



Spray-Applied Colloidal Nano-Silica for Waterproofing and Deicing Chemical Protection of Concrete Pavements

Brent Rollins, Spray-Lock Concrete Protection

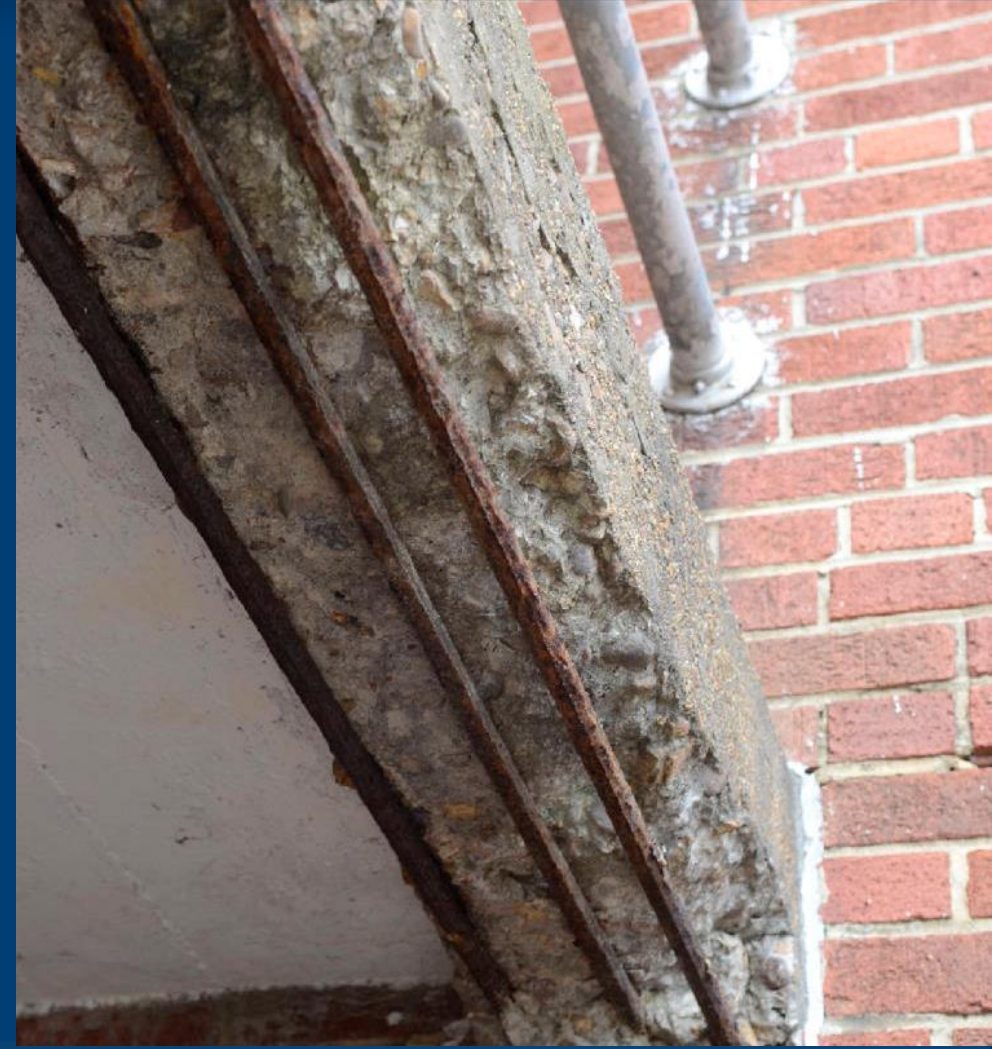


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Setting up the Discussion Today

- We are working hard to help concrete last longer.
- We are still not where we need to be as an industry.
- This is why I am here today.

Photo Credit: Chattanooga Times/Free Press



Basic Relationship Between Permeability and Durability

There are many causes of concrete deterioration and most of these involve either the movement of moisture or the movement of species, such as chlorides and sulfates, dissolved in the water. Generally, the greater the resistance of the concrete to the movement of water, the lower its permeability and the greater its resistance to deterioration.

