CarbonCure's Impact on the Global Warming Potential (GWP) of Concrete

CarbonCure manufactures a technology that beneficially reuses carbon dioxide (CO_2) in the concrete production process to reduce the carbon footprint of concrete without compromising performance. CarbonCure enables a 4-6% carbon reduction and may be used in addition to other carbon-reducing strategies in concrete.

The Carbon Impact of Concrete

Concrete is a mixture of aggregates, water, chemical admixtures, and cementitious materials which act as the critical binding agents that give concrete its strength and unique properties. The manufacturing of ordinary Portland Cement involves heating limestone (calcium carbonate) mined from quarries to a temperature of 2700°F. This process breaks the calcium carbonate bond, resulting in the direct release of CO_2 to the atmosphere as a by-product. Largely due to this chemical reaction, cement manufacturing is the most carbon-intensive process in the concrete production life cycle; therefore solutions that enable cement reduction in concrete mixes are effective strategies for reducing carbon emissions.

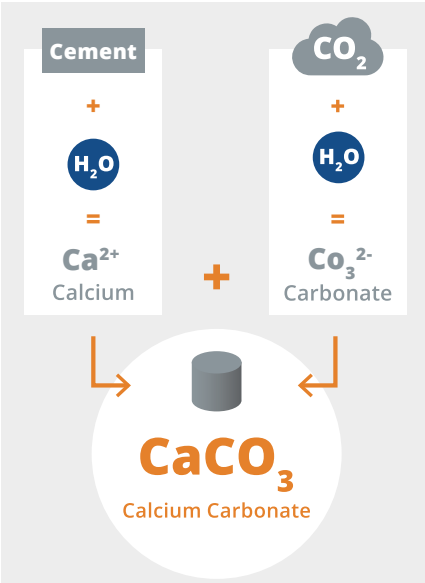
DID YOU KNOW?

Cement and concrete account for approximately 7% of global emissions.

THE CARBONCURE SOLUTION

Concrete made with CarbonCure reduces the carbon impact (GWP) of concrete by 4-6%.

The concrete industry is actively developing and implementing solutions to reduce its carbon impact, such as switching fuel sources used in cement kilns, using Supplementary Cementitious Materials (SCMs) such as slag or fly ash as alternatives to Portland Cement, and incorporating CO_2 utilization technologies such as CarbonCure during concrete production.



CO_2 mineralization creates concrete using waste CO_2. In this process CO_2 is converted to a solid mineral (calcium carbonate), permanently removing these emissions from the atmosphere.

The CarbonCure Concrete Technology

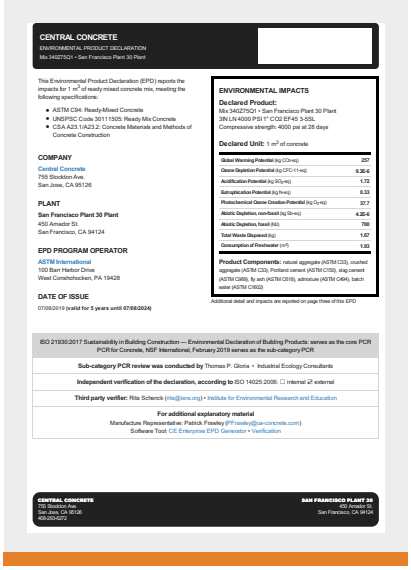
CarbonCure is leading a global mission to reduce the carbon footprint of the built environment by using post-industrial CO_2 to improve the manufacturing process of concrete.

The CarbonCure Technology is installed in concrete plants to introduce CO_2 into fresh concrete. Once injected, the CO_2 undergoes a process known as CO_2 mineralization, where it converts into a solid mineral (calcium carbonate) and becomes permanently embedded in the concrete. CO_2 mineralization improves the concrete's compressive strength, enabling concrete producers to reduce cement content in their mixes and achieve further carbon reductions without compromising the concrete's quality.

Global Warming Potential (GWP) and Environmental Product Declarations (EPDs)

Global Warming Potential (GWP) is a unit of measurement that assesses the quantity of CO_2 emissions (CO_2e) in the production of a particular building material using life cycle assessment methodologies that adhere to international standards.

