Blended Cements & SCMs

The Pathway to Success

John Dale

November 7th, 2025

CRH Americas Cementitious Materials

ECOMATERIAL TECHNOLOGIES
A CRH COMPANY

Leader in marketing fly ash for concrete production

ASH GROVE®
A CRH COMPANY

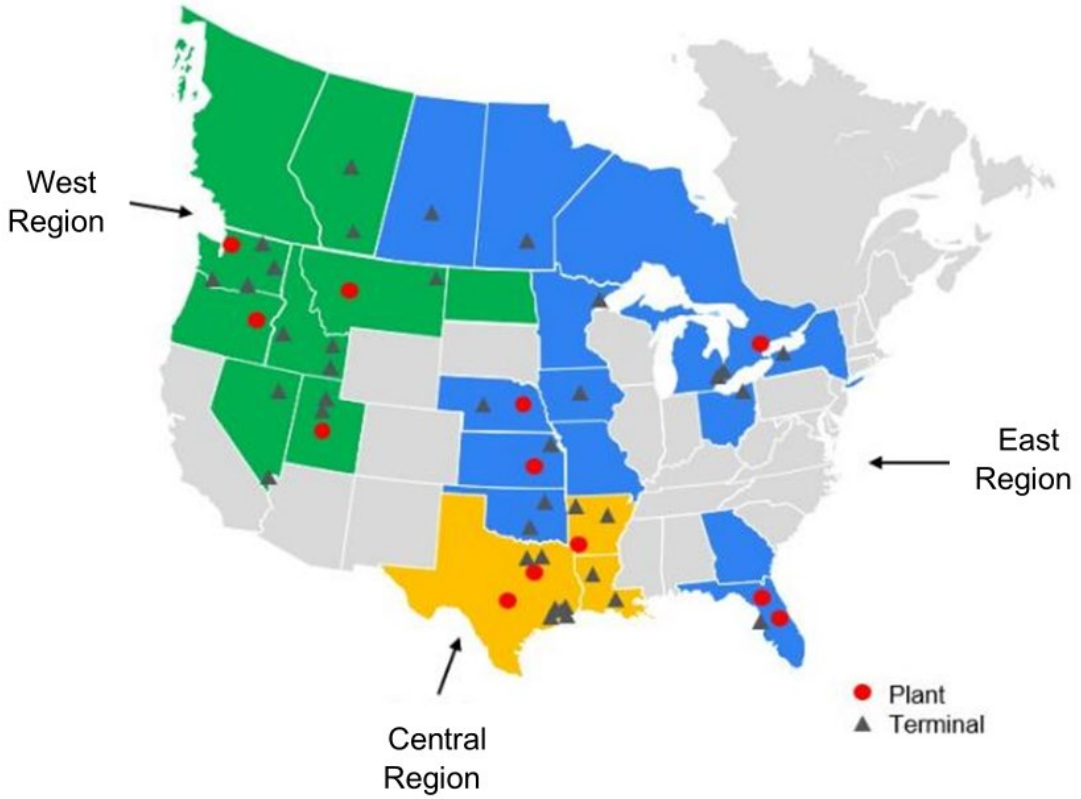
One of North America's leading cement manufacturers

SAPPHIRE
A CRH COMPANY

Transforming residual and non-recyclable materials into alternative fuels and raw materials for cement manufacturing

Ash Grove

One of North America's leading cement manufacturers



- 2,200 Employees
- 12 world-class Cement Plants
- 2 Materials Processing Plants
- 41 Terminals
- Cement 14.00 M st
- SCM 1.3 Mt

