
Slag Cement, Today's Strongest Carbon Reduction Tool
NRMCA Live Learning | Concrete Innovation Webinar | L. Rowland
7/17/2024
Heidelberg Materials

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Slag Cement

What is it

- History of Slag Cement aka Slag
- Chemistry and why it works
- Performance, making concrete better and how it impacts the mix

Why slag cement is considered a powerful low carbon solution

- EPD data by the numbers
- Embracing Circularity and optimize mixes
- Why it is important to Heidelberg Materials and to you too…
- Examples of producing Low Carbon Concrete

History of Slag Cement

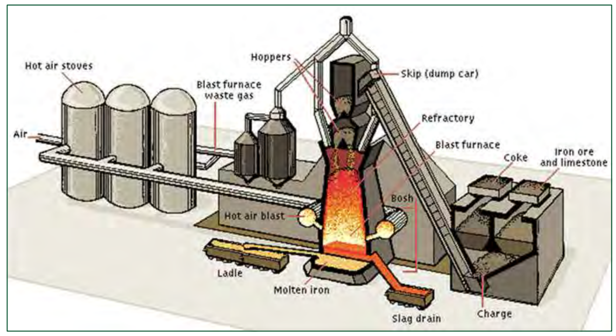
- Slag cement use in the 1700s, combined with lime to make mortars
- The first U.S. production of slag cement in 1896
- By 1901 slag was combined in portland cement @ 30% GGBFS in Germany
- In the 1950s, granulated slag was used in the manufacture of blended portland cements in US
- First granulation facility in the U.S. to make a separate slag cement was in the early 1980s
- US now uses ~ 4-million tons of slag cement annually

What is Slag Cement

Slag Cement - What is it?

Slag cement aka Ground Granulated Blast Furnace Slag

- Blast Furnace Slag byproduct of primary iron production
- Slag can be air cooled to produce aggregate
- Quenching and granulation are necessary process



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What is Slag Cement

Slag Cement - What is it?

Slag cement aka Ground Granulated Blast Furnace Slag

- Slag must be granulated to produce slag cement
- Slag granules look like angular coarse sand
- Lighter color than cement due to having almost no iron

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From Slag Granules to Slag Cement

Ground Granulated Blast Furnace Slag (GGBFS)

- Quenching and Grinding are critical to reactivity
- Slag Cement powder similar to cement in fineness
- Same type of grinding equipment as for cement
  - Ball Mills
  - Vertical Mills
- Increasing fineness = increased reactivity
- Often finer than portland cement

Why Slag Cement Works in Concrete Systems

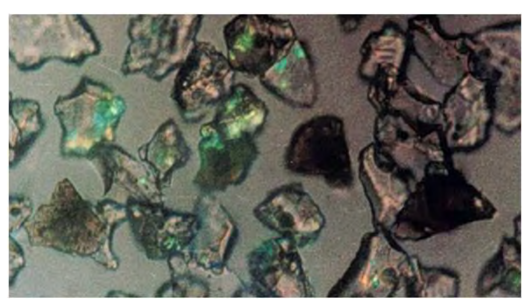
- Slag contains calcium, silica, and alumina compounds

  Typical compound ranges are shown >

- It is critical that the slag be quenched in a granulator rapidly cooling it, so the slag "freezes" in a glassy state
- This glassy state is critical for reactivity
- Air cooled slag will crystallize and become non-reactive and is only suitable for use as aggregate
- Portland Cement / Portland Limestone Cement systems generate calcium hydroxide Ca(OH)2

	Portland Cement	Slag Cement*
CaO	65%	38%
SiO2	20%	36%
Al2O3	4%	10%
Fe2O3	3%	0%
MgO	3%	11%
Alkalis'	1%	1%

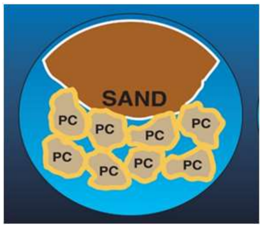
*Percentages vary based upon the source of slag granules and cement manufacturing.



