ASSOCIATE MEMBER WEBINAR SERIES – CARBONCURE TECHNOLOGIES INC.

Facilitator

Tracey DaSilva

Office Manager

Concrete Ontario

tdasilva@concreteontario.org

Facilitator

Oliver Xiao

Technical Services Engineer

Concrete Ontario

oxiao@concreteontario.org

Housekeeping

GoToWebinar

- Approximately 40 minute webinar with Q & A at the end, followed by a Kahoot! Pop Quiz
- All participants are muted
- Questions? Use the GoToWebinar ‘Questions’ Pane
- Webinar will be recorded and posted on the Concrete Ontario website along with a PDF copy of the presentation.
- https://www.rmcao.org/publications/webinar-presentations/

Presenter

Kevin Davis

West Region Sales Director

CarbonCure Technologies

kdavis@carboncure.com

Reducing Embodied Carbon through CO_2 Mineralization

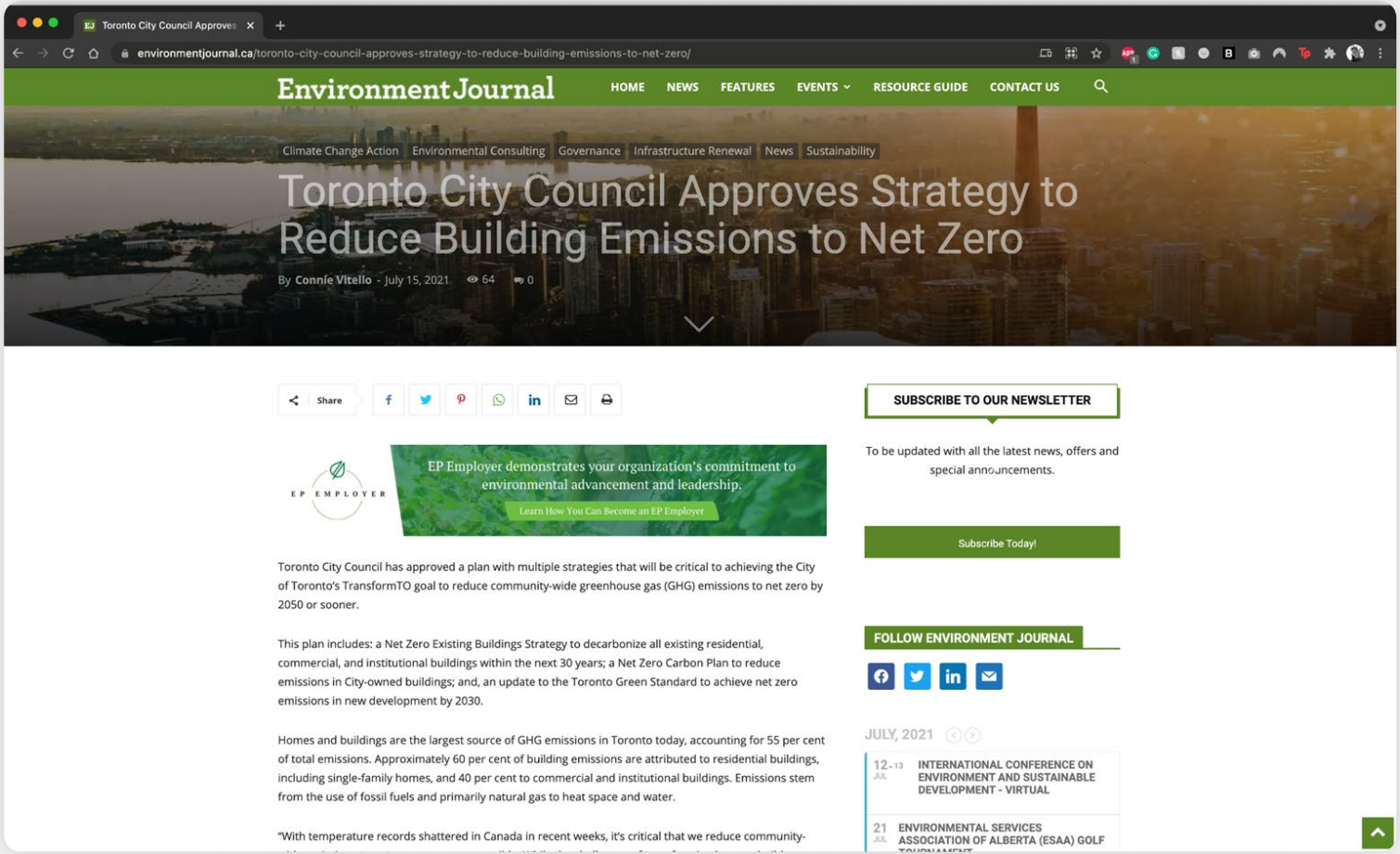
Kevin Davis
Regional Sales Director, Canada
CarbonCure Technologies

July 2021

CONCRETE ONTARIO

Did you know?

