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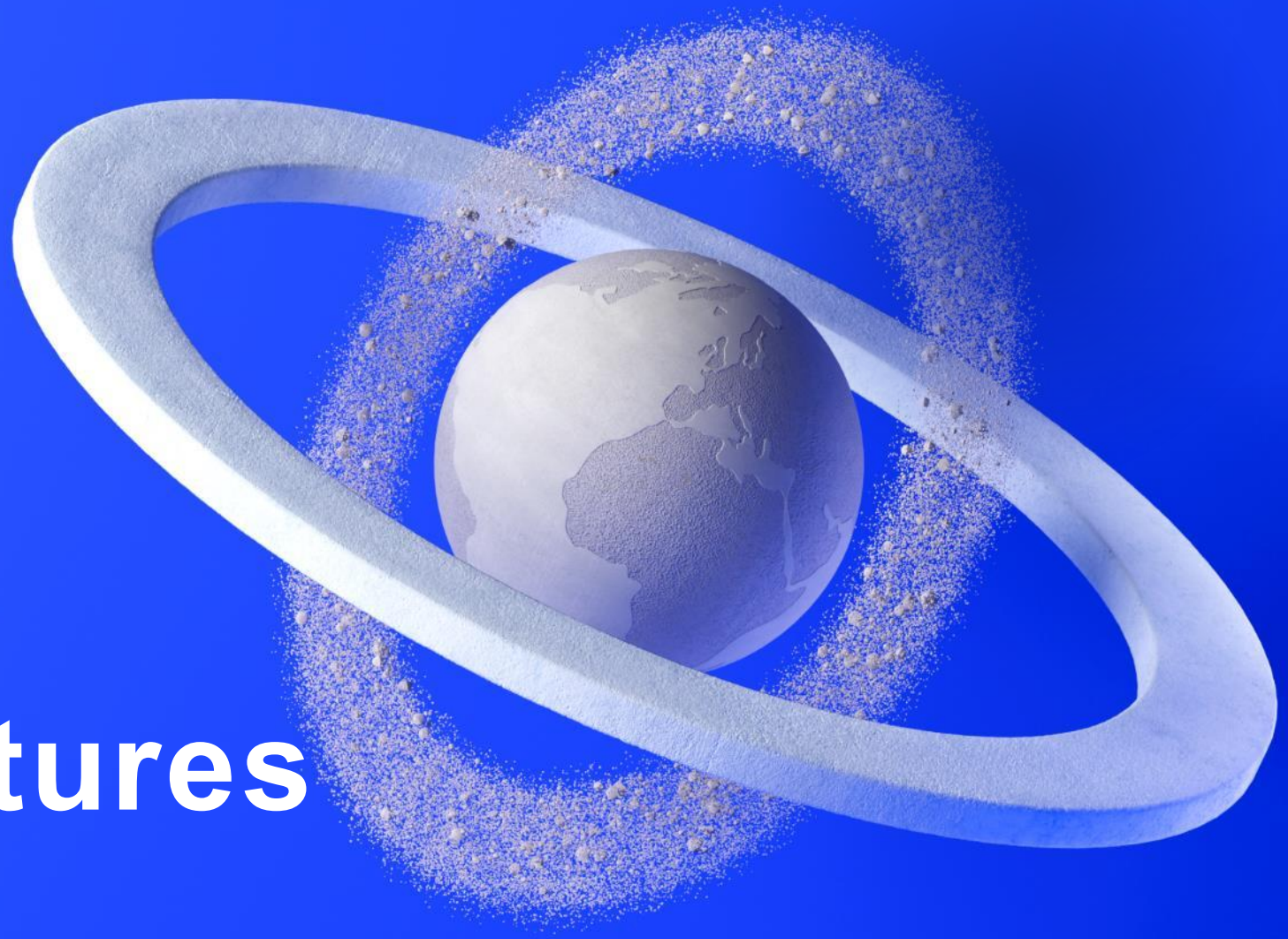

