NATIONAL CONCRETE MASONRY ASSOCIATION
Sustainable Concrete Products for Structures and Hardscapes

Do Manufactured Concrete Products Sequester CO_2?

Yes. From the moment a concrete masonry unit, segmental retaining wall unit, or other manufactured concrete product is formed the material will begin to chemically bind to the carbon dioxide (CO_2) in the environment. This sequestration, or absorption and storage, of CO_2 will continue indefinitely provided that there is a source of hydrated, hydraulic cement in the unit that is exposed to carbon dioxide. Because the very nature of concrete means the presence of hydrated cement, and because it is virtually impossible to prevent exposure to CO_2, carbon sequestration is in essence a fundamental characteristic of concrete.

The fact that concrete masonry carbonates and sequesters CO_2 has been well documented for decades [1]. Past research efforts, however, have focused simply on the fact that concrete masonry absorbs carbon dioxide, without attempting to define how much or how quickly CO_2 is absorbed. As the sustainable attributes and environmental impact of different construction materials becomes an increasingly important design objective, questions such as these continue to be raised. In the context of recognizing that CO_2 is released during the manufacturing of portland cement and related hydraulic cements, the next evolution of this question then becomes how much CO_2 is subsequently reabsorbed during the service life of the manufactured concrete product.

Variables Impacting CO_2 Sequestration

Ideally one would be able to definitively state that concrete masonry sequesters 'X' pounds of carbon dioxide over a defined timeframe. Unfortunately, the chemical and physical processes involved are highly complex resulting in a range of absorption values that can vary significantly. These include:

- Exposure: While carbon dioxide is virtually everywhere, it is not found in equal concentrations nor is concrete masonry used in applications with identical exposures and finishes.
- Unit Porosity: The rate at which carbon dioxide is sequestered is also a function of the porosity of the unit, as more open material structures allow for carbonation to occur more quickly.
- Moisture Content: As the moisture content within a manufactured concrete product increases, the sequestration of carbon dioxide accelerates.
- Exposure Time: The rate at which manufactured concrete products sequester CO_2 is not linear, but instead generally slows with time.
- Constituent Materials: The raw materials used to produce manufactured concrete products can impact the rate and degree of CO_2 absorption.

All other variables being equal, an assembly will likely carbonate more quickly if: used above grade rather than below grade; used on the exterior versus interior; or has been in service for a relatively short time.

Measuring CO_2 Sequestration

Measuring sequestered carbon dioxide is technically difficult, time consuming, and expensive. As a further complication, there is no industry standard for measuring sequestered CO_2; and certainly different test methods can produce different results. While there are test methods that can readily measure the amount of CO_2 a given mass of concrete contains, these tests have potential issues that would require additional considerations depending upon the purpose(s) of performing the tests:

- Testing cannot differentiate between the CO_2 that was absorbed by the unit following production and the CO_2 that was present in the constituent materials prior to production. While the quantities may be very small or relatively large, virtually all of the constituent materials used in the production of manufactured concrete products contain some latent CO_2. If the goal is to quantify the net CO_2 that a unit has absorbed post-production, a more accurate assessment would be obtained by first measuring the CO_2 absorbed by the raw materials prior to production.
- Testing only quantifies the sequestered CO_2 at the time of testing; not the projected level of sequestration over a material's useful life.

References

1. TEK 10-3, *Control Joints for Concrete Masonry Walls – Alternative Engineered Method,* NCMA, 2003.