The world's building stock is expected to double by the year 2060. This means we're building an entire New York City every month for the next 40 years.


Toronto City Council Approves
environmentjournal.ca/toronto-city-council-approves-strategy-to-reduce-building-emissions-to-net-zero/
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Toronto City Council Approves Strategy to Reduce Building Emissions to Net Zero
By Connie Vitello - July 15, 2021
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EP EMPLOYER
EP Employer demonstrates your organization's commitment to environmental advancement and leadership.
Learn How You Can Become an EP Employer
Toronto City Council has approved a plan with multiple strategies that will be critical to achieving the City of Toronto's TransformTO goal to reduce community-wide greenhouse gas (GHG) emissions to net zero by 2050 or sooner.
This plan includes: a Net Zero Existing Buildings Strategy to decarbonize all existing residential, commercial, and institutional buildings within the next 30 years; a Net Zero Carbon Plan to reduce emissions in City-owned buildings; and, an update to the Toronto Green Standard to achieve net zero emissions in new development by 2030.
Homes and buildings are the largest source of GHG emissions in Toronto today, accounting for 55 per cent of total emissions. Approximately 60 per cent of building emissions are attributed to residential buildings, including single-family homes, and 40 per cent to commercial and institutional buildings. Emissions stem from the use of fossil fuels and primarily natural gas to heat space and water.
"With temperature records shattered in Canada in recent weeks, it's critical that we reduce community-
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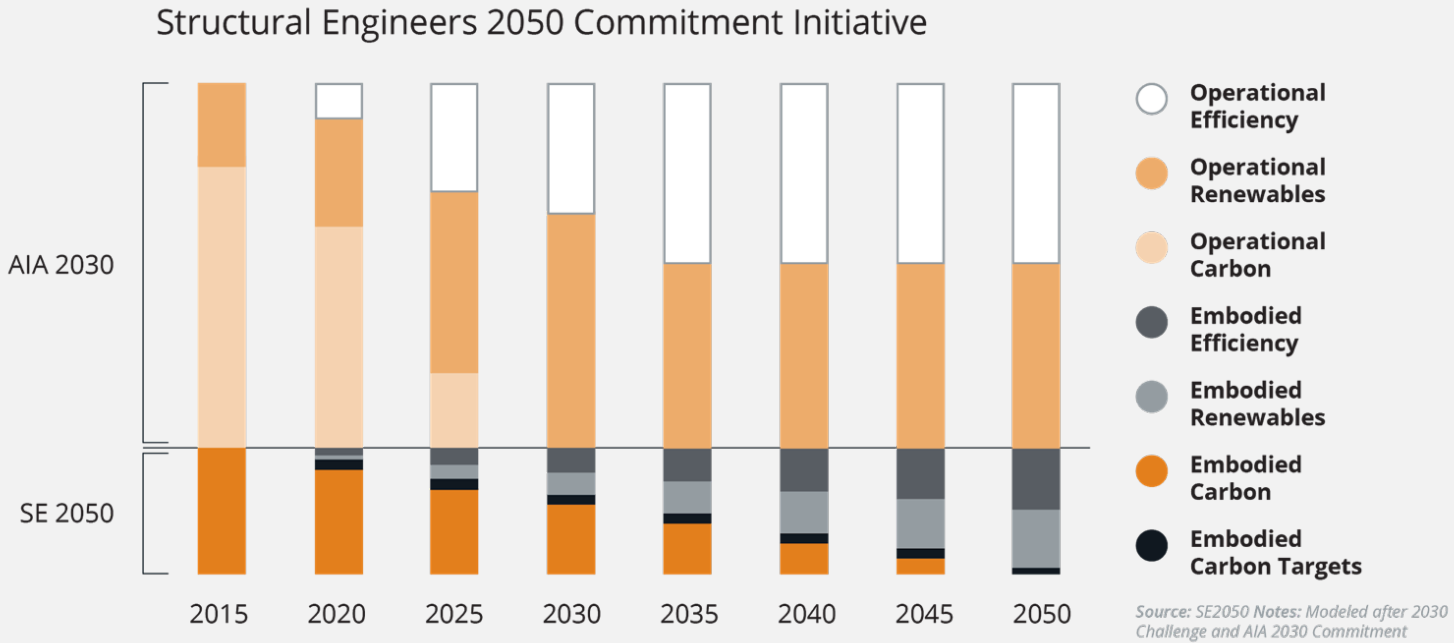
JULY, 2021
12 - 13 JUL INTERNATIONAL CONFERENCE ON ENVIRONMENT AND SUSTAINABLE DEVELOPMENT - VIRTUAL
21 JUL ENVIRONMENTAL SERVICES ASSOCIATION OF ALBERTA (ESAA) GOLF

Structural Engineers 2050



Why Now?