Type S Admixtures

and other Interesting Stuff

G. Terry Harris Sr., FACI

September 9, 2025

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Agenda

01 Strength Enhancers

02 Workability Retaining Admixtures

03 Viscosity and Rheology Modifying Admixtures

04 PRA & PRAH

05 Shrinkage Reducing Admixtures

06 Interesting Stuff

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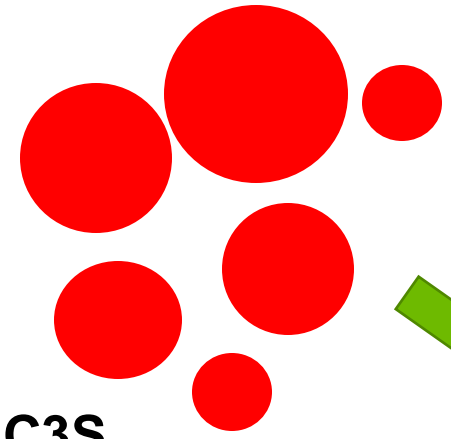
Strength Enhancing Admixtures

Hydration occurs by dissolution-precipitation



C3S
(or cement)

Dissolution step

- Controlled by C3S undersaturation
- Different dissolution mechanisms

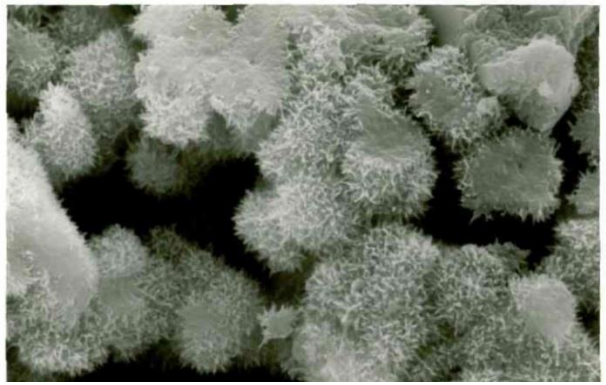
Aqueous Pore Solution

$H_2SiO_4^{-2}$ Ca^{+2} Ca^{+2}
Ca^{+2} $H_2SiO_4^{-2}$
$H_2SiO_4^{-2}$ Ca^{+2}
Ca^{+2} Ca^{+2} $H_2SiO_4^{-2}$

Precipitation step

- Controlled by C-S-H and CH oversaturation
- Nucleation and growth process

Hydration product



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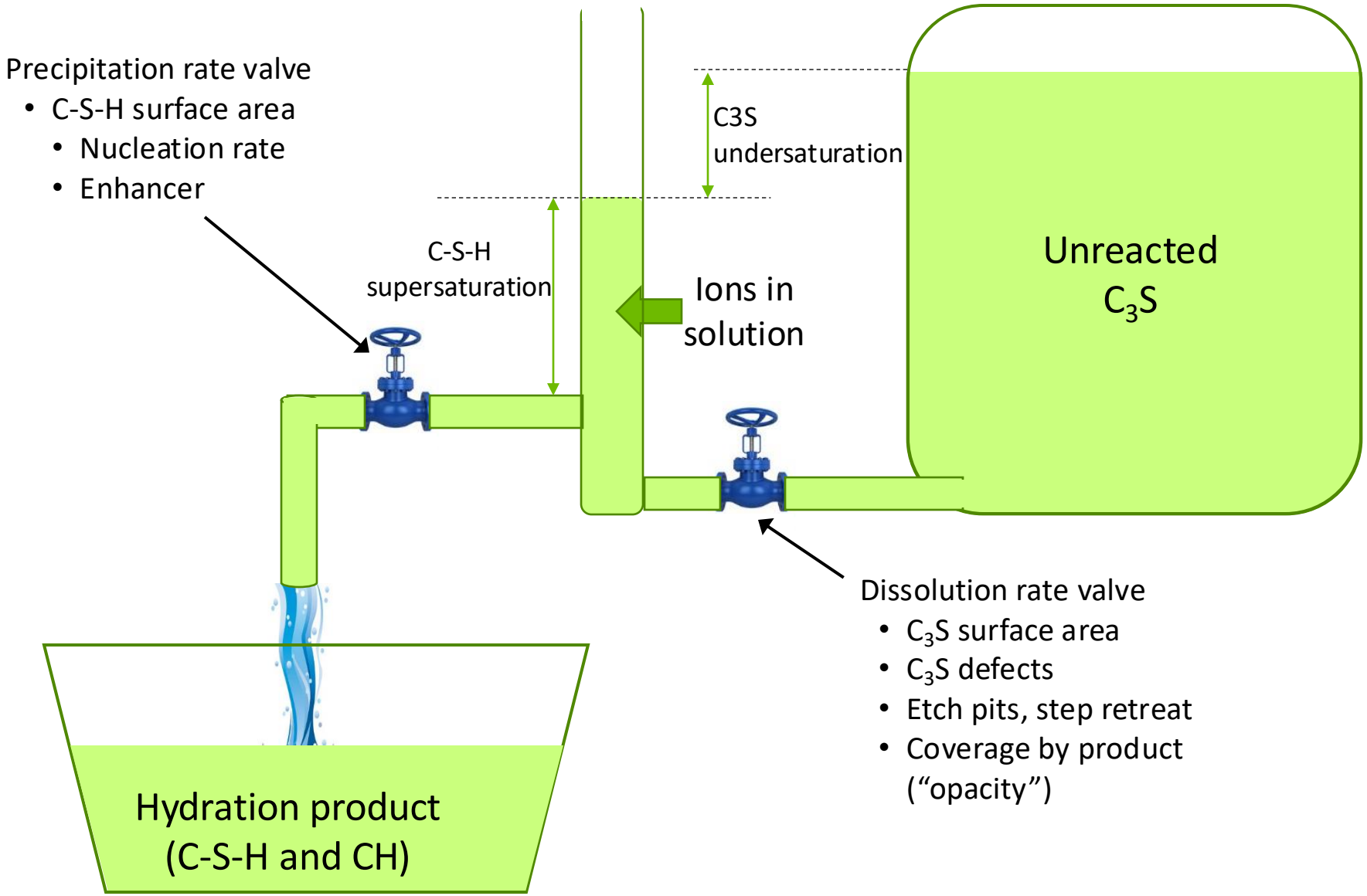
Water flow analogy for C_3S hydration



