The CarbonCure Technical Services and Support team has provided answers to frequently asked technical questions regarding how the installation and use of the CarbonCure Technology will affect your plant's operations and final product.
What effect does CO₂ have on fresh properties?

CO₂ has no measurable effect on concrete fresh properties at the dosages recommended by CarbonCure (see white paper – CarbonCure's effect on fresh concrete properties).

Please see Technical Note: CarbonCure's effect on fresh concrete properties (available in the Technical Data Library at www.carboncure.com).

When in my batching sequence does the CO₂ get added? How will this impact my cycle times?

CO₂ is added during the batching sequence when at least 50% of the cement has entered the mixer/truck. CO₂ injections typically take between 20 – 40 seconds to complete. However, the field engineer performing the installation will configure your batching software to commence CO₂ injection so that no additional time is added to your cycle times.

What is stored in the CO₂ tank and what is actually going into the mixer/truck?

The tank is filled with liquid CO₂. The top portion of the tank (headspace) is filled with CO₂ gas to maintain the liquid under pressure. Once the liquid CO₂ exits the valve enclosure, it converts to a mixture of gas and solid CO₂ due to the drop in pressure. It is this mixture of gas and solid CO₂ that enters the concrete mixer/truck.

Liquid and solid CO₂ are very cold, should I be concerned about temperature changes to my concrete?

Solid CO₂ is very cold (-110°F), but only a small amount relative to other ingredients in the mix design is added to the concrete batch. Also, the chemical reaction between CO₂ and cement is an exothermic reaction (heat is released). There is no noticeable change in concrete temperature with the addition of CO₂ based on the recommended dosages.

Should I be concerned about my staff working with or near CO₂?

The majority of CarbonCure customers have their CO₂ tanks installed outside to prevent the CO₂ from being trapped in a confined space. Concrete producers may choose to source and install CO₂ sensors near the mixer, loading area, or anywhere in the concrete plant to ensure concentrations do not exceed harmful concentrations. Please reference CarbonCure's safety notes for more information.

Does CO₂ effect set time?

Calorimetry is used during the commissioning process to determine if CO₂ is having an accelerating or retarding effect on each cement type. The variation in set time is minimal and the optimum dosage can be selected to reduce the likelihood of impacting set time.
Does CO\textsubscript{2} react negatively with any other admixtures?
CarbonCure has completed lab scale and full scale testing surrounding the interaction of CO\textsubscript{2} with a variety of classes and brands of chemical admixtures. CarbonCure has yet to come in contact with an admixture that negatively impacts the addition of CO\textsubscript{2} or an admixture that is negatively impacted by the addition of CO\textsubscript{2}. CarbonCure customers have treated over 4 million cubic yards of concrete with various admixtures and there have been no reported cases of an adverse effect on or with admixtures.

Can CO\textsubscript{2} be added to mix designs that contain supplementary cementitious materials (SCMs)?
Yes, almost all CarbonCure customers have been using CO\textsubscript{2} in mix designs that include SCMs (including ternary blends) from many different regions across North America. CO\textsubscript{2} has no negative impacts on SCMs in concrete.

What kind of maintenance is required for the CarbonCure system?
The injection nozzle will need to be cleaned to prevent concrete build up every few weeks depending on usage. CarbonCure staff continuously monitor pressure and temperature sensors within the system and will travel to site, as needed, to replace any faulty components. In the unlikely event of a system failure, all faulty components that have been damaged on the customer site will be replaced by CarbonCure per the license agreement for the duration of the term.

Will finishers have issues due to the reduced cementitious content and addition of CO\textsubscript{2}?
CarbonCure has completed blind testing with finishers to verify finishability of CarbonCure treated concrete and in each instance found that finishers saw no difference between concrete that has and has not been treated with CarbonCure. CarbonCure customers have shipped over 4 million cubic yards of CO\textsubscript{2} treated concrete to job sites and there have been no cases of a finisher refusing a batch of concrete due to the addition of CO\textsubscript{2}.
How do I determine what size CO\textsubscript{2} tank my plant will need?