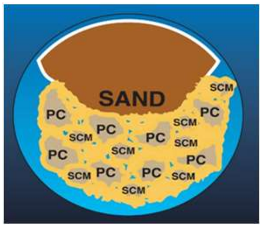
What is Slag Cement

How Slag Cement Works in Concrete

- Slag cement binds up $Ca(OH)_2$ by forming Calcium-Silicate-Hydrates (CSH), the crystals that make concrete work
- Remove alkalis from system, improves resistance to ASR
- Increased CSH reduces voids, fills areas around aggregates in system, increasing bonds and reducing pore structure
- Greater CSH = Increased compressive, tensile, and flexural strengths
- The densified concrete is less permeable which helps prevent chemical attack from chlorides and sulphates
- High-strength and high-performance mixes often use slag mixes for their increased flexural strengths, durability and lower CO_2



Portland cement concrete system



Portland cement concrete system with slag cement

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What is Slag Cement

References for Using Slag Cement

ACI 233R-17 Guide for the Use of Slag Cement in Concrete and Mortar

- Gives guidance on the use of slag cement
    - Gives overview of material
    - Includes typical replacement rates & applications
    - Gives info on Batching and Proportioning
    - Effects on Fresh and Hardened properties

Specifications

- ASTM C989 / AASHTO M 302 for use as SCM
- ASTM C595 / AASHTO M 240 in Blended Cements
- Canadian Specifications, CSA A3001 – Cementitious materials for use in concrete
- Is allowed in cements conforming to ASTM C1157 Performance Spec for Hydraulic Cements

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What is Slag Cement

Blended Cement i.e. IS(40) Benefits

Slag granules can be interground with clinker or ground then blended at the cement plant

- All the advantages of using slag cement … plus…
- Quality control managed by cement supplier
- Reduced storage needs, users need only one silo
- Ease of use and simplified concrete mixtures
- Can be combined with pozzolans or limestone in Ternary blends optimizing environmental benefits & performance

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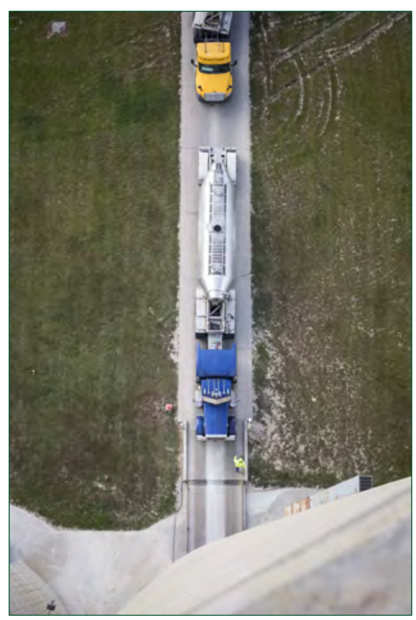
What is Slag Cement

US Shipments of Slag

- 43 out of 50 US states used slag cement in 2023
- ~ 4 million M tons used in the United States last year
- 3.1 million tons of CO_2 avoided emissions



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What is Slag Cement

Ready Mixed Concrete Benefits

Slag in RMC, measurable improvements…

- Better concrete workability and consistency
- More consistent plastic and hardened properties
- Can result in lower admixture doses
- Lighter color resulting in higher reflectivity
- Reduced environmental impacts
- Higher compressive and flexural strengths

Typical replacement ranges

- Dosage rates in concrete range from 25% to 50% of the cementitious material by mass, with special applications having addition rates of 80% or higher

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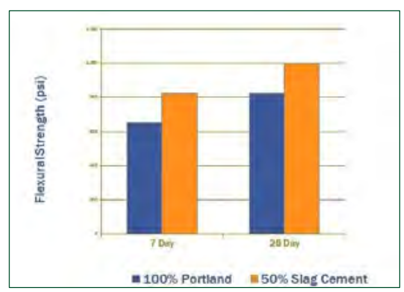
What is Slag Cement