Strength Enhancing Admixtures

- Multiple Products on the Market
- Some products include C-S-H seed
- Performance can vary with cement source
- Most products are type S while some are type A
- Generally are “set neutral”

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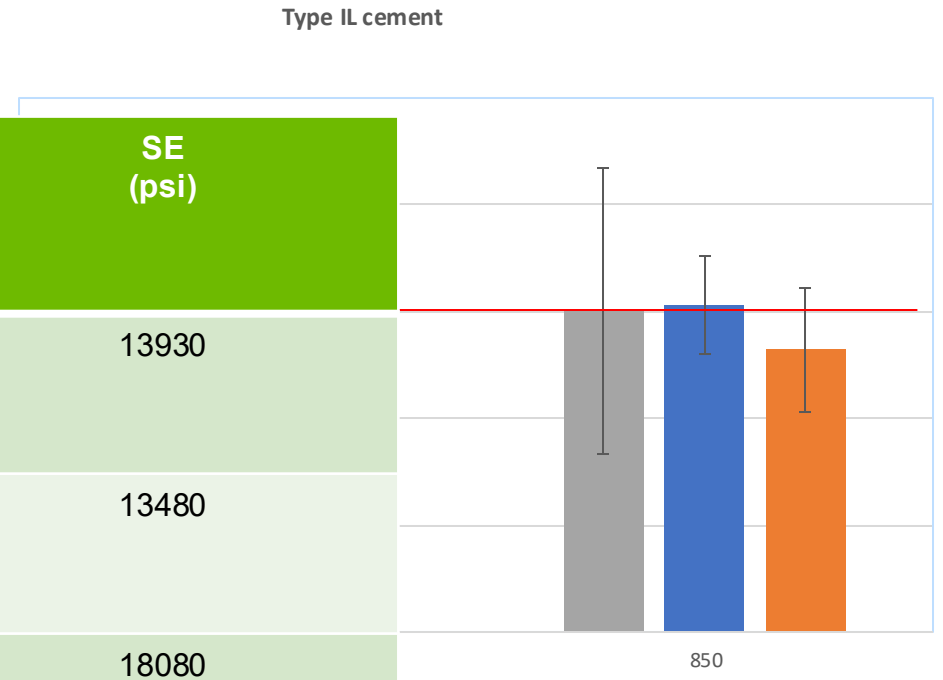
Strength Enhancing Admixtures

Age (Days)	Control (psi)	SE (psi)
7	8290	13930
7	7880	13480
28	11960	18080
28	12160	17810
28	12190	17590



