1 – User Guide - <https://nepis.epa.gov/Adobe/PDF/P100HN53.pdf>.
- US EPA, November 2020. Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Construction Materials Chapters, v15. https://www.epa.gov/sites/default/files/2020-12/documents/warm_construction_materials_v15_10-29-2020.pdf