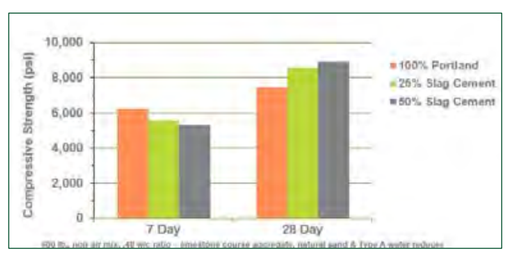
Slag Cement in High Performance Concrete

Slag Cement's performance is well understood, and documented

- Example mixes shown exhibit higher strengths at 28 days vs. reference no slag mix
- Higher percentage of Slag Cement vs Portland Cement (Type I/II) or Portland Limestone Cements (Type IL) result in higher ultimate strengths.
- Slower set times/lower early strength gain at standard or low temperatures
- Slag responds very favorably to heat and use of PLC cements
- Yield higher Flexural Strengths which are critical to high performance mixes
- Properly adding slag to your mixes can reduce shrinkage

Flexural Strength especially important in Pavements and High-Performance Mixes





"Compressive and Flexural Strength." Technical Bulletin No. 14. Slag Cement Association, 2006.

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What is Slag Cement

Slag Cement in High Performance Concrete

Slag Cement will increase strengths of mixes

- @ standard curing temps (72° F) slag has slower strength gain
- Catches up/exceeds reference mix @ 14-days in all % additions
- Slag responds very favorably to heat and use of PLC cements

Example Award Winning Project: TSX Broadway in New York

- Used ~ 10k cubic yards of 14,000 psi mix @ 40% Slag
- 96% of all mixes contained slag
- 93% of all mixes had a minimum of 40% slag replacement
- Slag's use resulted in 3,000 + metric tons of CO_2 savings
- Structural Engineer Severud Associates

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We use Slag Because it is our Strongest Carbon Reduction Tool

"At Heidelberg Materials, we aim to be the industry leader on the path to net zero concrete."

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Pioneering the decarbonisation of our sector

Our industry-leading concrete promises

400kg CO_2/t cementitious material as average across the whole portfolio in 2030[1]

47% emission reduction[2] across the cementitious materials portfolio by 2030

50% of our revenue will be generated from sustainable products by 2030

10 million tons cumulative CO_2 reduction through CCUS by 2030

Corporate carbon footprint reduction in line with SBTi 1.5°C path by 2030

[1] Scope 1, 2 acc. to GCCA; [2] Reference year 1990 with an average of 750 kg CO2/t of cementitious material

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CO_2 in concrete

CO_2 during ready-mixed concrete production

- Process technology in cement
- Alternative binding agents
- Implementation in concrete by utilising flexible concrete technology mean

- Local, low energy and low GWP building materials are a central.
- An uncounted CO2 success factor

- Efficient logistics
- Utilising state-of-the-art drive units
- Openness for new technologies

- Renewable energy is a usable benefit today

CO_2 in concrete is more than just cement

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OPC / Portland — ~ 94% Clinker, ≤ 5% Limestone

PLC Type IL / GUL — ~ 82% Clinker, ≤ 15% Limestone

Blended Cements Type IS(40) — ~ 56% Clinker, 40% Slag Cement

Innovative Products

Low Carbon Cements and Concrete Mixes

Clinker reduction

- Key strategy for reducing embodied CO_2 aka GWP
- Performance Specifications enable use
- Significant reduction potential depending on available materials and type of application

Current technologies at the cement plant

- Interground limestone and SCM incorporation
- Recycled raw materials for clinker production
- Alternative fuels and heat recovery technologies