Growing movement to reduce emissions from buildings and construction

40% of GHGs.
Buildings generate 40% of the world's annual GHG emissions.

Growing Impact.
The world's building stock will double by 2060: like building a new NYC every month.

Embodied Carbon.
Will be responsible for ½ of new construction emissions between now & 2050.

Mission Alignment.
AEC Embodied Challenge: achieving net zero embodied carbon by 2040.

What is CarbonCure?

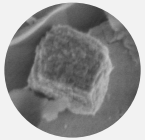
CarbonCure's technology **beneficially repurposes carbon dioxide** (CO_2) to reduce the carbon footprint of concrete without impacting performance.

CARBON CURE™

What Happens When CO_2 is Injected?

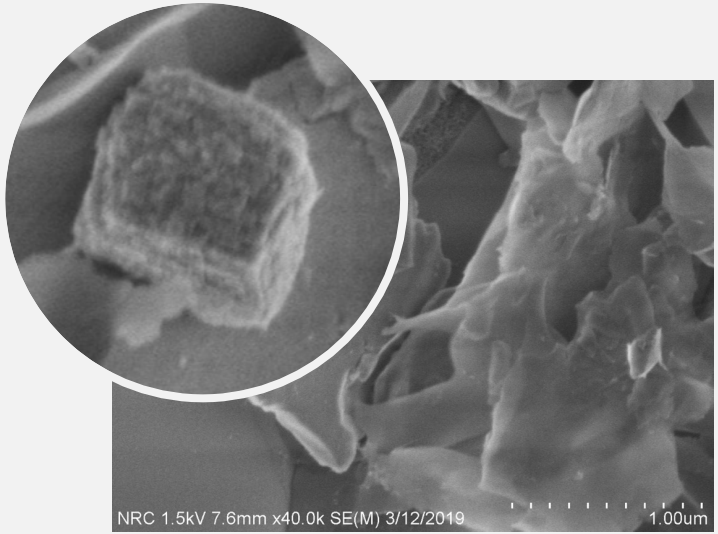
Cement + H_2O → Ca^{2+} Calcium

CO_2 + H_2O → CO_3^{2-} Carbonate

Ca^{2+} + CO_3^{2-} =  $CaCO_3$ Calcium Carbonate

- CO_2 mineralization occurs
- CO_2 converts into **$CaCO_3$ (solid limestone)**

Converting CO_2 into a Mineral



Carbonate product formed
about 400 nm dimension

Nano-calcium carbonate particles act as nucleation sites for hydration. Compressive strength benefits can arise from this interaction.

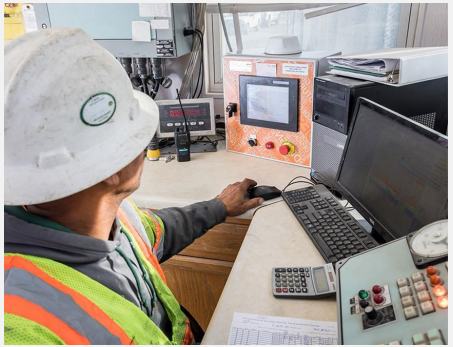
How it Works: Technology

Seamless retrofit technology that operates with no disruption to normal batching procedures

Installation

- CarbonCure engineers install the proprietary equipment into existing concrete plans