Our Plants

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West Region

Durkee, OR

Leamington, UT

Seattle, WA

Montana City, MT

Rivergate, OR

Tooele, UT

Central Region

Hunter, TX

Midlothian, TX

Foreman, AR

East Region

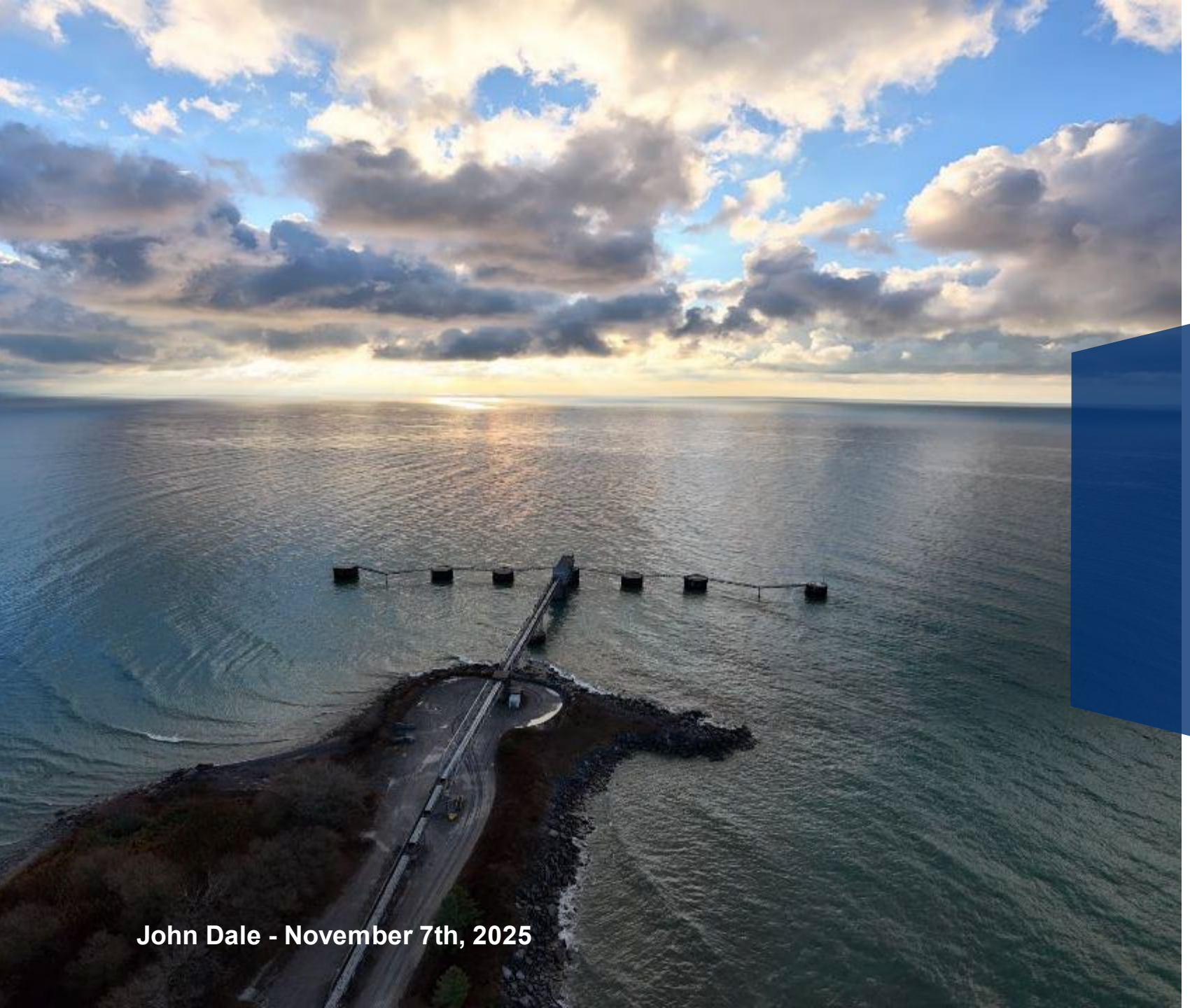
Chanute, KS

Louisville, NE

Branford, FL

Sumterville, FL

Mississauga, ON



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ACA Roadmap to Neutrality

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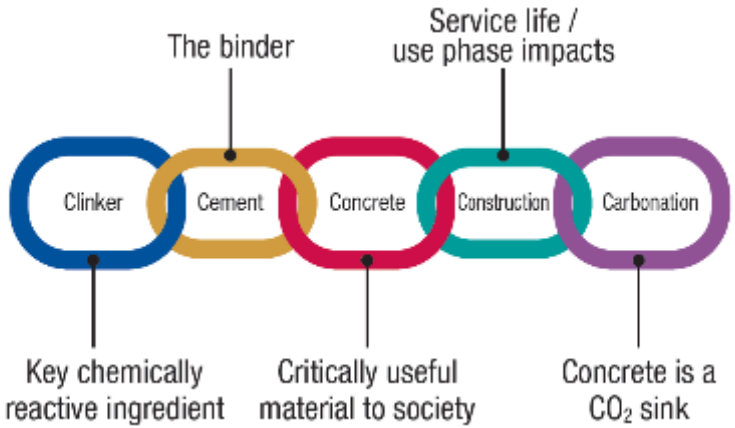
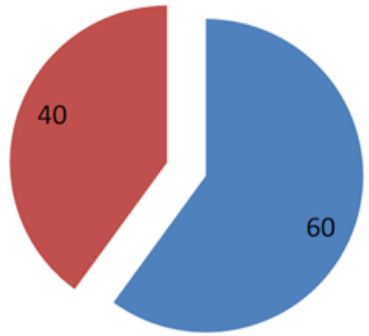
Blended cement and SCMs, where are we at?

ROADMAP TO CARBON NEUTRALITY
American Cement Association



- Blended cements provide **immediate opportunities**
- Carbon neutrality **requires increased acceptance and adoption of all blended cements**



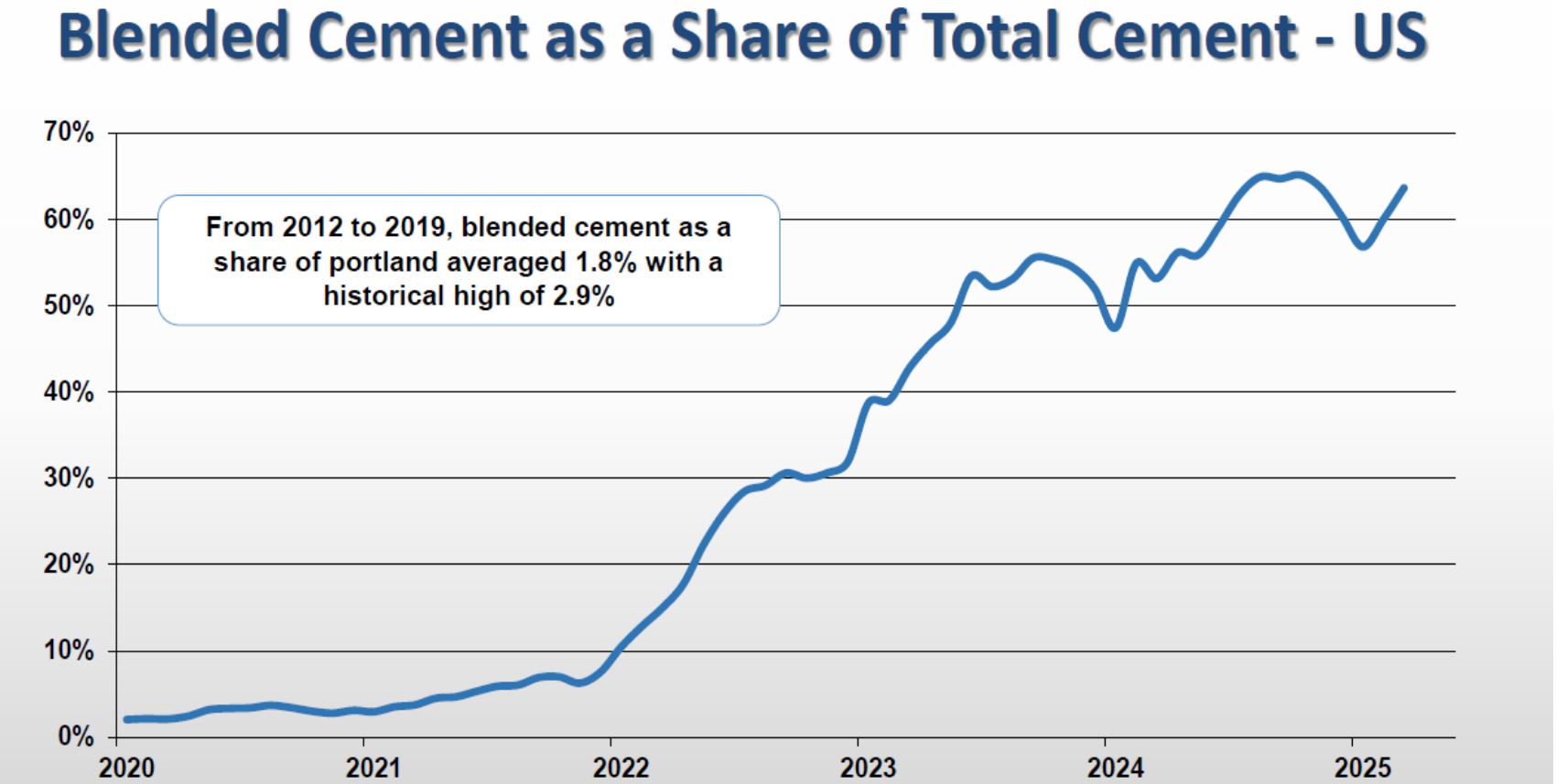
1 tonne of clinker leads to the emission of 750 – 900 kg CO_2
Average 850kg/t *