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Whole Building LCA Stages

Production Stage			Construction Stage		Use Stage							End Of Life Stage			
Extraction And Upstream Production	Transport To Factory	Manufacturing	Transport To Factory	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction / Demolition	Transport	Waste Processing	Disposal Of Waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = Included in Cradle to Gate

MND = Module Not Declared

A material's GWP is determined by completing a Life Cycle Assessment (LCA)

- As required by the North American PCR (Product Category Rule) for Slag Cement GWPs are for…
- Cradle to Gate - accounting for all the inputs in a LCA Production Stage (Modules A1 to A3)
- Findings from LCAs are best summarized in a Type III EPD

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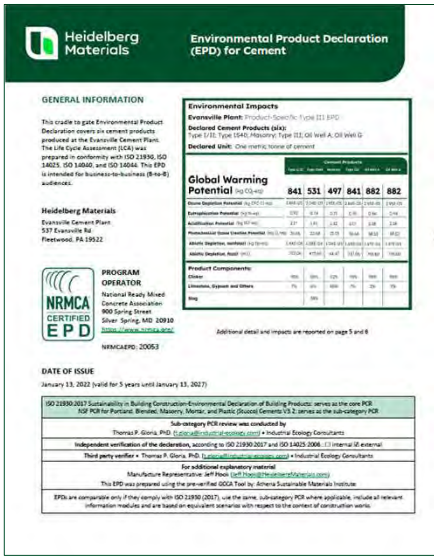
Plant Specific EPD

EPDs Show the Impact of Cement/Binders as Primary GWP Contributors



Environmental Impacts

Evansville Plant: Product-Specific Type III EPD

Declared Cement Products (six): Type I/II; Type IS40; Masonry; Type III; Oil Well A; Oil Well G

Declared Unit: One metric tonne of cement

	Cement Products					
	Type I/II	Type IS40	Masonry	Type III	Oil Well A	Oil Well G
Global Warming Potential (kg CO_2-eq)	**841**	**531**	**497**	**841**	**882**	**882**
Ozone Depletion Potential (kg CFC-11-eq)	2.86E-05	2.04E-05	1.95E-05	2.86E-05	2.95E-05	2.95E-05
Eutrophication Potential (kg N-eq)	0.92	0.74	0.71	0.92	0.94	0.94
Acidification Potential (kg SO^2-eq)	2.17	1.41	1.32	2.17	2.28	2.28
Photochemical Ozone Creation Potential (kg O_3-eq)	36.66	22.68	21.15	36.66	38.52	38.52
Abiotic Depletion, nonfossil (kg Sb-eq)	1.44E-04	1.08E-04	1.04E-04	1.44E-04	1.47E-04	1.47E-04
Abiotic Depletion, fossil (MJ)	757.06	475.60	44.47	757.06	793.80	793.80

Type	IS40	I/II GU
GWP	531	841

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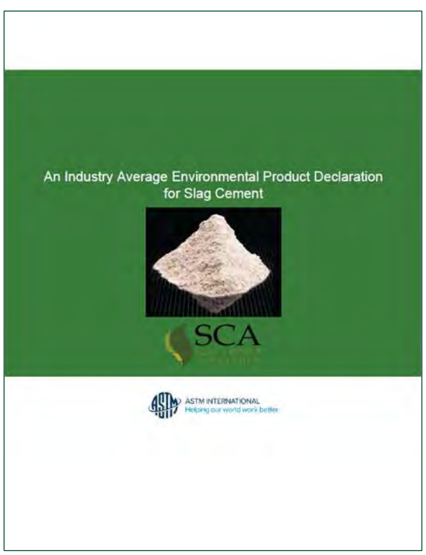
PCRs & EPDs provide transparency