Integration

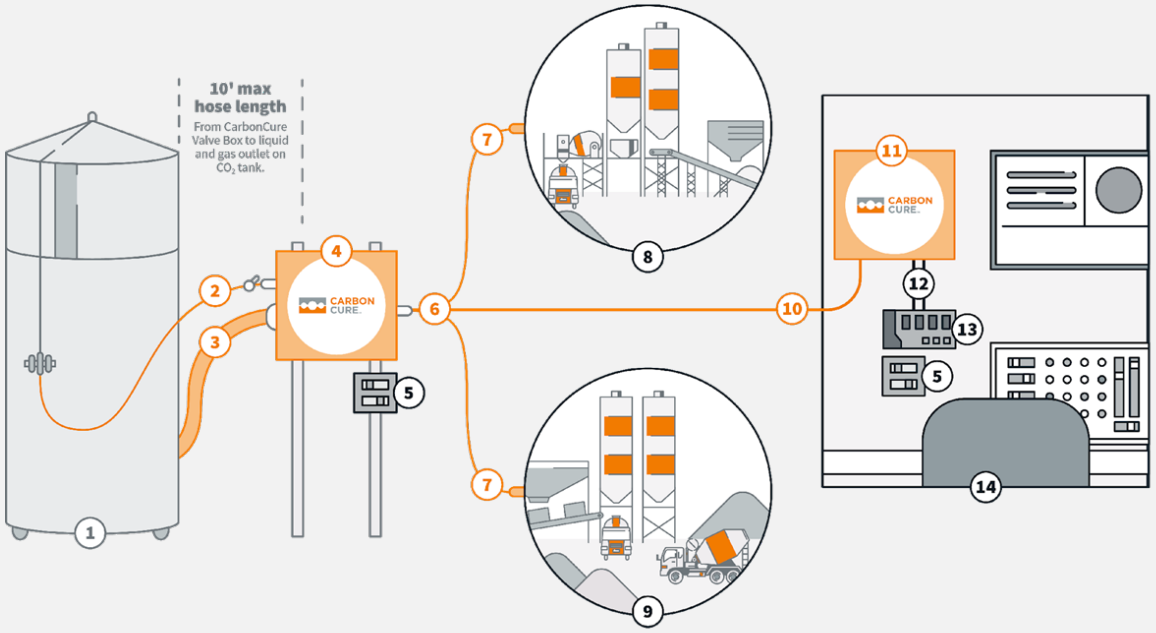


- The CarbonCure software integrates seamlessly with the plant's existing batching software

Injection

- The equipment injects a precise automated dosage of CO_2 snow into concrete as it mixes

How it Works: Installation



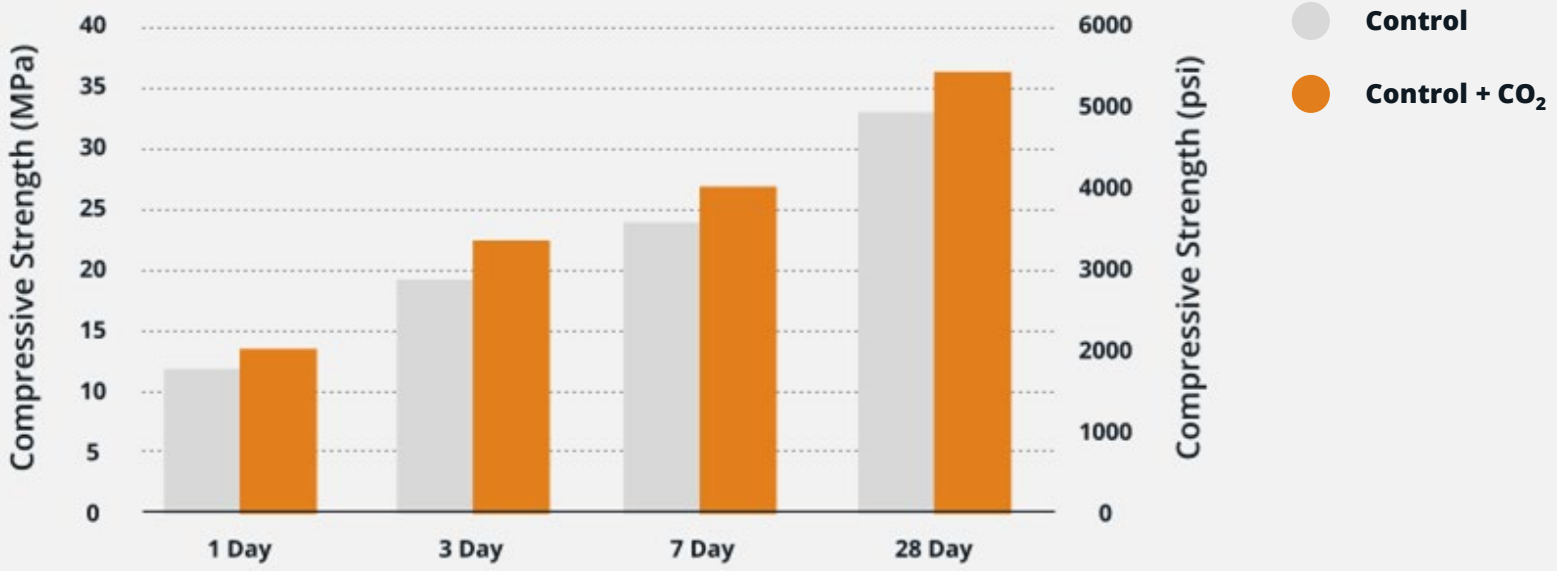
Orange: Supplied by CarbonCure
Black: Supplied by Concrete Producer
Grey: Supplied by Gas Company