- CaCO3 decomposition (CHEMICAL)
- Fuel

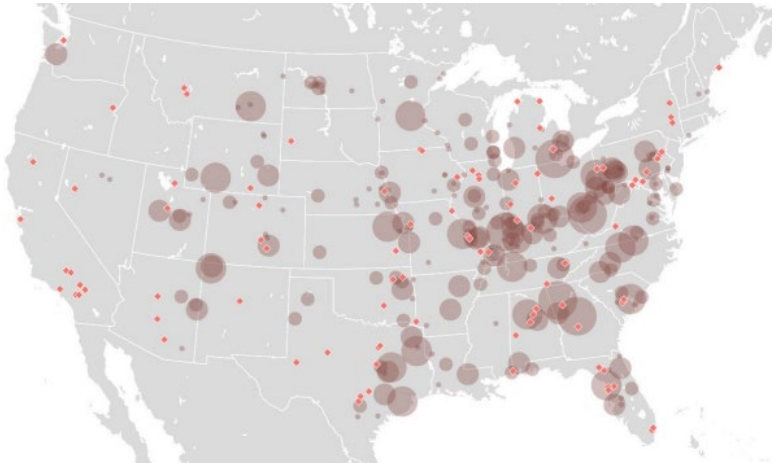
$CaCO_3 \rightarrow CaO + CO_2$

Limestone 80% of raw material

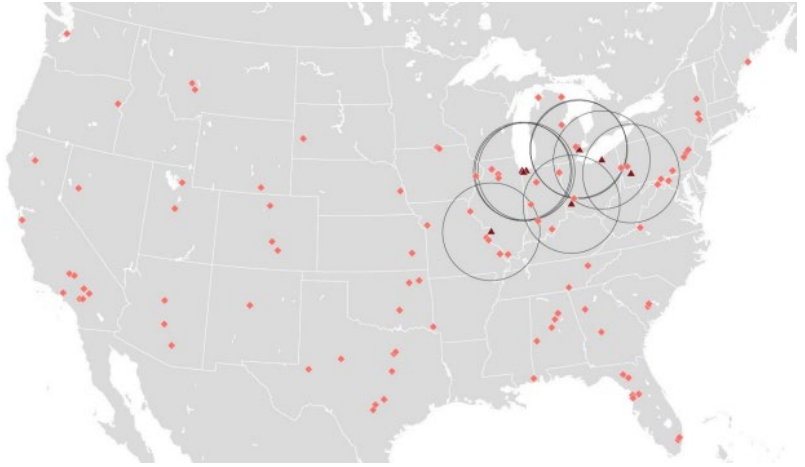
Blended cements are making the real impact



Geographic distribution of SCMs



Coal ash production



Slag production

NP deposits

*Adapted from Jamie Farny (ACA) presentation at Spring 2025 NCC, “Blended Cements Survey of NCC Member State DOTs” Contact: jfarny@cement.org

Alternative Binder Development

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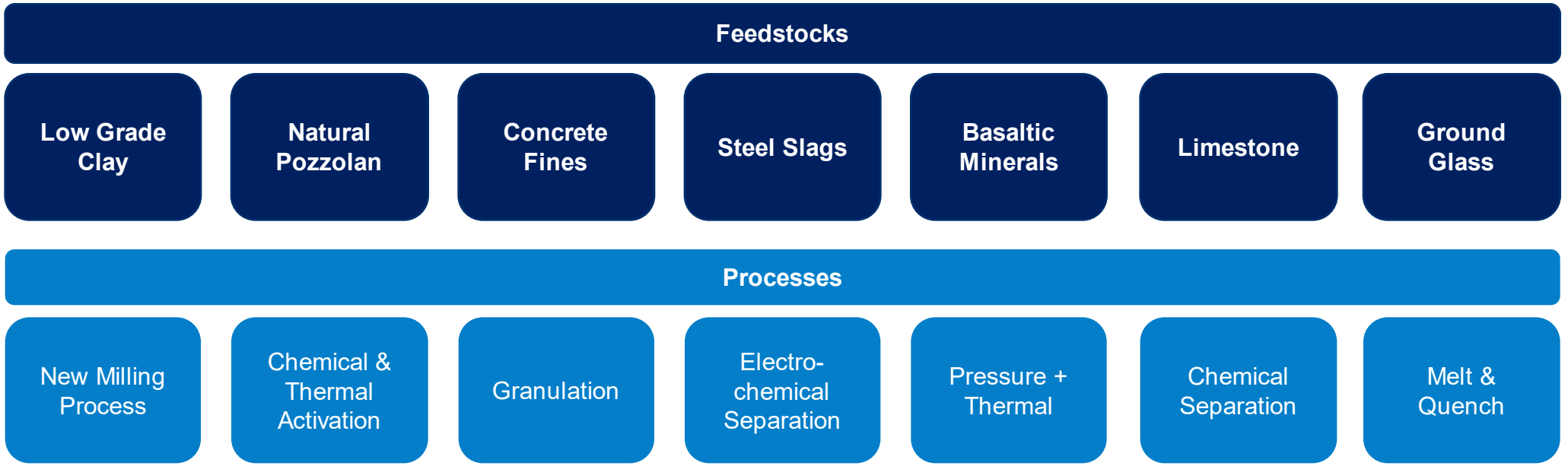


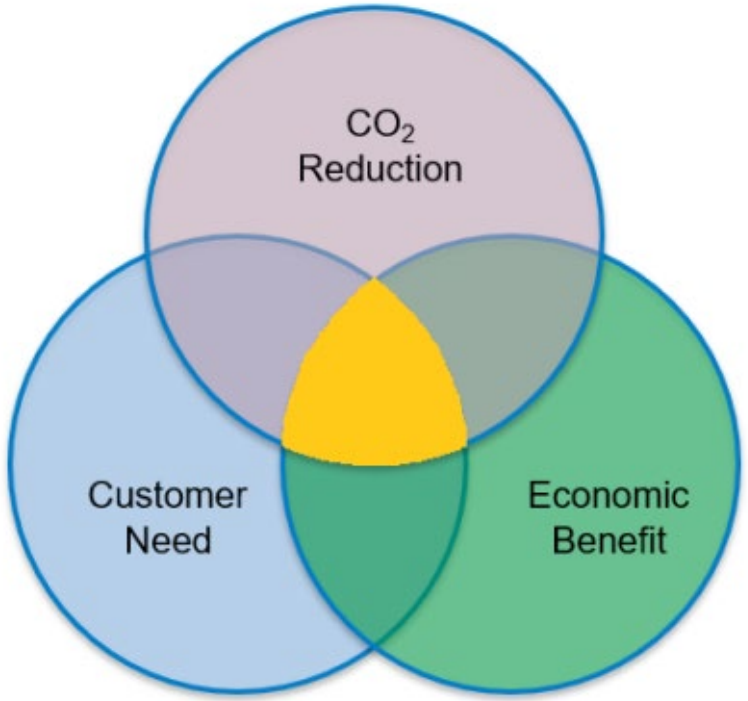
Polysius® meca-clay · EMC Cement · c2ca technology · Sublime Systems · fortera · PHNX MATERIALS · ENVICORE · cocoon · TERRA CO2 · QUEENS CARBON · R-E-D INDUSTRIAL PRODUCTS · CemGreen · CO REACTIVE · carbon upcycling

Handful of companies specialise in alternative binder development

Evaluating SCM Options

A lot to unpack…

- **How will it deliver value for customers?**
- **Is there a specification it could fit in?**
- **Compatibility with existing admixtures & mix designs**
- **Is it Scalable?**
  - Regional availability…
  - How much will it cost?
- **Can the supply chain infrastructure handle the material or is major CX required?**
- **And many others…**



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Case Study:
Ash Grove
Calcined Clay Development

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Solutions to customer pain points

Challenges in the 1990's for the Nebraska Department of Transportation

- Cements with high alkali levels
- Local reactive sands & gravels
- Non-reactive aggregates were not readily available