Your local gas supplier will conduct a site visit to determine where the tank will be installed and what size is required for your anticipated production. CarbonCure staff will provide the CO\textsubscript{2} supplier with the system's engineering requirements for flow rate and pressure and will help the customer to determine how much CO\textsubscript{2} they will be using on a monthly basis. It is not recommended that the customer source CO\textsubscript{2} without first consulting a CarbonCure technical representative as the engineering requirements are critical for proper equipment function.

What is the effect of CO\textsubscript{2} on long term durability?

Durability testing has shown that the utilization of CO\textsubscript{2} in concrete production does not impact the concrete's durability properties. Please refer to the white paper on CarbonCure's website (CarbonCure's effect on durability of concrete).


My plant has more than one lane, can I use one CarbonCure system to service both?

No, a separate system is required for each lane. CarbonCure technical staff should be consulted when considering the installation of the technology in a dual lane plant to assess the best equipment application for that specific plant.

Does the addition of CO\textsubscript{2} affect pH?

Research conducted by CarbonCure in collaboration with leading educational institutions has shown that injecting CO\textsubscript{2} using the CarbonCure Technology does not affect the pH of the pore solution of mature concrete. Please refer to the technical note on CarbonCure's website (CarbonCure and pore solution pH).

How do I determine the optimum dosage of CO₂ for each mix designs?

After installing the system, the field engineer will perform a dosage ramp with the customer’s QC department to determine the optimum dosage of CO₂ for each cement type used in their production. A single truck is loaded and the field engineer manually injects three separate CO₂ dosages while sampling at each stage to determine the optimum dosage based on compressive strength increase at 7 and 28 days.

Please see Technical Note: Overview of CarbonCure’s ready mix technology system & plant integration (available in the Technical Data Library at www.carboncure.com).

Why do we perform a single truck dosage ramp to find the optimum dosage instead of separate trucks throughout the day?

Production and truck-to-truck variation can hide the benefit CO₂ has on concrete products. A single truck is used to reduce variability (ex: truck equipment, water to cement ratio, air content, etc.) and to set a realistic expectation for compressive strength gain.

After the commissioning process is complete, which mixes should we adjust with CO₂?

Residential and light commercial mix designs (i.e. performance based, non-specified mixes) should be targeted first. Once these mix designs have been adjusted, the focus should shift to high strength mixes. Additional quality testing should be conducted at this point on a mix by mix basis to achieve maximum cementitious reduction.

How do I determine the maximum cementitious reduction for my mix designs?

The maximum cementitious reduction for mix designs will be determined during the commissioning process. Once the 28-day compressive strength increase is determined, CarbonCure staff compare cement efficiencies before and after the addition of CO₂ to determine the maximum cementitious reduction without compromising compressive strength. Customers work directly with CarbonCure’s technical team during the mix adjustment phase. It is recommended to start at a conservative 3% cementitious reduction immediately after the dosage ramp to offset the CarbonCure Technology cost, and to increase cementitious reduction as indicated by data collection.

Is CO₂ a bottle feed or direct feed admixture?

CO₂ behaves as a direct feed admixture whereas the injection process and metering happen in tandem. The CarbonCure Technology sends pulse signals back to the customer batching computer at predetermined volumes until the required dosage has been injected, much like any other admixture.
What’s a typical dosage of CO₂? Is it entered into mix designs as oz/cwt or oz/yd³?

CO₂ is dosed based on the cement content of a mix design. A typical dosage of CO₂ is between 0.50 – 1.00 lbs/yd³ (8 – 16 oz/yd³). The customer chooses whether to enter CO₂ into their batching software as oz/cwt or oz/yd³. The CO₂ Dosage Calculator (a tool provided by CarbonCure) should be consulted whenever a new mix design is being adjusted or if the cementitious contents of a mix design change.

How can we confirm that CO₂ actually went into the mixer/truck?