CARBON CURE

1. **Bulk CO_2 Tank**
   Sized according to anticipated CO_2 usage
2. **Gas CO_2 Transfer Line**
3. **Liquid CO_2 Transfer Line**
4. **CarbonCure Valve Box**
5. **120 VAC Electrical Supply**
   (5A breaker)
6. **CO_2 Snow Discharge Hoses**
   60' max hose length
7. **CO_2 Snow Discharge Nozzles**
   Mounted to inject inside central mixer or in loading area for dry batch
8. **Ready Mix Plant Central Mixer**
9. **Dry Batch Loading Area**
10. **Communication Cable**
    Variable Length
11. **CarbonCure Control Box**
12. **18AWG Comm Wires**
13. **Batching Junction Box**
    Open admixture feed card and pulse card
14. **Control Room**

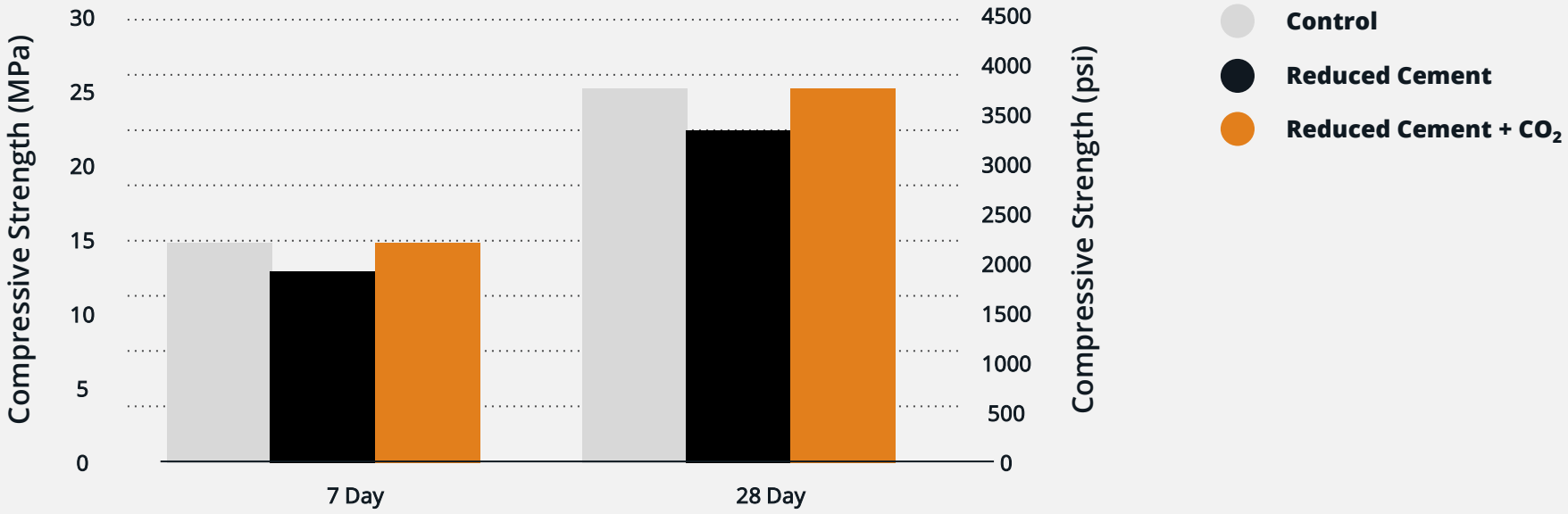

CARBONCURE™

Compressive Strength Gain



Conclusion: *The formation of a calcium carbonate nanomaterial* ***improves the compressive strength*** *of ready mix concrete.*
Source: *"Calculating Sustainability Impacts of CarbonCure Ready Mix" (2017)*

Mix Optimization Using Less Cement



Conclusion: *CarbonCure enables concrete producers to* ***reduce cement content*** *without sacrificing strength.*
Source*: "Ready Mix Technology Trial Results" (2015).*

CO_2 Savings with CO_2 Mineralization

~ 15 kg CO_2 reduced /m^3 of ready mix concrete

- 1 lb. sequestered
- 10 – 15 kgs avoided through cement reduction
- ~ 5% reduction in GWP (stackable carbon benefit with SCMs)

CO_2 has a Neutral Impact on...

