Drafting an Understanding of Densified Concrete

Densified Concrete

Course Number CDI03E

Provider: CureCrete / Ashford Formula

An AIA Continuing Education Program

Credit for this course is 1 AIA CE LU/HSW

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Course Description

This course will provide an understanding of the benefits and limitations of chemically densified and hardened concrete. It also includes a discussion on how chemical densifiers work, how they are specified, and in which types of buildings they are most appropriate. It also includes information on the environmentally friendly properties of chemical densifiers, and how they promote worker safety. Information on cost and long-term maintenance is also reviewed.

Learning Objectives

Upon completion of this course, the design professional will be able to:

1. Explain the densifying process and differentiate it from traditional floor coatings

2. Understand the properties of chemical densifiers, and how they work.

3. Differentiate among methods of densifying.

4. Identify the sustainable attributes of concrete in terms of materials, indoor air quality, and energy savings and how this can contribute to earning LEED certification

5. Identify the benefits of densified concrete floors in terms of design, maintenance, energy savings, and occupant health

What is Concrete ?

The Basics of Concrete Hydration

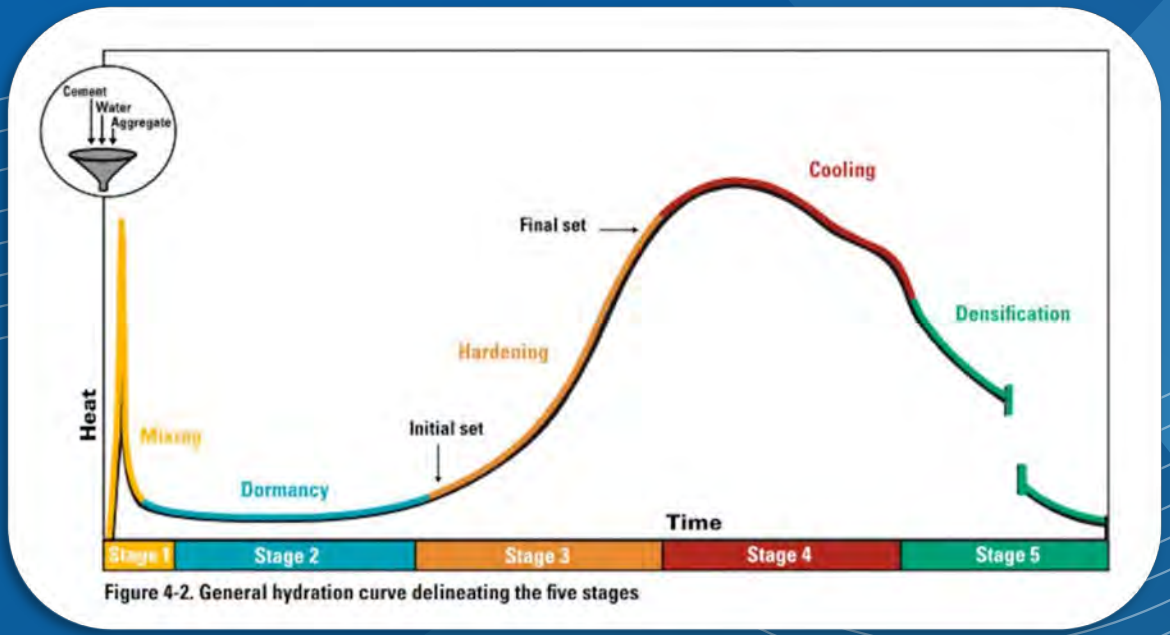
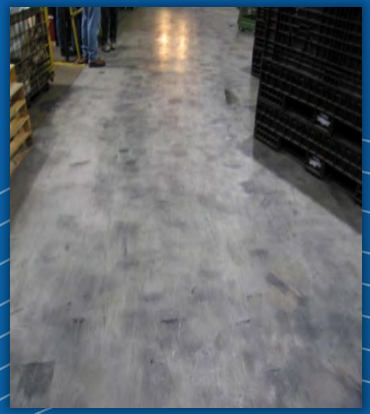