Slag Cement Industry Average EPD



A1 to A3 Impacts

- GWP is 147 kg CO_2 eq / metric ton (1,000 kg)*

  **Portland Cement industry average GWP is 922 kg CO_2 eq / ton*

- A3 Grinding = 56% of GWP, Transport A2 = 43%

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	1.8	62.7	82.6	**147.0**
Ozone depletion potential, ODP[2]	kg CFC-11 eq	2.9E-07	1.4E-05	1.0E-05	**2.4E-05**
Smog formation potential, SFP[2]	kg O_3 eq	0.19	33.1	4.28	**37.6**
Acidification potential, AP[2]	kg SO_2 eq	8.7E-03	1.7	2.6E-01	**2.0**
Eutrophication potential, EP[2]	kg N eq	2.9E-03	0.08	2.4E-01	**0.33**
Abiotic depletion potential for non-fossil mineral resources, ADP elements[3]*	kg Sb eq	1.7E-06	2.4E-06	6.8E-05	**7.2E-05**

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EPDs provide transparency

Interpreting Concrete EPDs Cement/Binders are Primary GWP Contributors

Heidelberg Materials — Environmental Product Declaration (EPD)

Heidelberg Materials
Environmental Product Declaration
Mix CA42P15X -37 Leeds Plant

This cradle to gate Environmental Product Declaration (EPD) reports the impacts for one cubic meter of ready-mixed concrete, meeting the following product specifications:
ASTM C94 Standard Specification for Ready-Mixed Concrete
CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction
CSI Masterformat Division 03-30-00: Cast-in-Place Concrete
UNSPSC Code 30111500: Ready Mix

PLANT
37 Leeds Plant
8732 Parkway Drive
Leeds, Alabama

PROGRAM OPERATOR
NRMCA
400 Rivermills Business Park
Birmingham, AL 3524

DATE OF ISSUE
June 12, 2023

PERIOD OF VALIDITY
5 years; 1/24/2028

Environmental Impacts
Declared Product: CA42P15X
Description: Caisson - 56 Day
Compressive Strength: 4000 psi @ 56 days

Declared Unit: 1 m3 of ready-mix concrete		per m³
Global Warming Potential	kg CO2e	206.08
Ozone Depletion	kg CFC11e	5.49E-06
Acidification	kg SO2e	0.70
Eutrophication	kg Ne	0.27
SFP (Smog)	kg O3e	15.37
Abiotic depletion potential for fossil resources	MJ, NCV	[illegible]
Abiotic depletion potential for non-fossil mineral resources	kg Sbe	[illegible]

Product Components: Batchwater (ASTM C1602), Crushed Coarse Aggregate (ASTM C33), Natural Fine Aggregate (ASTM C33), Crushed Fine Aggregate (ASTM C33), Portland Limestone Cement (ASTM C595), Fly Ash (ASTM C618)

ISO 21930:2017 Sustainability in Building Construction-Environmental Declaration of Building Products: serves as the core PCR for Concrete; NSF International, August 2021 serves as a subcategory PCR
Sub-category PCR review was conducted by
Thomas P. Gloria, Bill Stough, and Michael Overcash
Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006: ☐ internal ☒ external
Third party verifier: Thomas P. Gloria, PhD (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants
For additional explanatory material
Manufacture Representative: Scott Kelley (Scott.Kelley@heidelbergmaterials.com)
LCA and EPD Developer: Athena Sustainable Materials Institute
Disclaimer: EPDs are comparable only if they comply with this document, 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.
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 90% 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 45%.

Product Stage		
Extraction and upstream production	Transport to factory	Manufacturing
A1	A2	A3
Disproportionately driven by cement (clinker) content	Dependent on haul distances and mode of transport. How close are aggregate and cement resources?	Dependent on energy sources – climate and electricity (hydroelectric or coal fired)?