Study

s./cu.yd. and 850

- Cement reduction of 40-85 lbs
- Same strengths at 28 days

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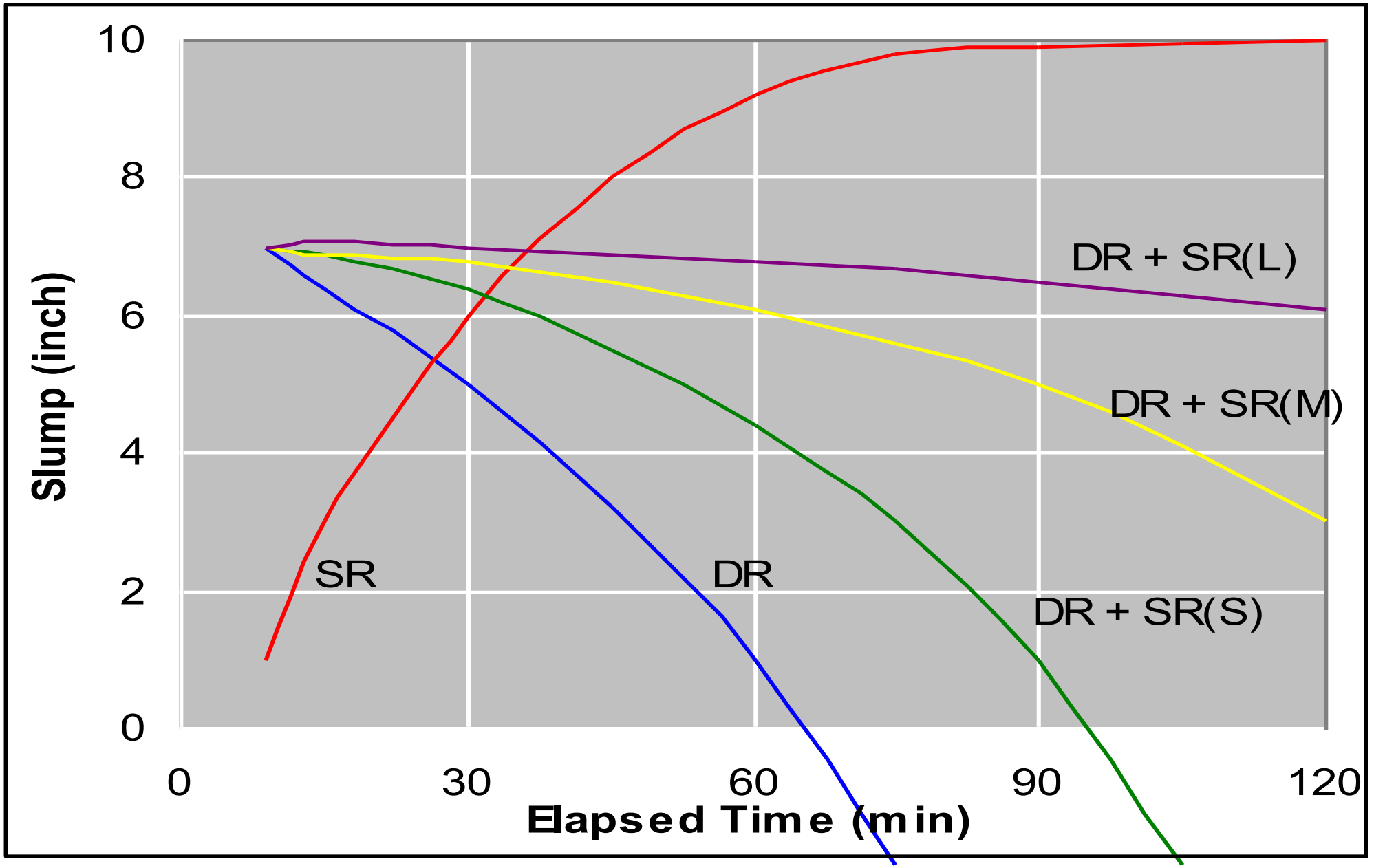
Workability Retaining Admixtures



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Workability Retaining Admixtures

- Different from type B & D in that they do not retard set
- Most products are type S while some are type A
- Delayed dispersion

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Clay Mitigatotion, Viscosity and Rheology Modifying Admixtures

Aggregate Impact on Concrete Production
Overview of Today's Challenge and Current Solutions