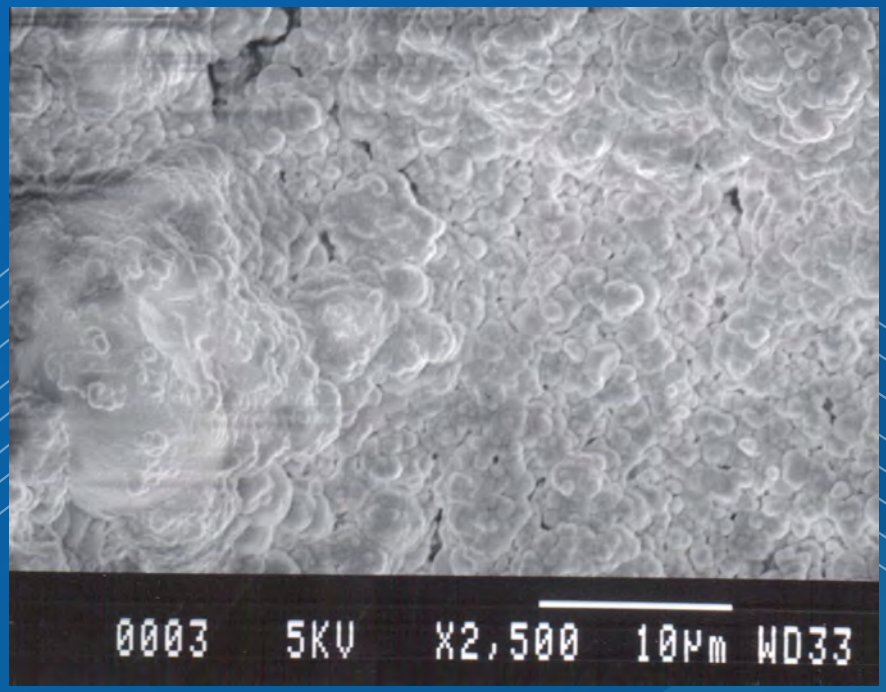
Figure 4-2. General hydration curve delineating the five stages

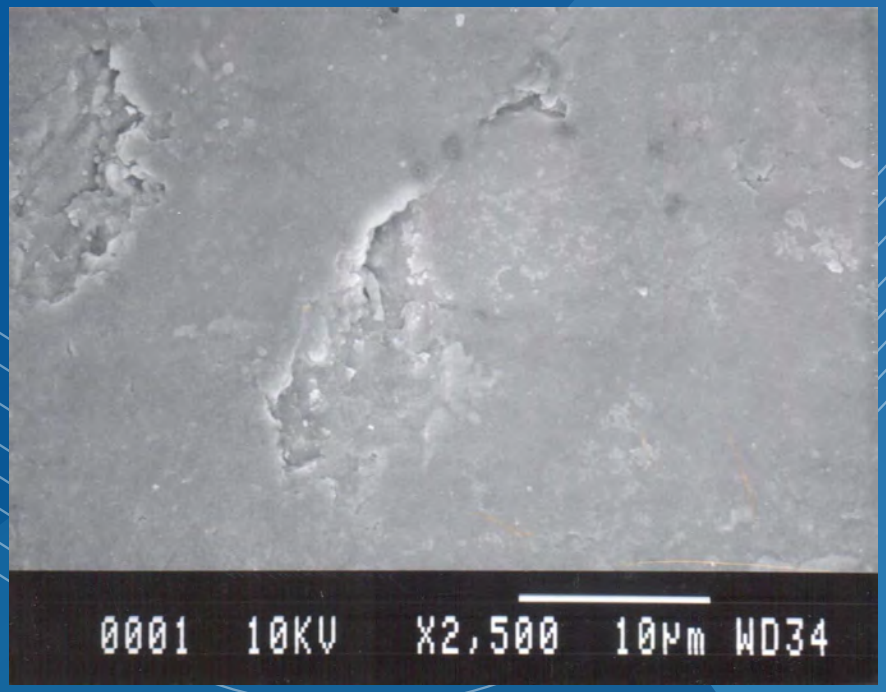
Challenges From Poor Finishing / Protection