Ash Grove actions

- Experimented with various supplementary cementitious materials to mitigate ASR
- Conducted extensive research and pilot projects
- 1993, Ash Grove, in conjunction with the NDOT, developed an inter-ground blended cement providing an effective ASR mitigation solution

Outcomes

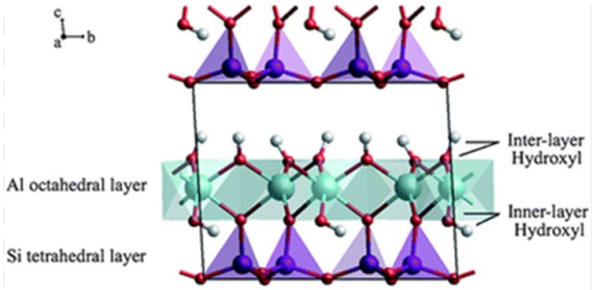
- NDOT specified blended cements for all paving projects

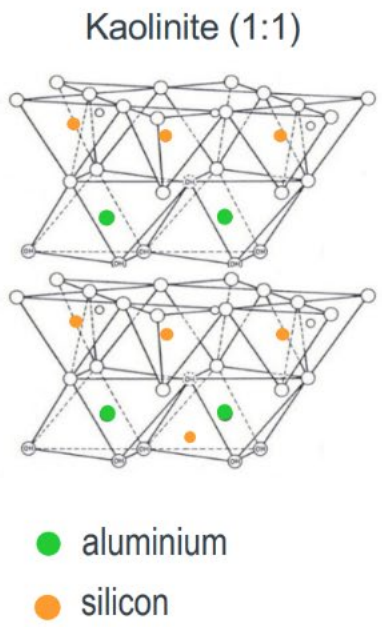
What is Calcined Clay?

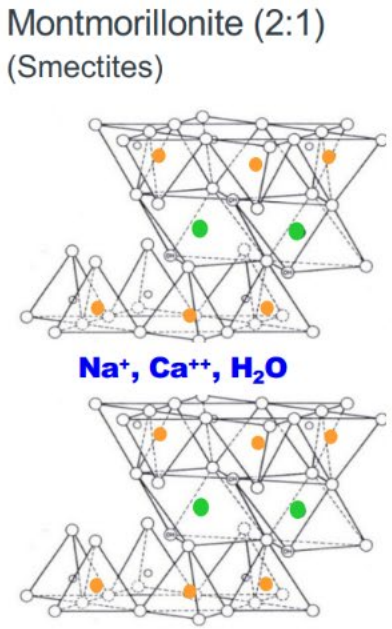
Calcined Clay is produced by heating raw clay to temperatures between 600°C and 900°C.

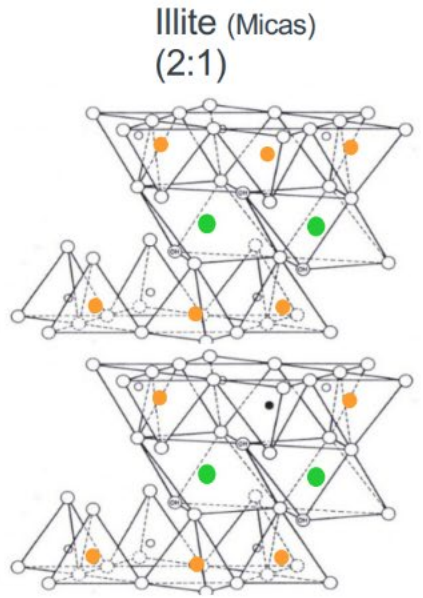
This process, dehydroxylates the clay to make it more reactive than glassy SCMs.

There are multiple clays that are suitable for calcined clay:





