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# Carbonation and Circular Economy – Through the Lens of Manufactured Dry-Cast Concrete

NIST Workshop: June 8, 2022

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[ncma.org](http://ncma.org)

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## The Humble Cinder Block...

From it's early beginnings...

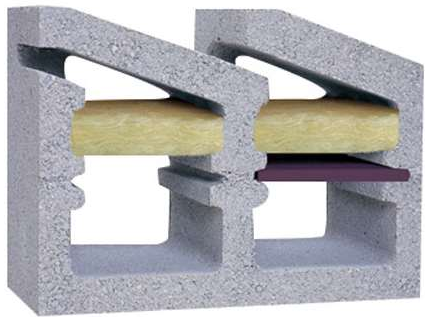




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# The Humble Cinder Block...

To thousands of products...





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# The Humble Cinder Block...

...Used in hundreds of applications.





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## Dry-Casting – Production Overview



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## Dry-Casting – Production Overview

Other unique production  
variables:

Aggregate Size





# Dry-Casting – Production Overview

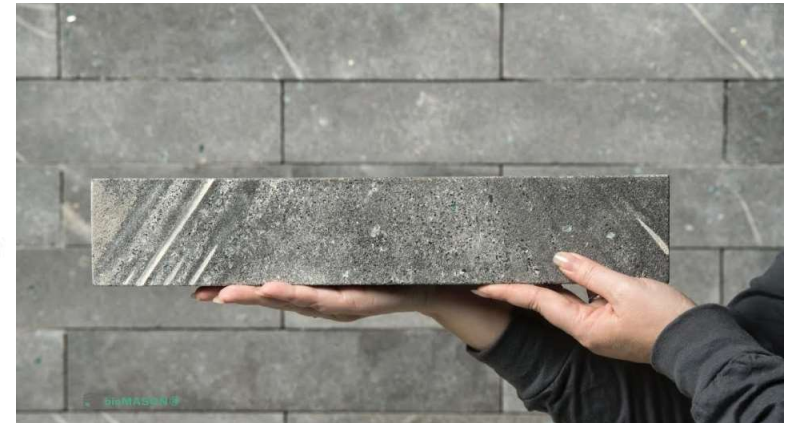
Other unique production variables:

Regrind



## Dry-Cast Manufactured Concrete

While dry-cast manufactured concrete is concrete, its combination of constituent materials, manufacturing methods, and curing process facilitate innovations in material use.





## Dry-Cast Manufactured Concrete

The modular, segmental characteristics of manufactured concrete products are uniquely suited for adaptive reuse...with some challenges.



## Dry-Cast Products – Circular Concepts

Design Intent vs. Inherent Attribute?

Segmental Retaining Walls





## Dry-Cast Products – Circular Concepts

Design Intent vs. Inherent Attribute?

Segmental Retaining Walls



## Dry-Cast Products – Circular Concepts

Design Intent vs. Inherent Attribute?

Interlocking Concrete Pavers





## Dry-Cast Products – Circular Concepts

Design Intent vs. Inherent Attribute?

Concrete Masonry

Mortar, grout, and rebar  
present challenges.



# Dry-Cast Products – Circular Concepts

Design Intent vs. Inherent Attribute?  
Concrete Masonry

Dry-stack CMU



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**Design and Construction  
Guidelines for Dry-Stack  
Concrete Masonry**  
(TMS-1430-21)





## Dry-Cast Products – Circular Concepts

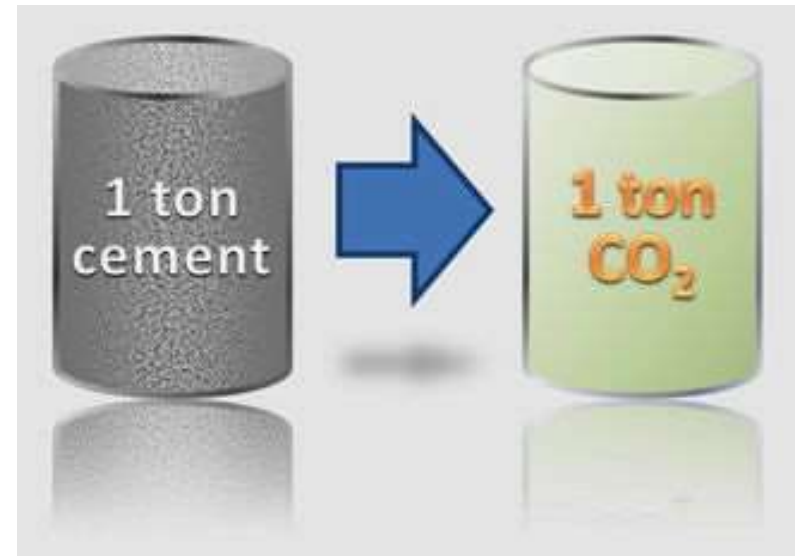
Dry-cast manufactured concrete products (by accident?) are specifically tailored to adapt and align with circular economy objectives.



## Dry-Cast Products – Carbon Sequestration

The other key market driver for the industry is minimizing our carbon footprint.