Limitations of Coatings/Coverings



The Shortfalls of Concrete Hydration and the Need for Chemical Densifiers



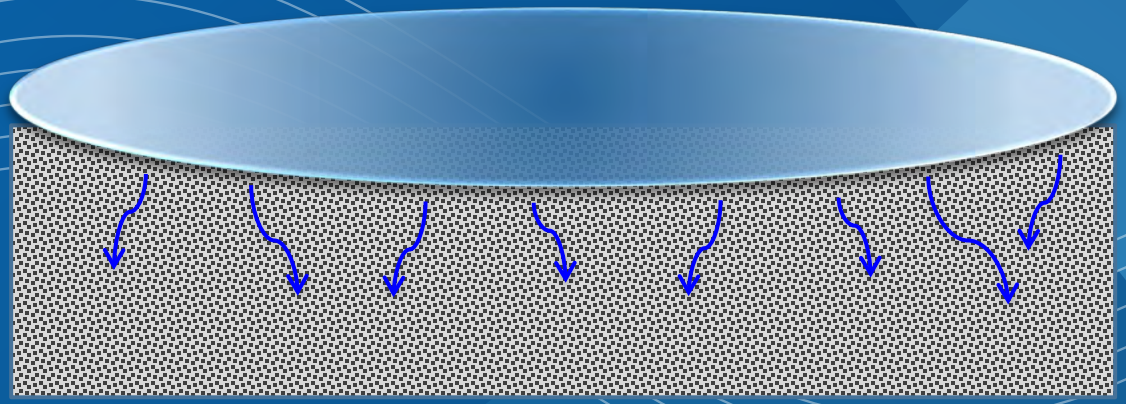


Calcium Silicate Hydrates (CSH) are the bonding agent that holds concrete together. Silicate densifiers create more CSH and new crystals that make the surface more dense.

What Exactly is Densified Concrete?

How Densified Concrete Works

Through capillary action the densifier is drawn into the surface of the concrete to interact with the calcium hydroxide, a by-product of cement hydration.



About 20%-25% of cured concrete is calcium hydroxide, which is soft and dusty. It does not contribute to the strength of concrete. Chemical densifiers can convert it into calcium silicate hydrates (CSH), which are the true binding agent in concrete.

Benefits of Densified Concrete

- Ease of cleaning
- Permanent and attractive sheen
- Absence of concrete dust
- Resistance to abrasion
- Resistance to tire marks
- No need for reapplication
- No film that can scratch, peel, or wear off
- Can remediate poor concrete
- Allows concrete to “breathe”

Limitations of Densified Concrete

Acid resistance

Not elastomeric. Will not “span” cracks.

Will not hide variations in the concrete color

Do not cover up blemishes or imperfections in the floor surface.

Not resistant to steel wheels under heavy point load.

Where are concrete densifiers used?

RETAIL

INDUSTRIAL

MANUFACTURING

EXHIBIT HALL

Imparting a sheen on interior slabs

STEEL TROWELED

DENSIFIED & BURNISHED

Silicates vs. Siliconates

Silicates

- The reactivity of silicates allows for more thorough extending and re-stacking of the polymers already in the concrete
- Completely inorganic chemistry

Simplified silicate molecule

Siliconates

- Partially organic chemistry. The carbon site, being organic, is not reactive
- Siliconates may be slightly more resistant to water penetration in the early months, but not over the long term. With only 3 oxygen sites, they cannot create the same stable crystals as silicates.

Simplified siliconate molecule

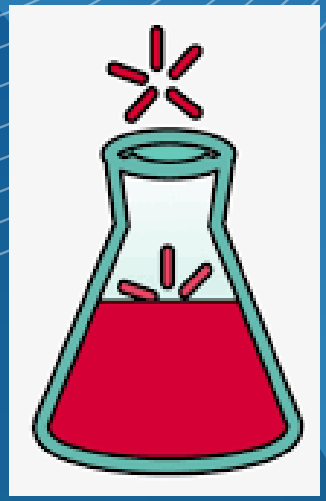
Comparison of silicates vs colloidal silica

Main characteristics of densification with a silicate-based densifier

- Increases the strength of the concrete and minimizes/eliminates the dusting concerns
- Is worked into the pores with an aggressive brushing action
- Creates a crystallization that increases repellency

Main characteristics of this process are:

- Attaches itself to the concrete through a chemical bond, not through a chemical reaction.
- Is applied topically with a microfiber pad.
- It does not create a crystallization growth.



Where do you specify densified concrete?

