FAQ 24-17

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 bind chemically to the carbon dioxide (CO$_2$) in the environment. This sequestration, or absorption and storage, of CO$_2$ will continue indefinitely if there is a source of hydrated, hydraulic cement 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 defining 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 related hydraulic cements, the evolution of this question then becomes how much CO$_2$ is subsequently reabsorbed during the service life of the 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 affect 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[2]. As a further complication, there is no industry standard for measuring sequestered CO$_2$, with different test methods producing 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 quantities may vary, virtually all of the constituent materials used in the production of concrete contain some latent CO$_2$. To assess the net CO$_2$ 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**