Production of portland cement is carbon intensive.





## Dry-Cast Products – Carbon Sequestration

There are numerous carbon capture, accelerated carbonation, and related technologies in use and in development today that permanently sequester CO<sub>2</sub>.

While it was well known that concrete carbonates, we didn't have a good baseline for dry-cast concrete carbonation.

## Dry-Cast Products – Carbon Sequestration

The assumption was that dry-cast and wet-cast concrete carbonate at roughly the same rate and therefore sequester about the same amount of CO<sub>2</sub>.





## Dry-Cast Products – Carbon Sequestration

In reality wet-cast and dry-cast concrete carbonate at vastly different rates.



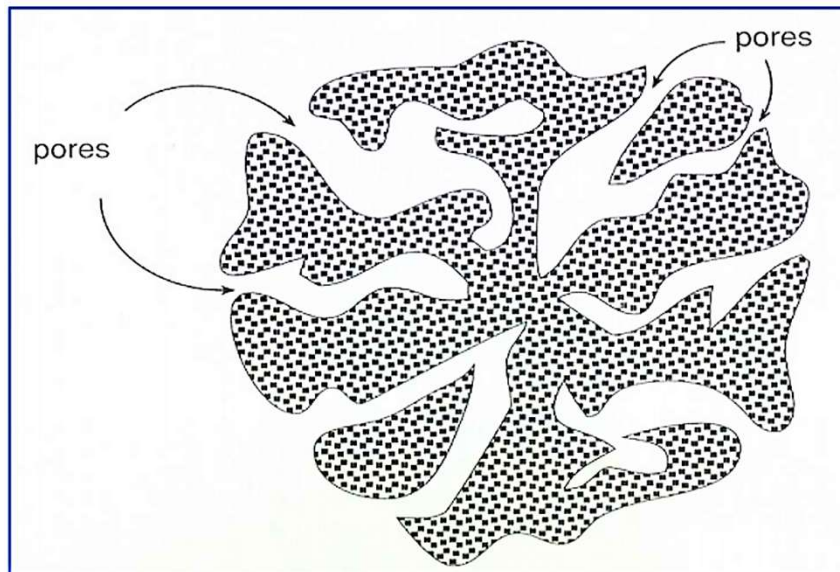
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## Dry-Cast Products – Carbon Sequestration

In reality wet-cast and dry-cast concrete carbonate at vastly different rates.



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## Dry-Cast Products – Carbon Sequestration

Research Underway:

CMU were collected from across the U.S. and Canada and allowed to naturally carbonate. TGA was performed periodically to measure carbon uptake.