Division 3 Concrete

Section 033000 “Cast in Place Concrete” (Typical)*
Section 030557 “Concrete Chemicals” (Not common)
Section 033900 “Concrete Curing” (Not common)

Division 9 Finishes
Section 096100 “Flooring Treatment” (Not common. No sub-category for exposed concrete)

*Part 2 Products or Materials

Flooring Treatment

Sealing or Hardening Compounds

Why do you Specify Densified Concrete?

What Is the Difference Between Densified and Polished Concrete?

Coloring Densified Concrete

Integral Color

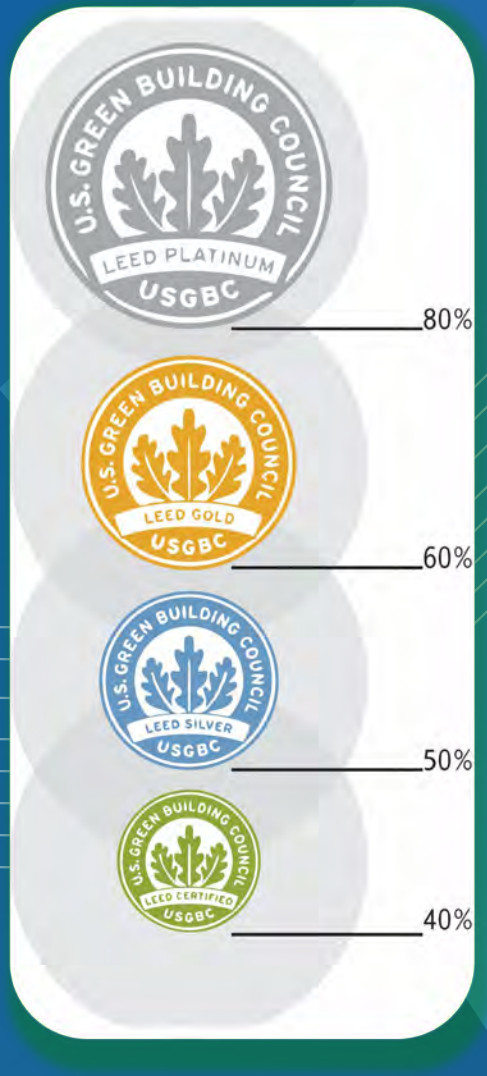
Acid Stain

Dyed Concrete

Sustainability and LEED®

LEED as the yardstick

Leadership in Energy & Environmental Design

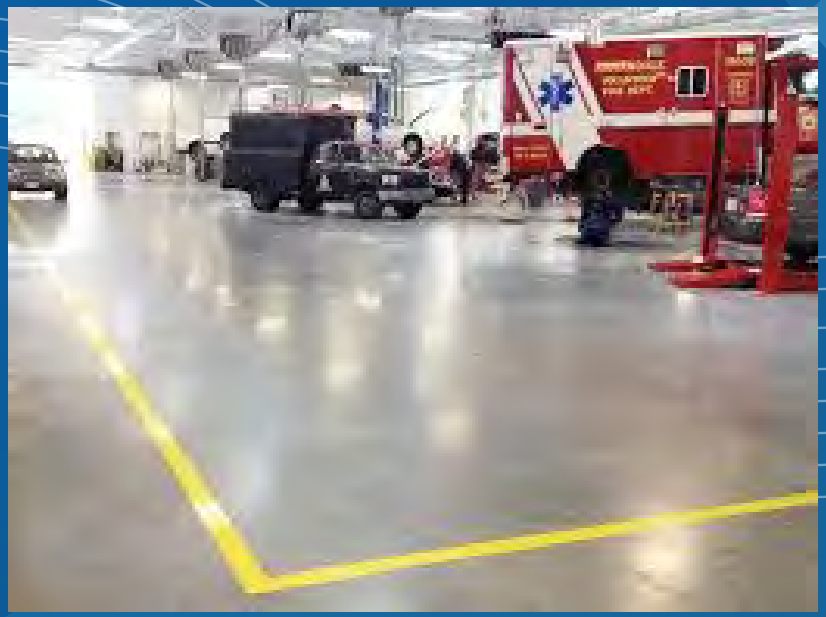


Environmental Benefits of Chemical Densification

- Eliminates the need to use adhesives
- No need for temporary floor coverings
- Energy cost savings
- Supports no combustion
- Reduce life-cycle impacts
- Easy to maintain
- No off-gassing
- No VOCs
- Improved thermal comfort
- Floor reflectivity means lower lighting costs

Take the (LEED) Credit

EA prerequisite Minimum Energy Performance (required)
EA credit Optimize Energy Performance (potential - 18 points)



Take the (LEED) Credit!