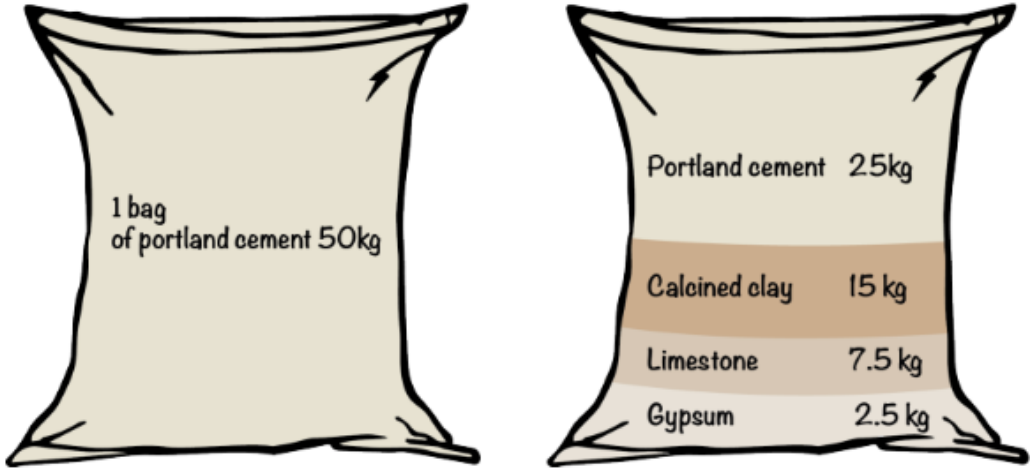




What is LC^3

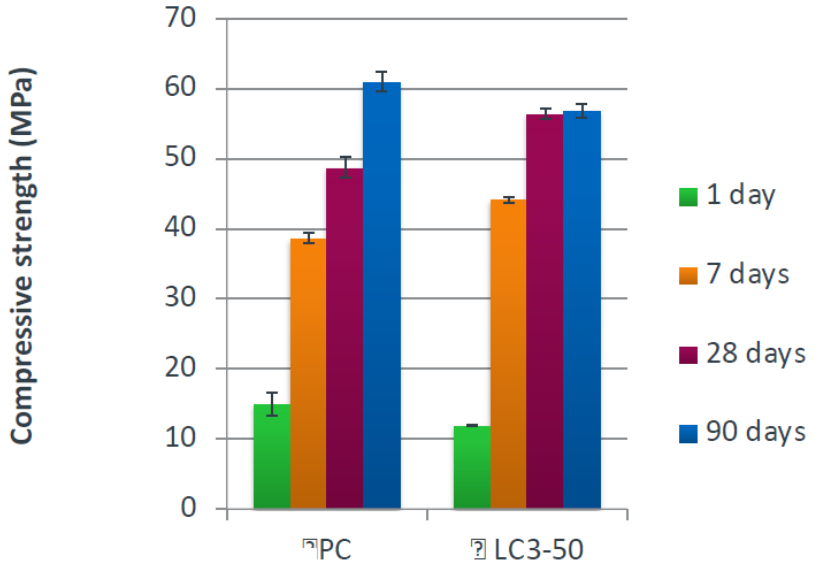
Limestone Calcined Clay Cement

LC3



CO2 Emissions = 80kg per 100kg

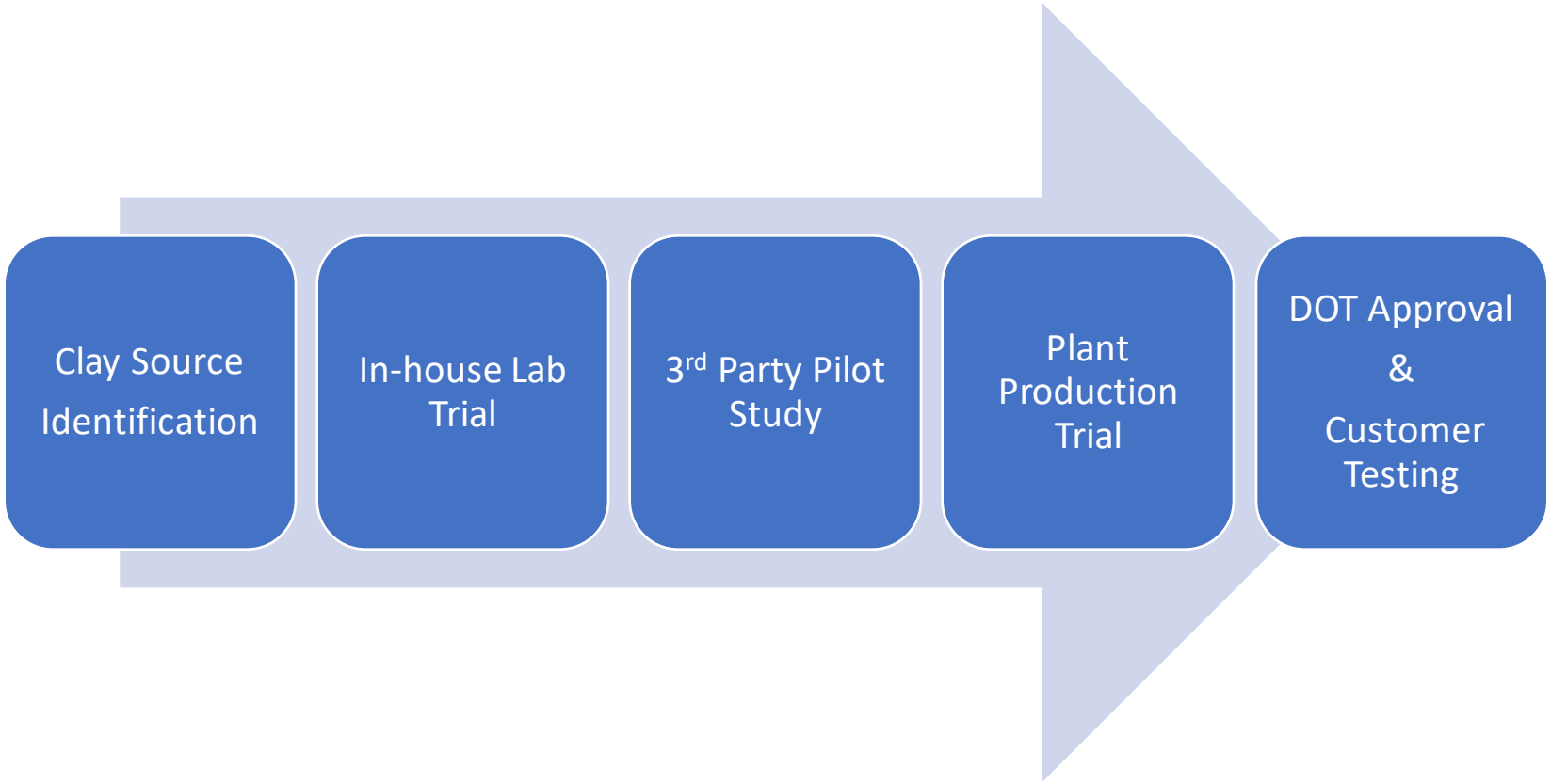
CO2 Emissions = 50kg per 100kg



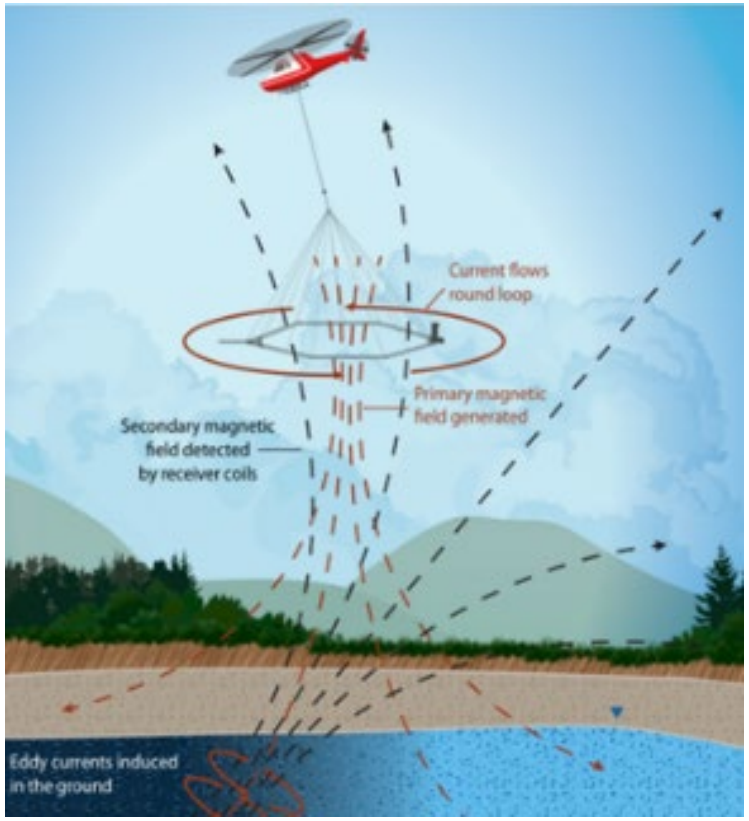
- 50% less clinker
- 40% less CO_2
- Similar strength
- Better chloride resistance
- Resistant to alkali silica reaction

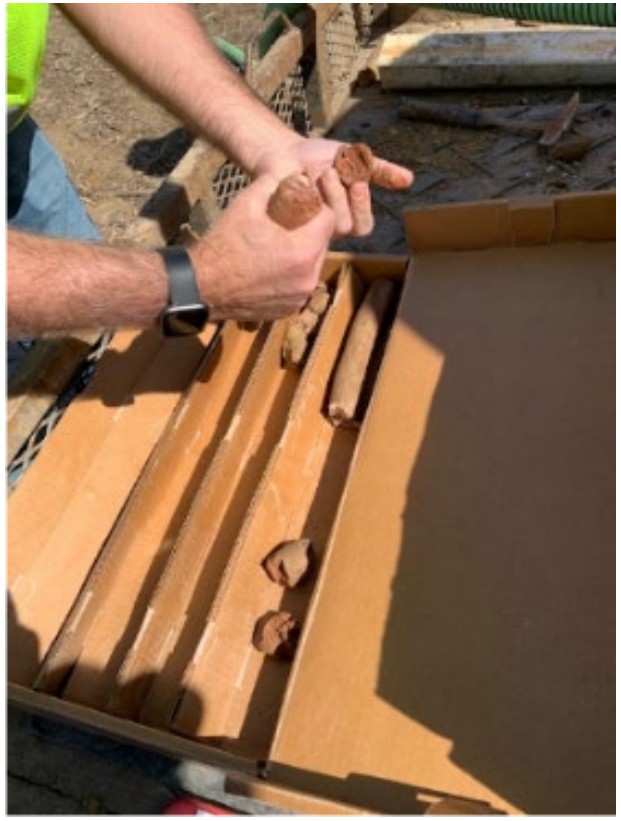
Adapted from Professor Karen Scrivener, FREng, EPFL, Switzerland Presentation: LC3: a realistic option for reducing CO2 emissions of cementitious materials fast and at scale