Set 6  
4 Week

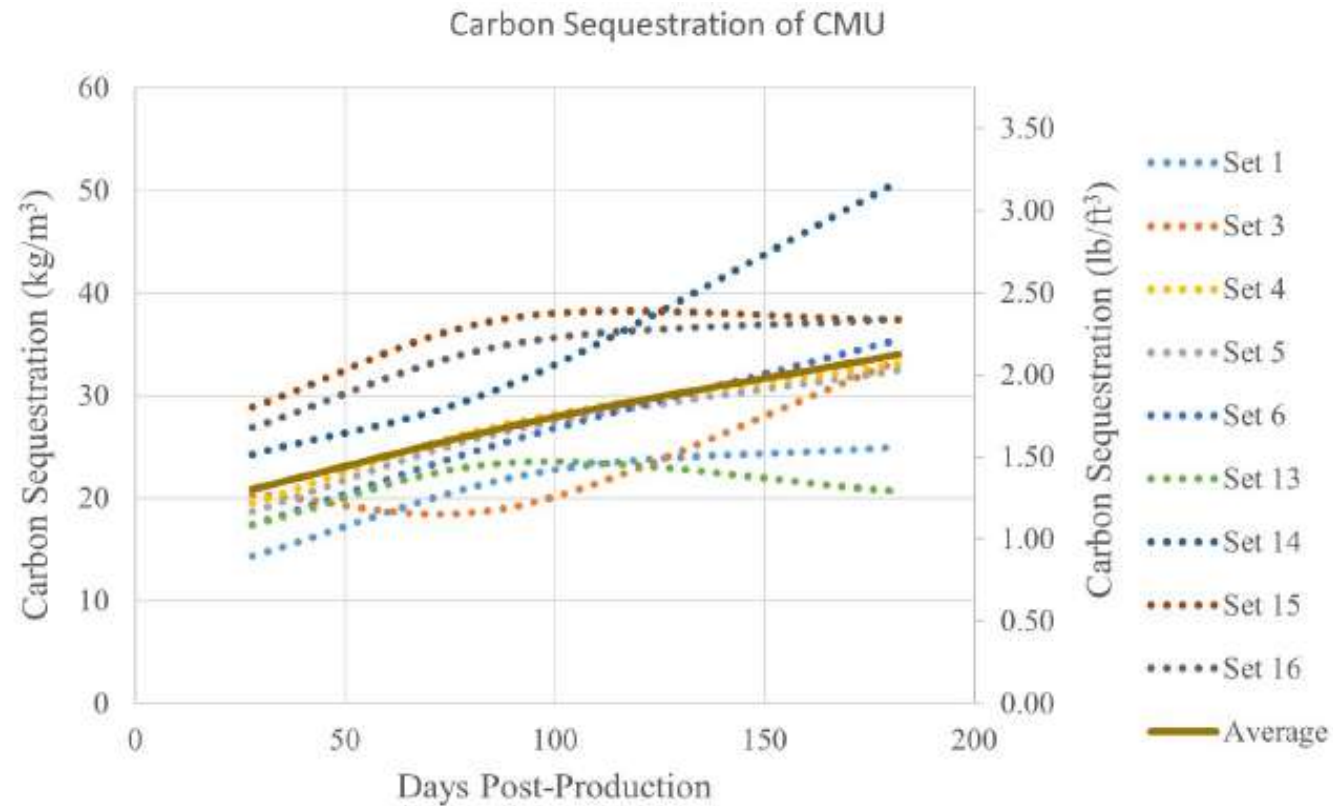
Set 6  
13 Week

Set 6  
26 Week

# Dry-Cast Products – Carbon Sequestration

Research Underway:

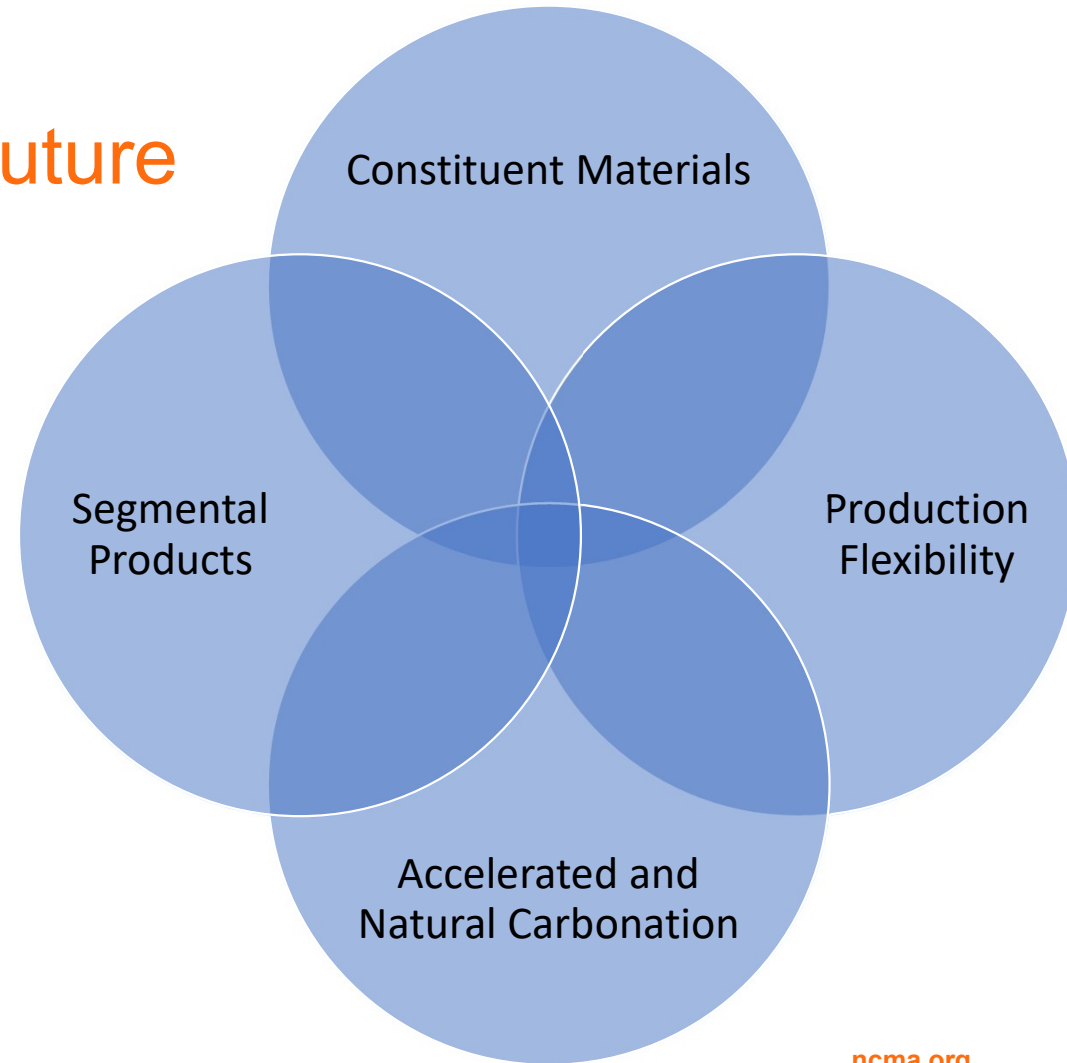
28 Day Uptake:  
21 kg/m<sup>3</sup>





## Dry-Cast Products – The Future

Today the dry-cast concrete products industry is at the cusp of integrating all these unique attributes.



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