MR credit Building Life-Cycle Impact Reduction (potential - 5 points)

Take the (LEED) Credit!

EQ credit Low-Emitting Materials (potential - 3 points)

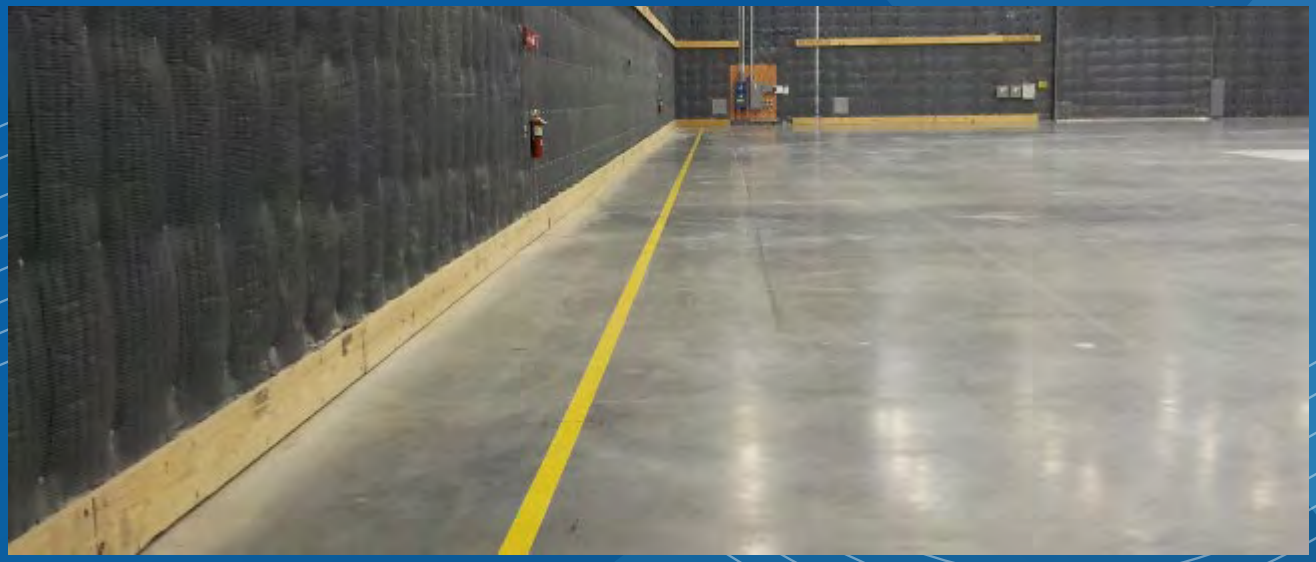
Take the (LEED) Credit!

EQ credit Thermal Comfort (potential - 1 point)

Worker Safety

Excellent reflectivity for better visibility

Worker Safety

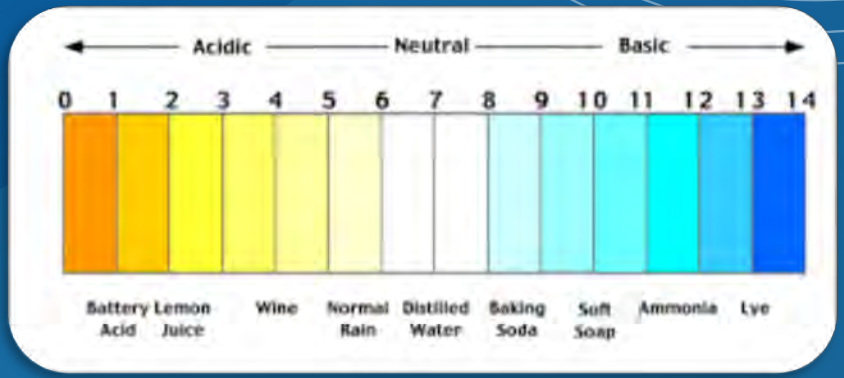


Much lower levels of silicate dust from efflorescence

Maintenance of densified concrete floors

Proper Maintenance Specifications

- It is best to recommend a cleaner that has been specifically formulated for densified concrete.
- You want the cleaner to be relatively neutral to the concrete floor surface. Most cleaners specifically formulated for these floors have an “in solution” pH of 9.5 or higher.