Calcined Clay: Product development process



Understanding the reserves

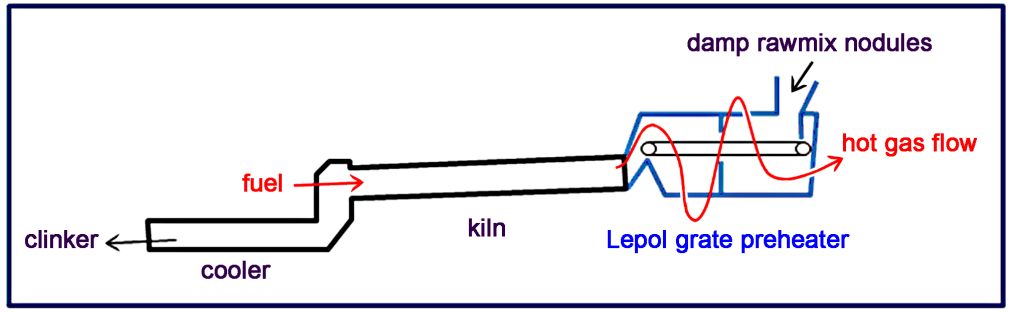




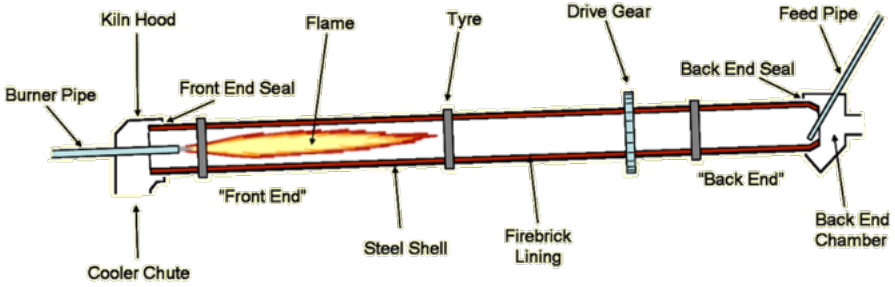
Low-grade, locally sourced clay when properly calcined delivers excellent strength and durability performances

Identifying the right process choices

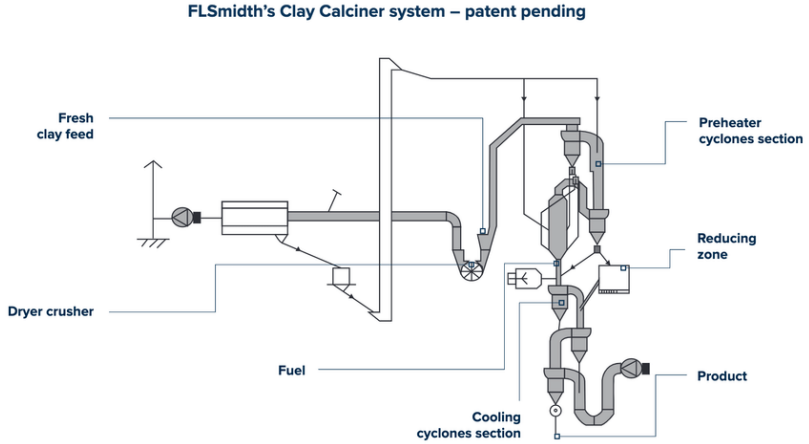
Lepol Kiln



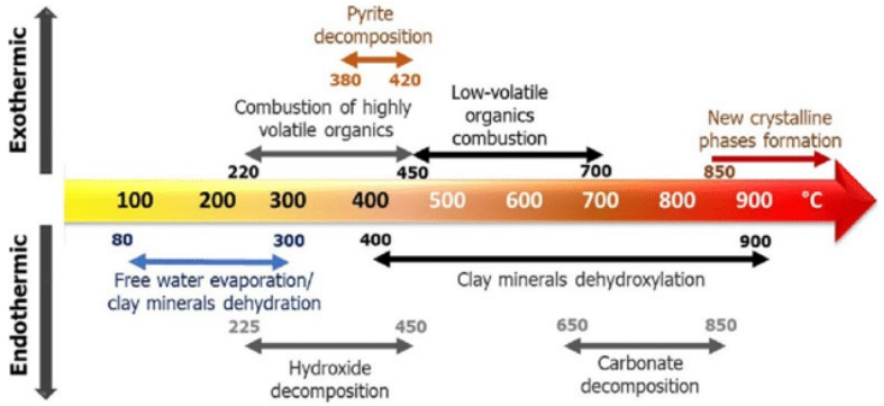
Rotary Kiln



Flash Calciner



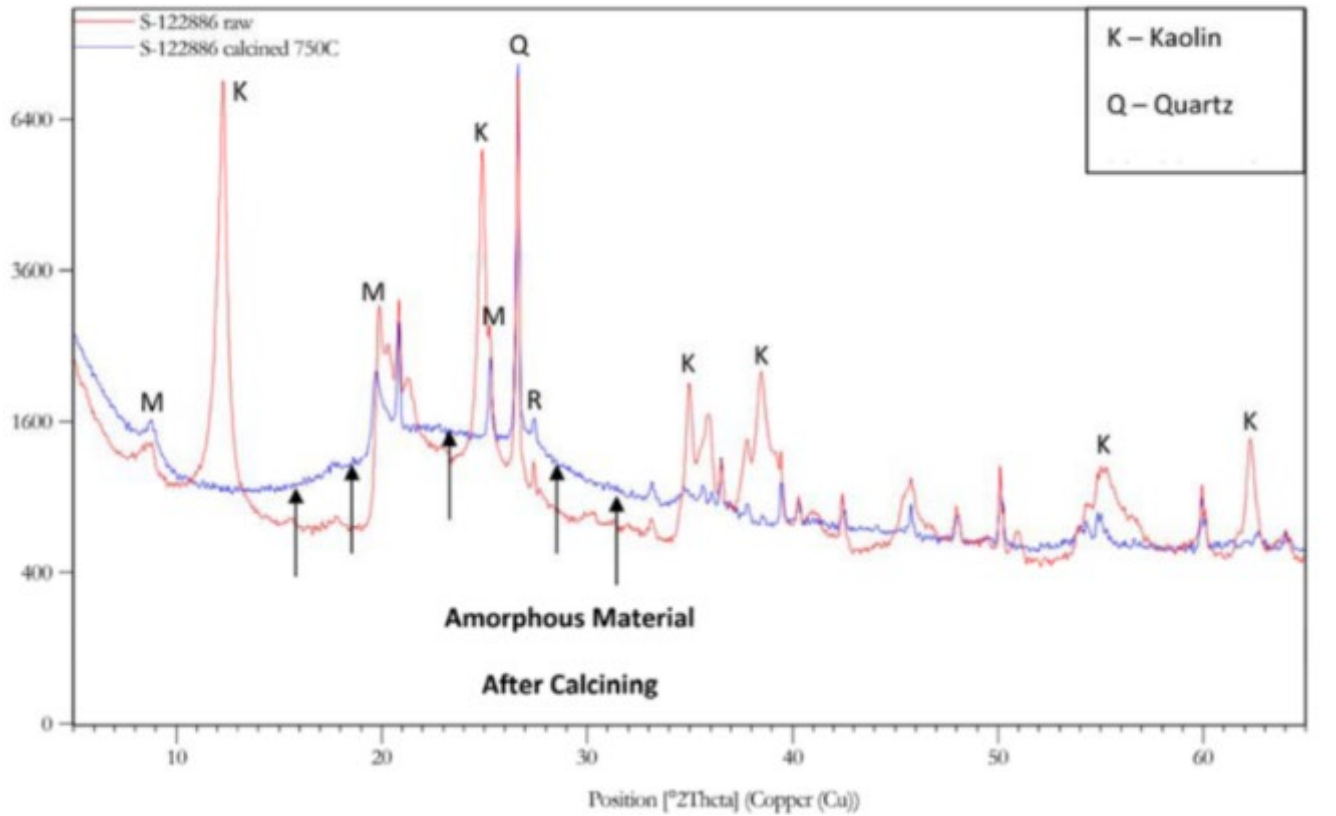
Fine tuning the clay calcination/dehydroxalation process