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Counting Carbon Emissions

Accounting for Concrete GWP Calculations by Leveraging EPD Data

Apply GWP values to Generic Mix for all mix components

- Binder, 350 kg/m³ "Average" Portland Cement
- No SCMs
- "Generic" course and fine aggregate
- Water reducing & Air-entraining admixtures
- **This Baseline Mix has GWP of 374.8**
- Note inclusion of A1 – A3 LCA Modules
    - GWP for A1 331.3
    - GWP for A2 34.1
    - GWP for A3 9.4

  Mix GWP Total **374.8 CO2 eq.**

Generic Concrete Mix Global Warming Potential A1 - A3			
Generic Concrete Mix Raw Materials A1	**Quantity kg/m³**	**GWP / Metric ton (1,000 kg)**	**GWP in Mix**
Industry Average Portland Cement (GU / Type I)	350	922	322.7
Generic Fly Ash	0	14.7	0.0
Generic Slag Cement	0	146.6	0.0
Generic Crushed Stone Course Aggregate	1,046	4.6	4.8
Generic Concrete Sand Fine Aggregate	791	2.8	2.2
Water	156	0.0	0.0
Generic Water Reducing Admixture	0.80	1880.6	1.5
Generic Air-Entrainer	0.05	524.7	0.03
Raw Materials Production CO_2 Footprint - Total A1			**331.3**
Material Transport to Concrete Plant A2			
Summary for Transport to BC Ready Mix CO_2 Footprint - Total A2			**34.1**
Concrete Manufacturing @ RM Plant			
Material Handling, Batching & Misc. Operations CO_2 Footprint - Total A3			**9.4**
		Total A1 + A2 + A3	**374.8**

Heidelberg Materials SCM, Aggregate and Admixture Data via FHWA Report No. FHWA-HIF-22-032, LCA Pave

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Counting Carbon Emissions

Portland Slag Cement Delivers Significant CO_2 Reductions, LCA Data

Compare industry average vs. high performing plant in Generic Mix

- Industry Average Portland Cement Type I / GU @ 922 GWP

Calculation for PCA "Average" Portland Cement GWP in Concrete Mix A1			
Generic Concrete Mix Raw Materials A1	Quantity kg/m^3	GWP / Metric ton (1,000 kg)	GWP in Mix
Industry Average Portland Cement (GU / Type I)	350	922	322.7

- Compared to actual EPD Data →
- Heidelberg Materials Evansville Plant
  - Preheater/Precalciner
  - Produces IS(40) Cement
- Portland Cement Type I @ 841 GWP
- Portland Slag IS(40) @ 531 GWP

Environmental Impacts

Evansville Plant: Product-Specific Type III EPD

Declared Cement Products (six): Type I/II; Type IS40; Masonry; Type III; Oil Well A; Oil Well G

Declared Unit: One metric tonne of cement

	Cement Products: Type I/II	Type IS40	Masonry	Type III	Oil Well A	Oil Well G
Global Warming Potential (kg CO_2-eq)	841	531	497	841	882	882
Ozone Depletion Potential (kg CFC-11-eq)	2.86E-05	2.04E-05	1.95E-05	2.86E-05	2.95E-05	2.95E-05
Eutrophication Potential (kg N-eq)	0.92	0.74	0.71	0.92	0.94	0.94
Acidification Potential (kg SO^2-eq)	2.17	1.41	1.32	2.17	2.28	2.28
Photochemical Ozone Creation Potential (kg O_3-eq)	36.66	22.68	21.15	36.66	38.52	38.52
Abiotic Depletion, nonfossil (kg Sb-eq)	1.44E-04	1.08E-04	1.04E-04	1.44E-04	1.47E-04	1.47E-04
Abiotic Depletion, fossil (MJ)	757.06	475.60	44.47	757.06	793.80	793.80
Product Components:						
Clinker	93%	56%	52%	93%	98%	98%
Limestone, Gypsum and Others	7%	6%	48%	7%	2%	2%
Slag		38%				

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Counting Carbon Emissions

Accounting for Concrete GWP with EPD Data for Evansville Portland Slag Cement in Mix

Apply GWP values to Generic Mix for all mix components

- Binder is 350 kg/m^3 Evansville Type IS(40)
- No SCMs
- "Generic" course and fine aggregate
- Water reducing & Air-entraining admixtures
- **Evansville IS(40) = - 37% vs Baseline Mix**
- Note inclusion of A1 – A3 LCA Modules
  - GWP for A1 194.4
  - GWP for A2 34.1
  - GWP for A3 9.4

  Mix GWP Total 237.9 CO2 eq.