The pressure and temperature sensors inside the CarbonCure system are constantly monitored during injection to ensure the CO₂ is properly flowing through the system. If at any time during the injection the system detects an anomaly or unusual sensor reading, the system shuts down and displays an error message on the touch screen. CarbonCure staff will also receive this error message in real-time and begin the troubleshooting process. If no error messages are displayed during an injection, and the customer’s batching software has received all the required pulses back from the CarbonCure system, and it is assumed that the CO₂ has been delivered to the mixer/truck.

How does the system meter the CO₂?

The CarbonCure system uses an array of pressure and temperature sensors to determine what state the CO₂ is in before and after leaving the system. Each system is calibrated prior to shipping to a customer’s plant.

Liquid and solid CO₂ are very cold, should I be concerned about temperature changes to my concrete?

Solid CO₂ is very cold (-110°F), but only a small amount relative to other ingredients in the mix design is added to the concrete batch. Typically 1 pound of solid CO₂ is added per cubic yard of concrete which has an insignificant effect on the concrete’s temperature. Also, the chemical reaction between CO₂ and cement is an exothermic reaction (heat is released). There is no noticeable change in concrete temperature with the addition of CO₂ based on the recommended dosages.

Why do I see fog coming from the loading area?

The cold temperature of solid CO₂ (-110°F) means that on humid days, or in dry climates, it can appear as though a lot of CO₂ is exiting the loading area. However, the cloud is simply moisture in the air that has cooled down from coming in contact with CO₂ and has created a thick fog.

Will my drivers have to add more water on their way to the job site?

An optimal dose of CO₂ has no measurable effect on concrete workability; there should be no reason to add water on the job site to achieve a desired slump value. Routine water control must be used in the same manner as non CO₂ treated concrete.

Please see Technical Note: CarbonCure’s effect on fresh concrete properties (available in the Technical Data Library at www.carboncure.com).
**Effectiveness of CO₂**

CarbonCure customers routinely conduct independent testing, such as the case study shown below, to confirm that CO₂ is successfully improving or maintaining the strength of concrete batches that have reduced cementitious content.

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**What do I do if my CO₂ tank is empty? How will I know?**

Once normal production with CO₂ begins, your local gas supplier will put you on a regular fill schedule (for example, once every 2 weeks) to ensure you never run out of product. In the unlikely event where you run out before your next scheduled fill, CarbonCure staff monitor the pressure of your CO₂ tank and will notify the gas supplier on your behalf if there is any sign that the tank is close to empty.

**What do I do if my batching system stops receiving pulses from the CarbonCure system?**

Notify your CarbonCure Technical Services rep immediately. The technical contact is likely to be already troubleshooting the issue.

**What happens if I get a low compressive strength result for an adjusted mix design?**

Truck and plant variations happen whether CO₂ is being used or not; it is an inherent aspect of doing business in the concrete industry. If you are consistently getting low compressive strength results on an adjusted mix design, it is recommended to return to your original mix design without CO₂ to investigate the possibility that there are other variables at play.

**Can I use the same dosage for all my mix designs?**

Dosages used during the dosage ramp are based on a percentage by weight of cement (WC). Once the WC dosage is selected it can be applied to all mix designs but the net volume of CO₂ dosed will depend on the weight of cement in that particular mix design. The more cement in the mix design, the more CO₂ that will be required.

**How often should I monitor the adjusted mix designs after the commissioning process?**

It is recommended to monitor mix designs that have been adjusted with the addition of CO₂ on a weekly basis until enough data has been collected to perform a statistical analysis of the data (roughly 3 samples). At this time the customer should see no change to compressive strengths for their adjusted mix design when compared to their historical data.
Once injected, CO₂ reacts with cement to form a nano sized mineral that becomes permanently embedded in concrete.

Batching is controlled by a simple interface integrated with the batch computer.

CarbonCure’s Technology is retrofitted to an existing concrete plant.

Carbon dioxide (CO₂) gas is primarily sourced as a by-product from industrial processes.

The purified CO₂ gas is delivered in pressurized vessels by commercial gas suppliers.

CarbonCure’s proprietary delivery system precisely injects the CO₂ into the concrete mix.

www.carboncure.com

Want to learn more? Contact us!

www.carboncure.com

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