Clay calcination technology: state-of-the-art review by the RILEM TC 282-CCL

December 2021 · Materials and Structures · 55(3)
DOI: 10.1617/s11527-021-01807-6

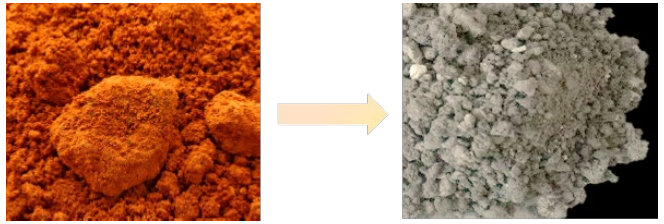
Theodore Hanein · Christian Thienel · Franco Zunino · Show all 20 authors · Jose Fernando Martirena Hernandez

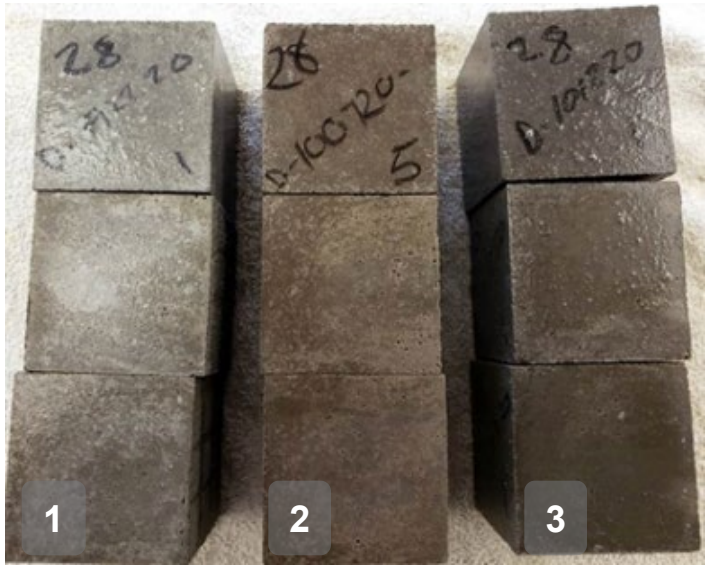


*Ash Grove product development data

Embracing the challenges

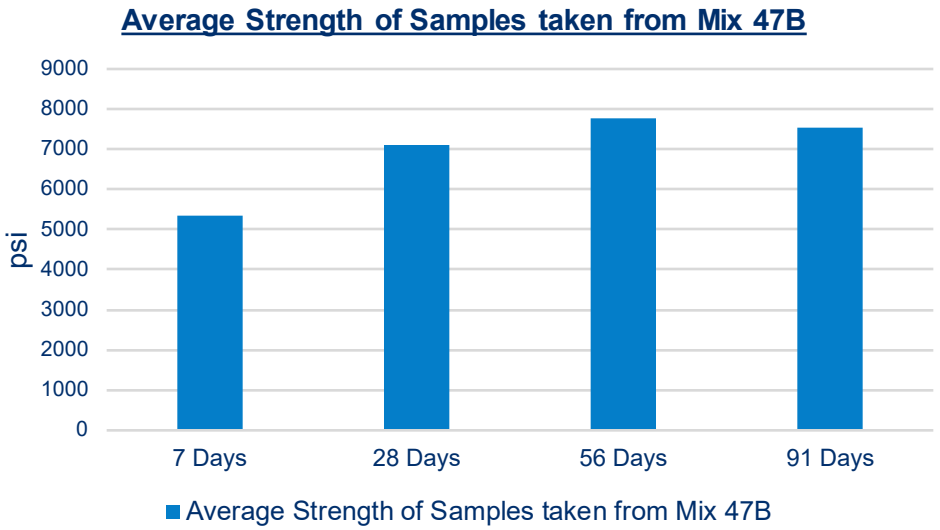
Working out the right solutions

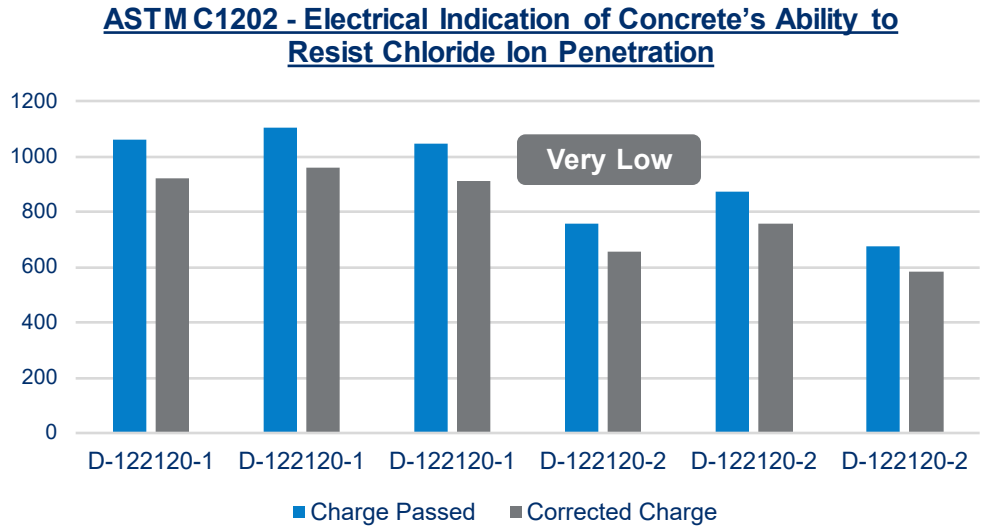


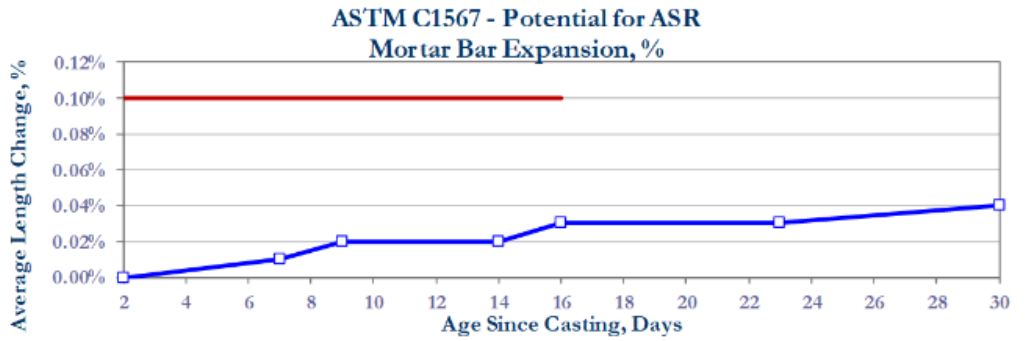


1. Type I/II cement
2. 30% calcined clay
3. 30% color managed calcined clay

Early product development
Calcined Clays from Louisville, NE -2020 & 2021







**Ash Grove product development data*

Field Performances

MnROAD
SAFER, SMARTER, SUSTAINABLE PAVEMENTS
THROUGH INNOVATIVE RESEARCH

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2022

Duracem N
30% CC, 5% LS