Generic Concrete Mix Global Warming Potential A1 - A3			
Generic Concrete Mix Raw Materials + Actual Cement GWP Values A1	**Quantity kg/m^3**	**GWP / Metric ton (1,000 kg)**	**GWP in Mix**
Heidelberg Materials Evansville Type IS(40) Cement	350	531	185.9
Generic Fly Ash	0	14.7	0.0
Generic Slag Cement	0	146.6	0.0
Generic Crushed Stone Course Aggregate	1,046	4.6	4.8
Generic Concrerte Sand Fine Aggregate	791	2.8	2.2
Water	156	0.0	0.0
Generic Water Reducing Admixture	0.80	1880.6	1.5
Generic Air-Entrainer	0.05	524.7	0.03
Raw Materials Production CO_2 Footprint - Total A1			**194.4**
Material Transport to Concrete Plant A2			
Summary for Transport to BC Ready Mix CO_2 Footprint - Total A2			**34.1**
Concrete Manufacturing @ RM Plant			
Material Handling, Batching & Misc. Operations CO_2 Footprint - Total A3			**9.4**
		Total A1 + A2 + A3	**237.9**

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SCM, Aggregate and Admixture Data via FHWA Report No. FHWA-HIF-22-032, LCA Pave

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Counting Carbon Emissions

Accounting for Concrete GWP with EPD Data for Evansville Portland Type I or III in Mix

Apply GWP values to Generic Mix for all mix components

- Binder is 210 kg/m³ Evansville Type I or Type III
- + 140 kg/m³ "Generic" Slag as SCM
- "Generic" course and fine aggregate
- Water reducing & Air-entraining admixtures
- **Evansville TI +40% Slag = - 34% vs Baseline**
- Note inclusion of A1 – A3 LCA Modules
  - GWP for A1 205.7
  - GWP for A2 34.1
  - GWP for A3 9.4

  Mix GWP Total **249.2 CO2 eq.**

Generic Concrete Mix Global Warming Potential A1 - A3 with 40% Slag Cement SCM

Generic Concrete Mix Raw Materials + Actual Cement GWP Values A1	Quantity kg/m³	GWP / Metric ton (1,000 kg)	GWP in Mix
Heidelberg Materials Evansville Type I or III +40% Slag SCM	210	841	176.6
Generic Fly Ash	0	14.7	0.0
Generic Slag Cement	**140**	**146.6**	20.5
Generic Crushed Stone Course Aggregate	1,046	4.6	4.8
Generic Concrerte Sand Fine Aggregate	791	2.8	2.2
Water	156	0.0	0.0
Generic Water Reducing Admixture	0.80	1880.6	1.5
Generic Air-Entrainer	0.05	524.7	0.03
Raw Materials Production CO_2 Footprint - Total A1			**205.7**
Material Transport to Concrete Plant A2			
Summary for Transport to BC Ready Mix CO_2 Footprint - Total A2			**34.1**
Concrete Manufacturing @ RM Plant			
Material Handling, Batching & Misc. Operations CO_2 Footprint - Total A3			**9.4**
		Total A1 + A2 + A3	**249.2**

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SCM, Aggregate and Admixture Data via FHWA Report No. FHWA-HIF-22-032, LCA Pave

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Counting Carbon Emissions

Accounting for Concrete GWP with EPD Data for Evansville Portland Type I or III in Mix

Apply GWP values to Generic Mix for all mix components

- Binder is 175 kg/m³ Evansville Type I or Type III
- + 175 kg/m³ "Generic" Slag as SCM
- "Generic" course and fine aggregate
- Water reducing & Air-entraining admixtures
- **Evansville TI +50% Slag = - 40% vs Baseline**
- Note inclusion of A1 – A3 LCA Modules
  - GWP for A1 181.4
  - GWP for A2 34.1
  - GWP for A3 9.4