Fresh Properties

- Setting time
- Workability/slump
- Concrete pumping
- Air content
- Temperature
- Finishing

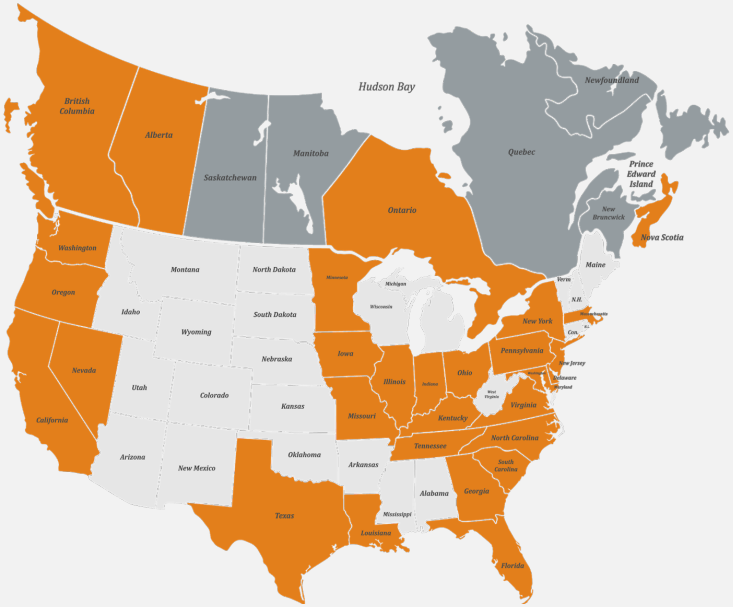
Hardened Properties

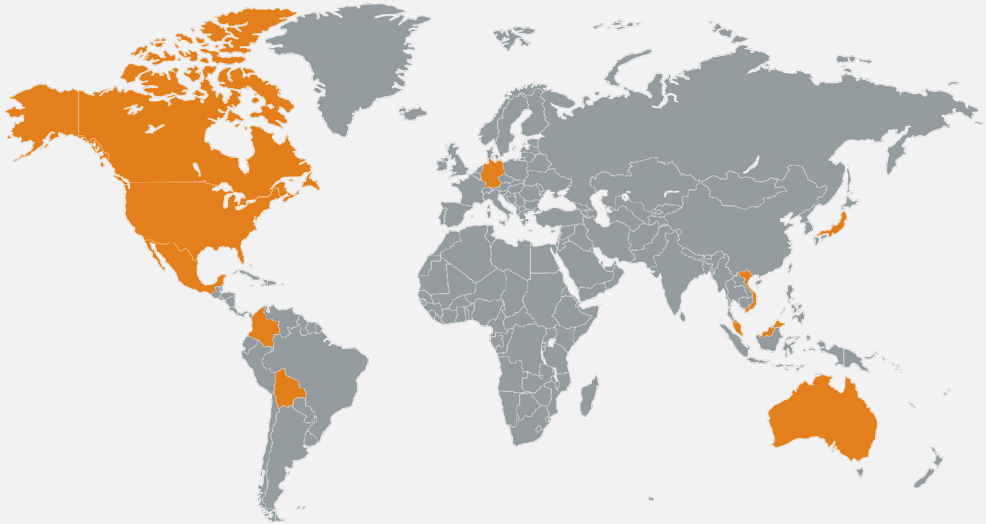
- Freeze-thaw
- pH
- Density
- Durability
- Color
- Texture

Note: Peer reviewed papers are available to support the above information at carboncure.com.

CO_2 Mineralized Concrete Locations

>350 ready mix plants and >9 million cubic meters of concrete produced





Reference Project:

YYC De-icing Apron - Calgary, AB

Concrete paving poured from on-site portable batch plant

Owner:
Calgary International Airport (YYC)

General/Concrete Contractor:
PCL Construction

Total CarbonCure Concrete Used:
25,230 m^3

Pouring time:
8 weeks

CO_2 savings:
160 tonnes

CO_2 savings equivalent:
85 hectares of forest absorbing CO_2 /year

Reference Project:

MDH Cedar Creek Distribution Center Lebanon, TN

"We're proud to have reduced the carbon footprint of Cedar Creek Distribution Center, and intend to continue to use CarbonCure in future construction across the country."

Arun Singh
CFA, Chief Financial Officer, MDH Partners LLC

Concrete Supplier: Irving Materials, Inc.