	Shape	Gradation	Clay
Concrete Properties	• Harsh mix • Difficult to move	• Does not pack well • Forms weak bond zone • Require more paste • High water demand	• Absorbs water • Absorbs admixtures
Effect on Concrete	• Workability / rheology	• Workability / rheology • Strength reduction • Durability	• Workability / rheology • Strength reduction • Operational QC demand • Process variability
Industry Solutions	• Material selection • Mix design optimization	• Material selection • Mix design optimization • Add more cement and water to increase paste	• Material selection • Mix design optimization • Use select chemicals only: NSFC, Lignin; over dose on PCs • Wash aggregates
Economics & Viability	• Costs • Long term sustainability	• Costs • Long term sustainability	• Costs • Long term sustainability

Aggregate Properties Make the Difference in Performance in Many Applications

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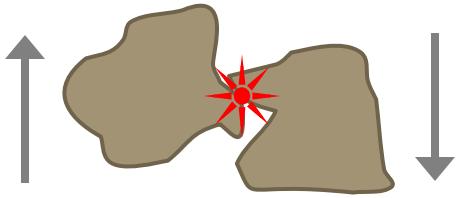
Aggregate Material Characteristics Affecting Concrete Performance

Shape/roughness

Sharp corners or surface roughness increase friction between particles

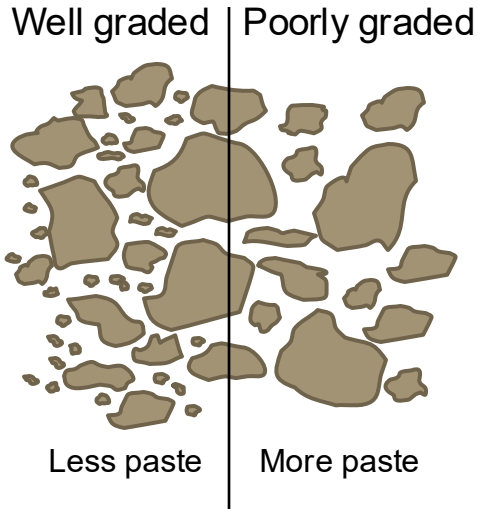
REDUCES RHEOLOGY & FLOW



Gradation

Small particles are not available to fill voids between larger particles

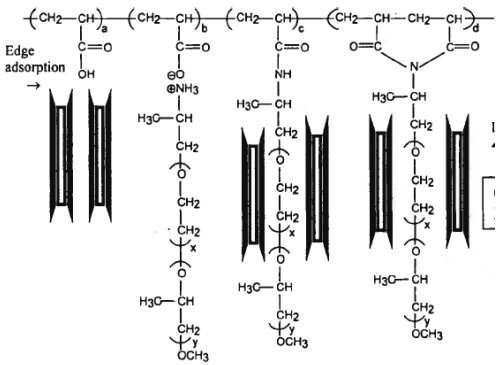
REDUCES STRENGTH



Cleanliness

Clay can consume water and/or chemical admixtures

ADDS VARIABILITY & COST



Product Solutions to Address Aggregate-Related Concrete Deficiencies

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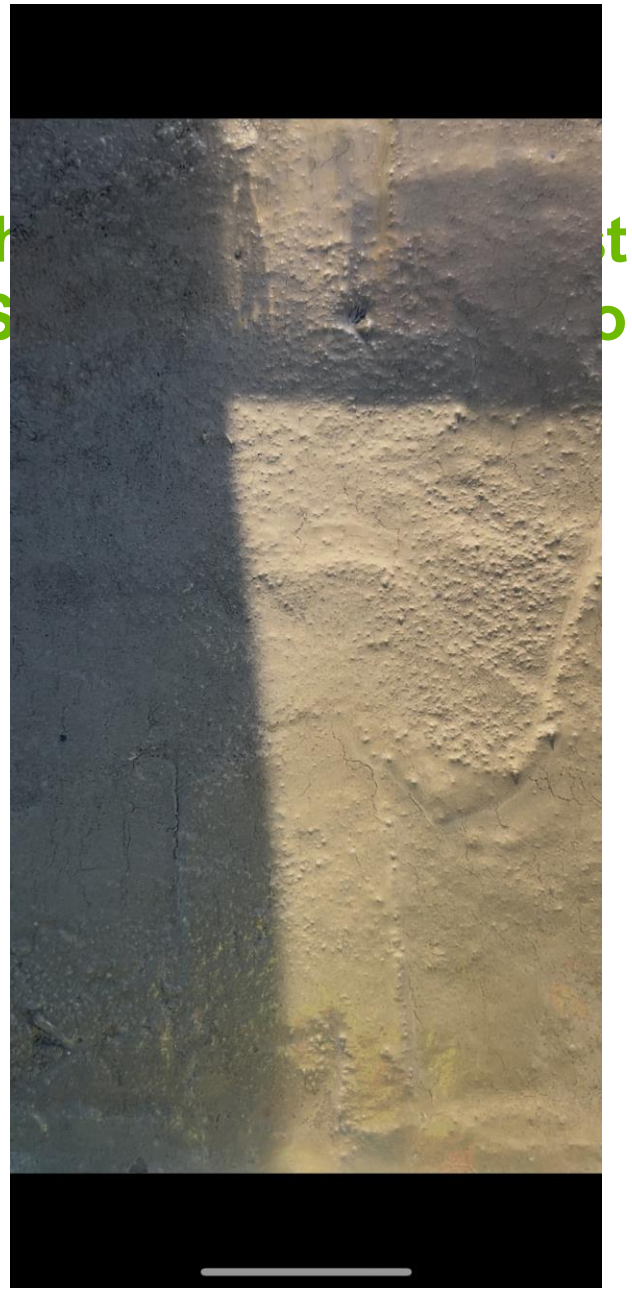
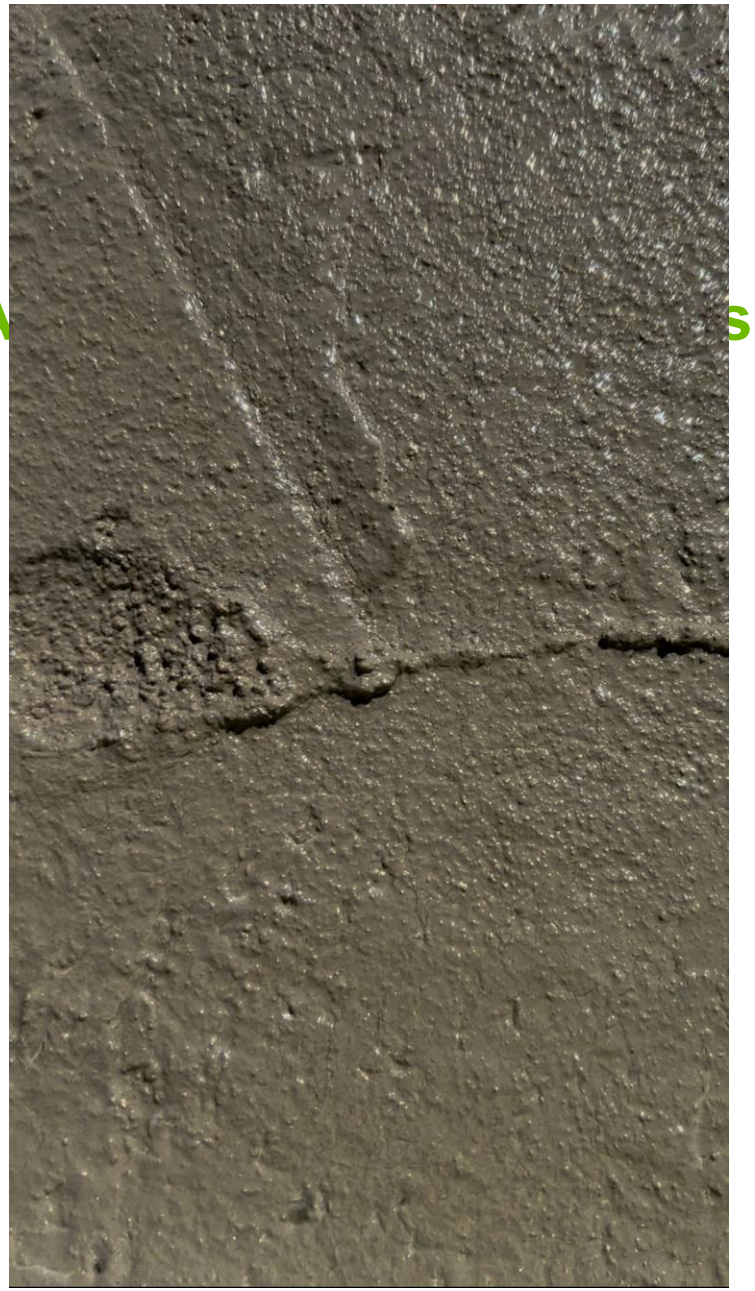
Testing