An Environmental Product Declaration (EPD) is an independently verified transparency tool that provides comparable quantitative measurements of the life-cycle impacts of building materials. In addition to GWP, an EPD also measures a comprehensive range of environmental impacts including effects on the ozone layer and contribution to acid rain.


CENTRAL CONCRETE
ENVIRONMENTAL PRODUCT DECLARATION
Mix 3402750+ • San Francisco Plant 30 Plant

This Environmental Product Declaration (EPD) reports the impacts for 1 m³ of ready-mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction

COMPANY
Central Concrete
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San Jose, CA 95126

PLANT
San Francisco Plant 30 Plant
400 Amador St.
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EPD PROGRAM OPERATOR
ASTM International
100 Barr Harbor Drive
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DATE OF ISSUE
07/08/2019 (valid for 5 years until 07/08/2024)

ENVIRONMENTAL IMPACTS
Declared Product:
Mix 3402750+ • San Francisco Plant 30 Plant
3N LN 4000 PSI 1" CO2 EF45 3-5SL
Compressive strength: 4000 psi at 28 days
Declared Unit: 1 m³ of concrete

Global Warming Potential (kg CO2-eq)	257
Ozone Depletion Potential (kg CFC-11-eq)	9.3E-6
Acidification Potential (kg SO2-eq)	1.72
Eutrophication Potential (kg N-eq)	0.33
Photochemical Ozone Creation Potential (kg O3-eq)	37.7
Abiotic Depletion, non-fossil (kg Sb-eq)	4.2E-6
Abiotic Depletion, fossil (MJ)	799
Total Waste Disposed (kg)	1.67
Consumption of Freshwater (m³)	1.93

Product Components: natural aggregate (ASTM C33), crushed aggregate (ASTM C33), Portland cement (ASTM C150), slag cement (ASTM C989), fly ash (ASTM C618), admixture (ASTM C494), batch water (ASTM C1602)

Additional detail and impacts are reported on page three of this EPD

ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products: serves as the core PCR
PCR for Concrete, NSF International, February 2019 serves as the sub-category PCR

Sub-category PCR review was conducted by Thomas P. Gloria • Industrial Ecology Consultants

Independent verification of the declaration, according to ISO 14025:2006: ☐ internal ☑ external

Third party verifier: Rita Schenck (rita@lsre.org) • Institute for Environmental Research and Education

For additional explanatory material
Manufacture Representative: Patrick Frawley (PFrawley@us-concrete.com)
Software Tool: CC Enterprise EPD Generator • Verification

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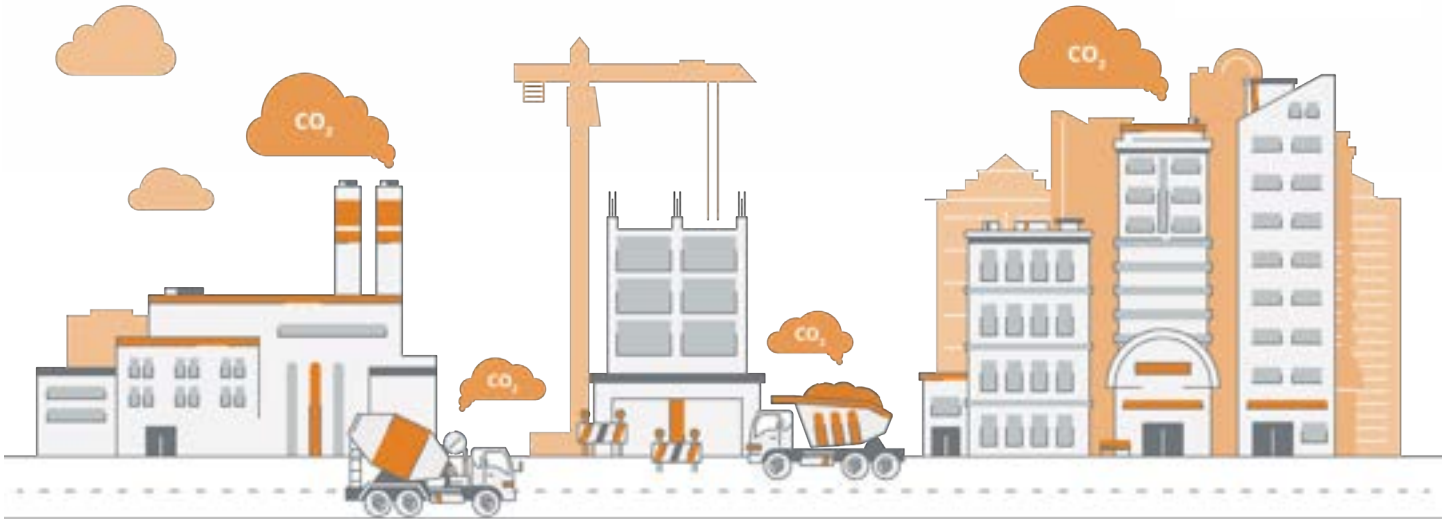
A sample EPD published by CarbonCure concrete producer partner Central Concrete Supply Company, a business unit of U.S. Concrete, located in the San Francisco Bay Area, California.