Cost Per Square Foot of Floor Coverings and Finishes based on 10 Year Life Cycle, per square foot.

Product	Installed Cost	Annual Maintenance Cost	Expected Life	Ten-Year Life-Cycle Cost
Acrylic Coating	$0.25	$0.50	6-12 mos	$7.50 (min)
Epoxy Coating	$1.50-$5	$1.50	1-5 yrs	$16.50 - $20
Urethane Coating	$0.75-$2	$1.50	2-9 yrs	$15.75 -$17
Sheet Vinyl	$3-$5	$1.50	9 yrs	$18 - $25
VCT	$1.50-$4	$1.50	10+ yrs	$16.50 - $19
Carpet	$2.50	$1.50	5-10 yrs	$17.50 - $20
Ceramic Tile	$7-$8	$1.50	10+ yrs	$22 -$23
Cement Terrazzo	$12	$.70	10+ yrs	$19
Epoxy Terrazzo	$13	$.50	10+ yrs	$18
Densified Concrete	$.15-$.40	$.25	10+ yrs	$4.50 - $6.50

Sources: Environmental Building News, National Terrazzo and Mosaic Association, and other independent sources. These figures are based on averages and do not take into account the cost of downtime and loss profits during product replacement. 2012

Densified Concrete in use in airline hangars

Densified concrete in use in a distribution center

Alberto Culver, Jonesboro, AR

Densified Concrete in a parking deck

Century City parking garage in Los Angeles, California

Densified concrete in a retail facility

Bunning's home improvement store, New Zealand

Densified concrete in use at a correctional facility

North County Correctional Center, Saugus, CA

REVIEW QUESTIONS

Review Question 1

Densified concrete is concrete that has been chemically altered by means of?

Review Question 1

Answer: Inorganic chemical reactions.

**Slide Reference: "What exactly is densified concrete?"*

Review Question 2

Densifiers work by reacting with calcium hydroxide to form additional calcium silicate hydrates, which are?

Review Question 2

Answer: The primary bonding agent with concrete.

**Slide Reference: "How densified concrete works"*

Review Question 3

Residue, such as paint, glue, epoxy, and even dirt, must be removed to allow chemical densifiers to?

Review Question 3

Answer: Penetrate the bare concrete and react from within.

**Slide Reference:* "Challenges from poor finishing/protection"

Review Question 4

Where are concrete densifiers used?

Review Question 4

Answer: On any facility with exposed concrete floors.

**Slide Reference: "*Where are densifiers used?*"*

Review Question 5

Unlike silicate densifiers, siliconate densifiers tend to oxidize over time, leading to?

Review Question 5

Answer: Wearing off when exposed to traffic.

**Slide Reference:* "Silicates vs. Siliconates"

Review Question 6

Colloidal silica densifiers do not have the ability to?

Review Question 6

Answer: Create a crystallization which will grow and close concrete pores.

**Slide Reference: " Comparison of Silicates vs. Colloidal Silica"*

Review Question 7

What is the difference between densified and polished concrete?

Review Question 7

Answer: While both employ a liquid densifier, concrete polishing uses diamonds to achieve much higher levels of sheen.

**Slide Reference: " What is the difference between densified and polished concrete?"*

Review Question 8

True or False – Densified concrete can be a contributing factor in earning LEED credits.

Review Question 8

Answer: True.

**Slide Reference: " Take the (LEED) credit"*

Review Question 9

Densified concrete should be cleaned a minimum of?

Review Question 9

Answer: 3-4 times a week.

**Slide Reference: " Maintenance of densified concrete floors"*

Review Question 10

Densified concrete is not only among the most durable of flooring options, it also is?

Review Question 10

Answer: By far the least expensive to maintain, both annually and over a period of 10 years.

**Slide Reference: " Cost per square foot of floor coverings"*

Drafting an understanding of densified concrete

Thank you for your attention

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