CRD C61 Wash sting
ASTM C1882 S on for A s for
Concrete





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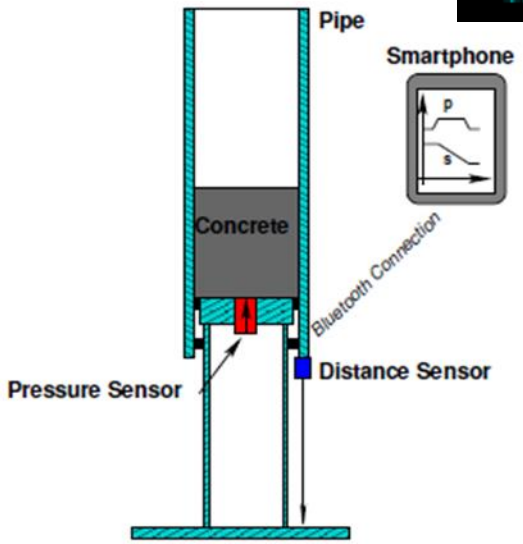
Testing for Pumpability

SLIPER – Sliding Pipe Rheometer



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VMA & RMA

VMA's use:

- Underwater Concrete
- SCC
- Reducing Pump Pressure
- Finishing Aid

RMA's use:

- High Powder Content Mixes
- SCC (Bughole Reduction)
- Reducing Pump Pressure
- RCC (Increased compaction)
- Curb
- Barrier Wall
- Paving

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PRA & PRAH

PRA & PRAH

For the purpose of this chapter, admixtures intended to reduce water ingress will be split into two subcategories:

PRAs for concrete exposed to **nonhydrostatic conditions (PRAN)** and PRAs for concrete exposed to hydrostatic conditions (PRAH).

In addition to permeability reduction, some PRAs may exhibit other beneficial characteristics such as reduced drying shrinkage (Munn et al. 2003), lowered chloride ion penetration (Aldred 1988; Munn et al. 2003), enhanced freezing-and-thawing resistance (Ramachandran1995; Rixom and Mailvaganam 1999), and enhanced autogenoussealing (Skoglund and Johansson 2003; Kubal 2000).

Users of a PRA should evaluate performance of a product in concrete based on the application requirements.

(ACI 212.3R-16)