Owner: MDH Partners

Scope: 226,000 ft^2 distribution center

CO_2 Savings: 140,000 lbs

CO_2 Savings Equivalent to: 82 acres of trees absorbing CO_2 for a year

CO_2 Mineralized Concrete Projects

Indianapolis, IN – Infosys Innovation Hub
Concrete Producer: Irving Materials

Mountain View, CA – LinkedIn Campus
Concrete Producer: Central Concrete

Washington DC - The Wharf Phase 2
Concrete Producer: Vulcan Materials

Halifax, NS – RBC Centre
Concrete Producer: Quality Concrete

Chicago, IL - McDonald's Flagship
Concrete Producer: Ozinga

Honolulu, HI – Dept. of Transportation
Concrete Producer: Island Ready-Mix

Atlanta, GA – Georgia Aquarium
Concrete Producer: Thomas Concrete

Calgary, AB – YYC East De-icing Apron
General Contractor: PCL Construction

Customer Success Stories

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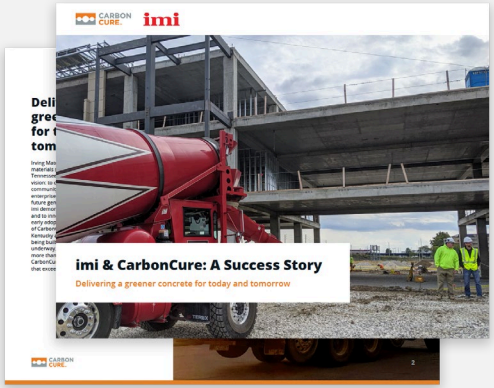


- Installed CarbonCure in 2017
- Currently in 60 plants, 15 more scheduled
- Total production: >1,500,000 m^3
- Total CO_2 savings: >18,00 tonnes

Thomas® CONCRETE

- Installed CarbonCure in 2016
- Currently in 26 plants, 12 more scheduled
- Total production: >2,800,000 m^3
- Total CO_2 savings: >33,000 tonnes

OZINGA®

- Installed CarbonCure in 2016
- 31 systems in 27 plants
- Total production: >1,200,000 m^3
- Total CO_2 savings: >17,000 tonnes

Barriers to Innovation: Specs

Prescriptive specs may result in unnecessary limitations to sustainability improvements

Prescriptive Spec		Performance Spec
Minimum cement/cementitious requirement Maximum supplementary cementitious content Maximum water/cement ratio	**Consider** ➡	Specify strength (eliminate minimum cement requirement) Specify strength (eliminate maximum SCM requirement) Use only when appropriate for exposure class and performance requirement

Specify Concrete Sustainably

- **Strategies for Low-Carbon Concrete:**
  - Performance-Based Specifications, not Prescriptive-Based Specifications
  - Require cement replacement %
  - Strength at 28, 56, and 84 Days
  - Set maximum (not minimum) cement content
- **Specify SCMs & Admixtures:**
  - Fly Ash
  - Slag
  - Superplasticizers
  - CO_2 Mineralization

Easiest option?
Ask your concrete producers what they can do!

Environmental Product Declaration (EPD)

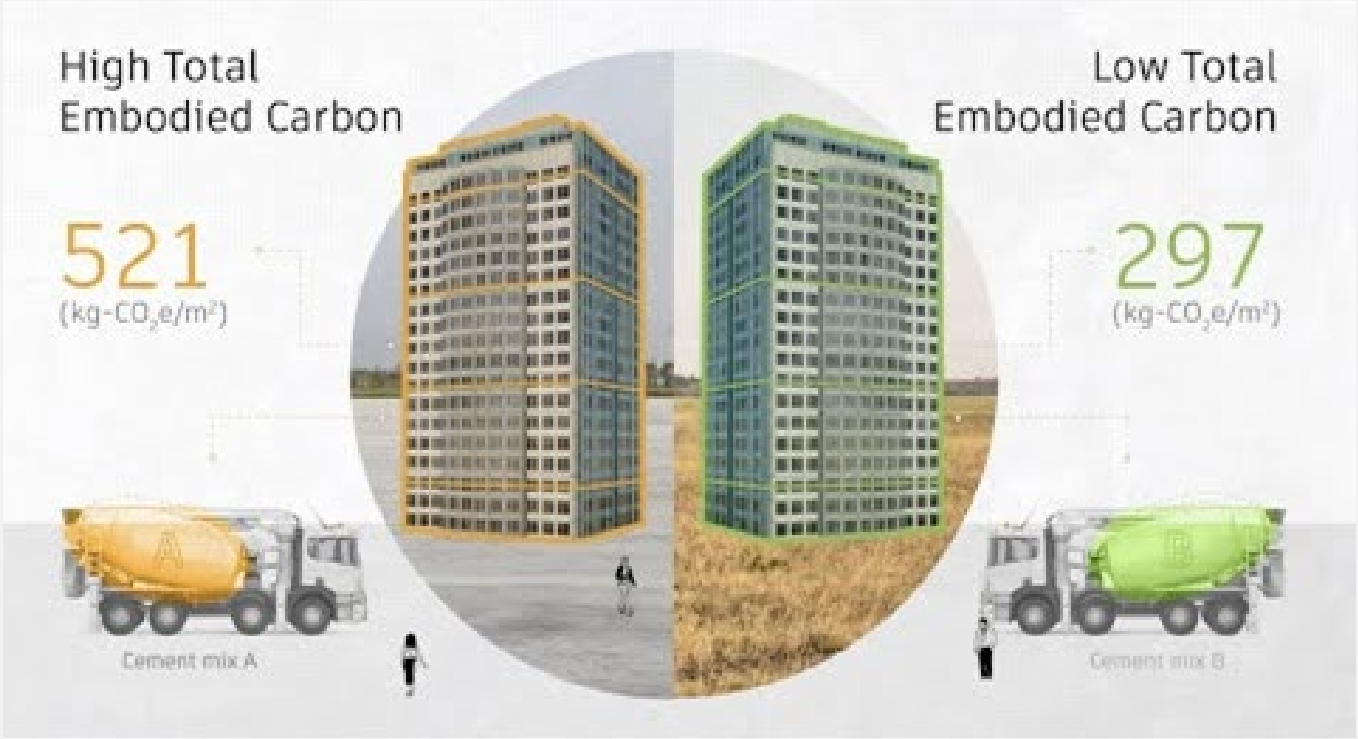
Think of EPD's as **a nutrition label for your concrete**. This tool gives transparency into the overall carbon impact.