CarbonCure's Impact on GWP

CarbonCure reduces embodied carbon emissions from concrete through two methods:

1 Post-industrial CO_2 is directly injected into the concrete mix. Upon injection it chemically converts into a solid calcium carbonate mineral that is permanently embedded in the concrete.

2 CO_2 mineralization creates cement efficiencies, enabling the reduction of cementitious content while maintaining compressive strength and other concrete performance properties. This results in avoided embodied carbon emissions and therefore a lower GWP impact.



Embodied Carbon
The emissions from manufacturing, transportation, and installation of building materials.

Operational Carbon
The emissions from a building's energy consumption.

Case Study: Ozinga Concrete EPD

Headquartered in Illinois, Ozinga is a concrete producer that has been at the forefront of the industry's sustainability movement. As part of this commitment to innovation, Ozinga was an early adopter of CarbonCure. In 2020, Ozinga contracted the Athena Sustainable Materials Institute to create EPD documentation for a subset of its concrete mix designs.

Ozinga selected 13 basic concrete mix designs produced at four of its concrete plants in Illinois and Florida. Mixes manufactured using slag (mix titles denoted with an "S"), high-range water reducers ("H"), and CarbonCure ("X") were analyzed. The results of this analysis showed that CarbonCure reduced GWP in every mix where it was used, including mixes made with slag. This demonstrates the universal ability of CarbonCure to reduce the carbon footprint of concrete and the stackable GWP benefit of using CarbonCure with other carbon-reducing strategies.

Ozinga Ready Mix has been producing CO_2 mineralized concrete via CarbonCure since 2016.

CarbonCure at Ozinga's Miami plant, which became the first CarbonCure system installed in the state of Florida in 2020.

Figure 1: CarbonCure's Impact on GWP (CO_2e) of Select Ozinga Concrete Mixes

Mix ID	Strength (psi @ 28 days)	GWP without CarbonCure (kg CO_2e/ yd^3)	GWP with CarbonCure (kg CO_2e/ yd^3)	GWP Reduction
1686SH	4000	294.48	274.63	6.74%
1474SH	6000	279.44	262.38	6.11%
1145S	8750	366.46	347.4	5.20%

Source: Environmental Product Declaration, Ozinga Ready Mix, issued March 26, 2020.

On average, across the 30 Ozinga mix design variations in which CarbonCure was used, CO_2 mineralization reduced the GWP of the concrete by 6.0%.

Finding EPDs with CarbonCure

EPDs for concrete mixes made with CarbonCure can be found on the free, open-access Embodied Carbon in Construction Calculator (EC3) tool found at buildingtransparency.org. To find EPDs for concrete manufactured with CarbonCure, under the Concrete EPD search tool select the "CO_2 Cured" option, or conduct an advanced search for "CarbonCure" in the description field.

Are you interested in producing concrete with a reduced GWP, or are you looking for support with regards to obtaining concrete EPDs?

CarbonCure has a team of experts waiting to help you take your next sustainability steps and answer any questions you may have.

Join the growing network of producers who are leading the movement to reduce the carbon footprint of concrete and the built environment. Connect with a CarbonCure representative at carboncure.com/contact-us.

DID YOU KNOW?

More than 10 million cubic yards of CO_2 mineralized concrete have been poured across North America.

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CARBON CURE™