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Test Methods for PRA & PRAH

ASTM C1585
BS EN 1881-122
DIN 1048
BS EN 12390-8
ASTM D5048
CRD C48

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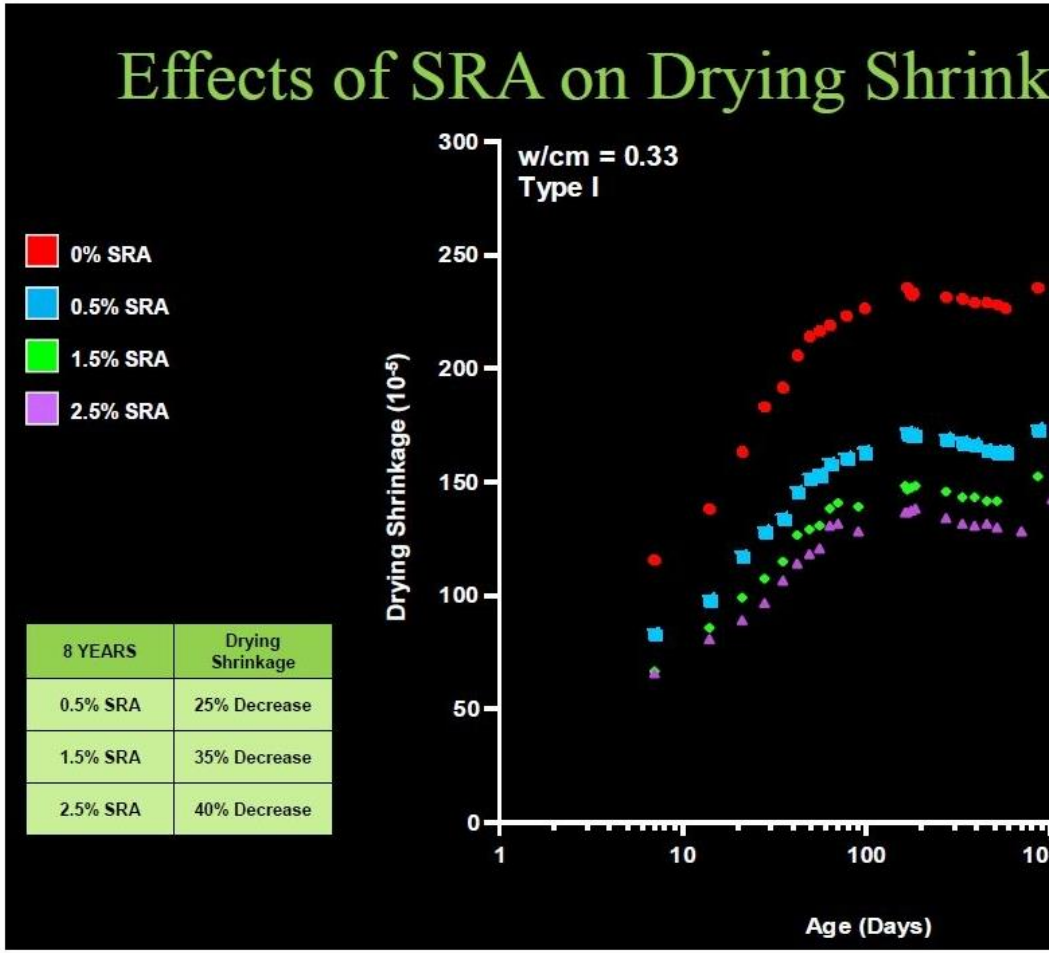
Shrinkage-Reducing Admixtures

SRA

SRAs have been in use since the 90's

Shrinkage reduction up to ~50%

Tested according to ASTM C157



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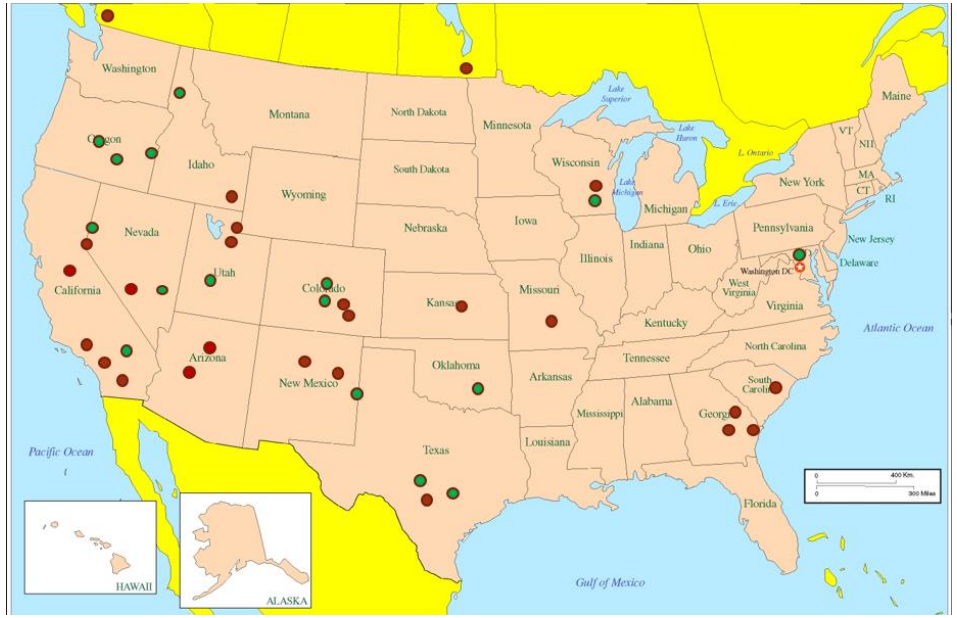
Interesting Stuff

Admixtures for Blended Cements and SCMs

Limestone Calcined Clay Cement LC3

Calcined Clay

Natural Pozzolans



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Thank you!
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