Photo Credit: Eric Giannini

LC3

2024

C3

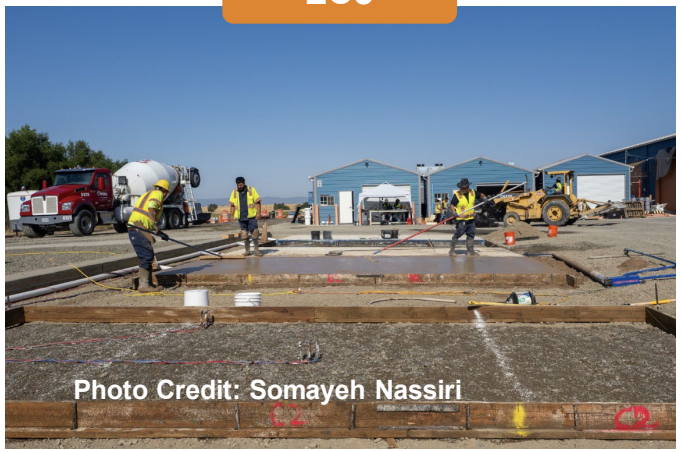

Photo Credit: Somayeh Nassiri

UC Davis Lab2Slab Project: June 2025

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Photo Credit: Somayeh Nassiri

Blended cements success: it is a team effort

UC Davis Lab2Slab Demo Project:

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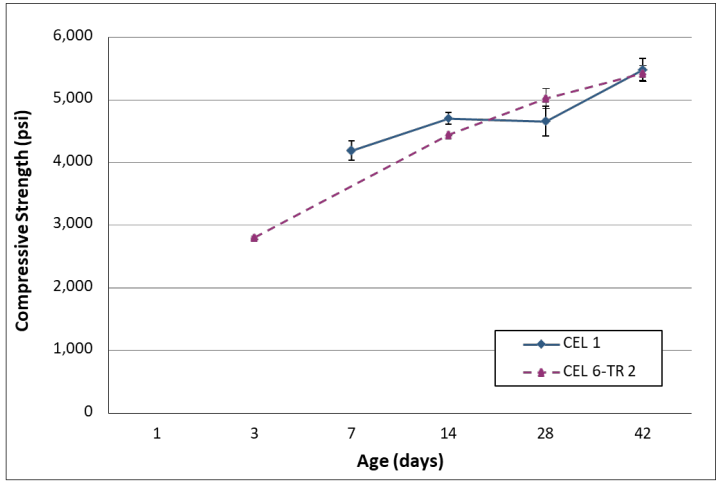
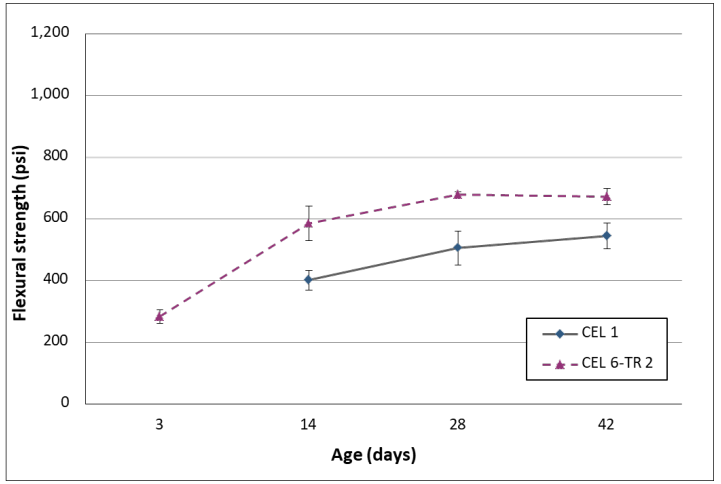
LC³ concrete mix outperforms

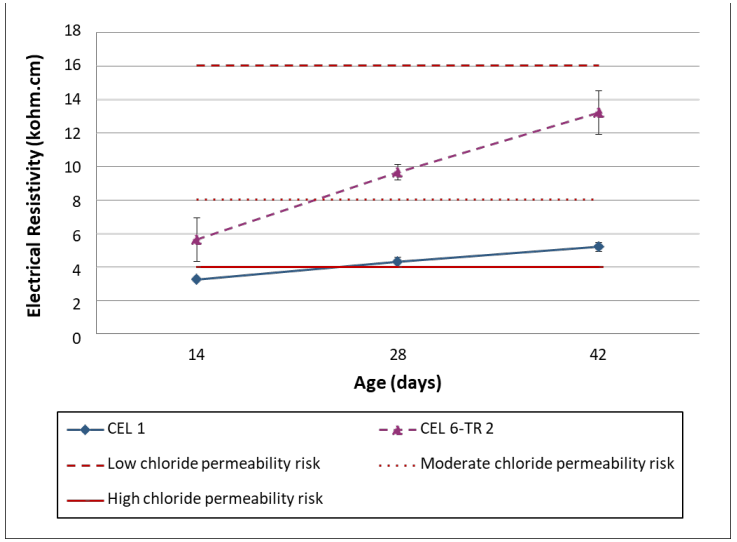
- Compressive strengths
- Flexural strengths
- Permeability resistance

Fresh Properties	LC3 CEL 6
Temperature (°C)	28.7
Slump (in)	4
Air Content (%)	2.3
Unit Weight (lb/ft³)	149.1
Yield (%)	102

Setting Time & Maturity	LC3 CEL 6
Initial Set Time (h:m)	4:55
Maturity at Initial Set (Celsius-min)	85-77
Final Set Time (h:m)	6:40
Maturity at Final Set (Celsius-min)	12-543







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