Things to consider:

1. Industry and governments are driving change
2. Be proactive in your adoption
3. EPDs report of 7 core mandatory impact indicators
4. Implement solutions that reduce Global Warming Potential (GWP) to gain a competitive advantage

EPD Providers: Athena, Climate Earth

EC3


High Total
Embodied Carbon
521
(kg-CO2e/m2)
Low Total
Embodied Carbon
297
(kg-CO2e/m2)
Cement mix A
Cement mix B

The Future

Decarbonization of concrete is *the* defining competitive issue for the industry and will be for the foreseeable future.

Our goals:

- Enhance producer competitiveness with added profitability and sales differentiation
- Rapid plant retrofits with very low barriers to adoption
- Seamless integration that is complementary to existing low-carbon solutions, regulations, and supply chains
- Continuous innovation of low-carbon, digital, and circular technologies
- Win-win partnerships across the construction value chain, government, and industry

Thank You!

Kevin Davis
Regional Sales Director, Canada
kdavis@carboncure.com
604.314.1065

www.carboncure.com
@CarbonCure
CarbonCure-Technologies
CarbonCure.Technologies

CARBON CURE™
Simply better concrete.

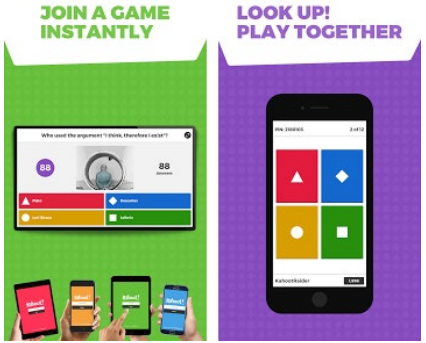
Questions?

Concrete Ontario Pop Quiz

Please use your smart phone to access the following website:

www.kahoot.it

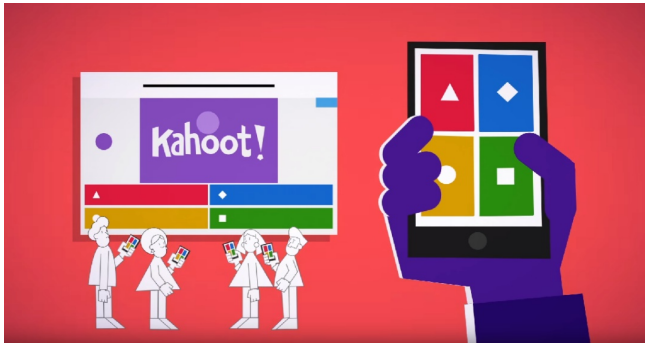
- Please enter the Game **“Pin”** that will be shown on the screen shortly
- Enter both your email address (so we can send you a prize if you finish in the top three) and your “**Nick Name**” (please think of your **HR** department and don’t use something you will regret!)
- The faster you answer each question the more points you can earn for correct answers



Concrete Ontario Pop Quiz

Amazon Gift Cards for
Today's Competition

- First Place = $150
- Second Place = $100
- Third Place = $50



Next Webinar

- Join us on **August 19th, 2021** at 10:00 am – 11:00 am
- **London Machinery** - Associate Member Webinar Presentation

Thank you!