  Mix GWP Total **224.9 CO2 eq.***

*Saves ~ 150 kg/m³ of CO_2 eq. vs. Industry Avg. Portland Cement Mix

Generic Concrete Mix Global Warming Potential A1 - A3 with 50% Slag Cement SCM

Generic Concrete Mix Raw Materials + Actual Cement GWP Values A1	Quantity kg/m³	GWP / Metric ton (1,000 kg)	GWP in Mix
Heidelberg Materials Evansville Type I or III +50% Slag SCM	175	841	147.2
Generic Fly Ash	0	14.7	0.0
Generic Slag Cement	**175**	**146.6**	25.7
Generic Crushed Stone Course Aggregate	1,046	4.6	4.8
Generic Concrerte Sand Fine Aggregate	791	2.8	2.2
Water	156	0.0	0.0
Generic Water Reducing Admixture	0.80	1880.6	1.5
Generic Air-Entrainer	0.05	524.7	0.03
Raw Materials Production CO_2 Footprint - Total A1			**181.4**
Material Transport to Concrete Plant A2			
Summary for Transport to BC Ready Mix CO_2 Footprint - Total A2			**34.1**
Concrete Manufacturing @ RM Plant			
Material Handling, Batching & Misc. Operations CO_2 Footprint - Total A3			**9.4**
		Total A1 + A2 + A3	**224.9**

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SCM, Aggregate and Admixture Data via FHWA Report No. FHWA-HIF-22-032, LCA Pave

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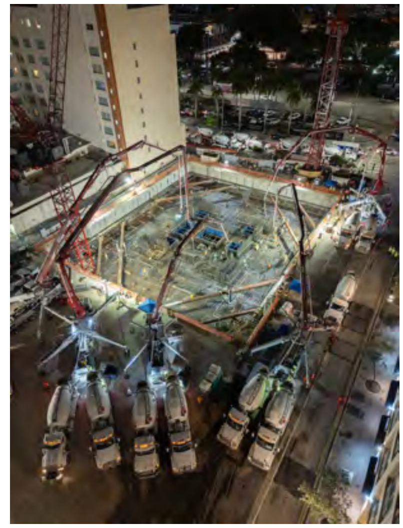
Slag Cement Delivers

Waldorf Astoria Project Miami

- Biscayne Blvd. 36-hour+ pour over weekend
- Transportation competing with Justin Timberlake concert
- Waldorf Astoria Hotel & Residences, 300 Biscayne Blvd.
- 13,500 CY of concrete



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Slag Cement Delivers

Waldorf Astoria Project Miami

13,500 CY of concrete, 36-hour+ pour over weekend

- 850# of total cementitious 60% Slag Mix
- 3,123 M tons slag used = 2,400 M tons CO_2 saved
- Avoided emissions equivalent to…
    - Planting more than 40,400 trees to maturity for 10-years
    - Removing 575 vehicles from the road for a year
    - 272,800 gallons of gasoline burned

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Decarbonizing Concrete

Using Slag Cement to Decarbonize Concrete

Slag Cement Overview

- Slag Cement comes from a primary iron production
- Quenching produces granules which are ground to cement fineness
- Slag Cement can be supplied as an SCM or in Blended Cements
- It densifies concrete and typically has slower strength gain
- Slag mixes ultimately stronger so often used in high-performance mixes
- Because it is a waste product it has very low embodied carbon
- Embodied carbon and other impacts are accounted for in EPDs
- Heidelberg Materials is committed to being the leader in decarbonizing the cement and concrete sectors
- Slag is a powerful tool in producing Low Carbon Concrete

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Questions?

Larry Rowland

Heidelberg Materials

Sustainability Market Manager

Larry.Rowland@HeidelbergMaterials.com

Mobile: 610-462-4250

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