Portland Cement Association Design and Control of Concrete Mixtures, 15th ed. p. 173



What is Colloidal Silica?



Silicon Dioxide on the nano-scale



Small enough to remain suspended in water without settling



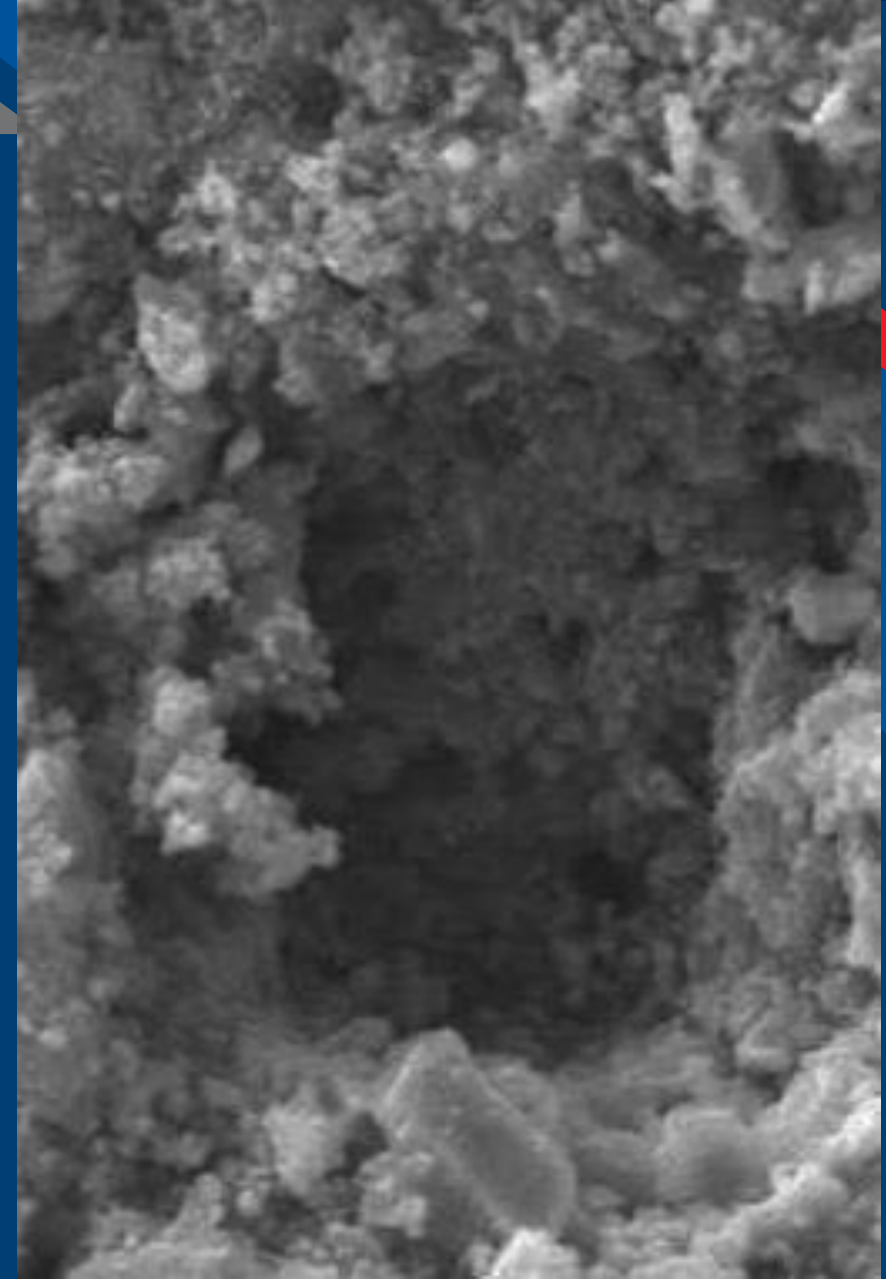
Insoluble in water

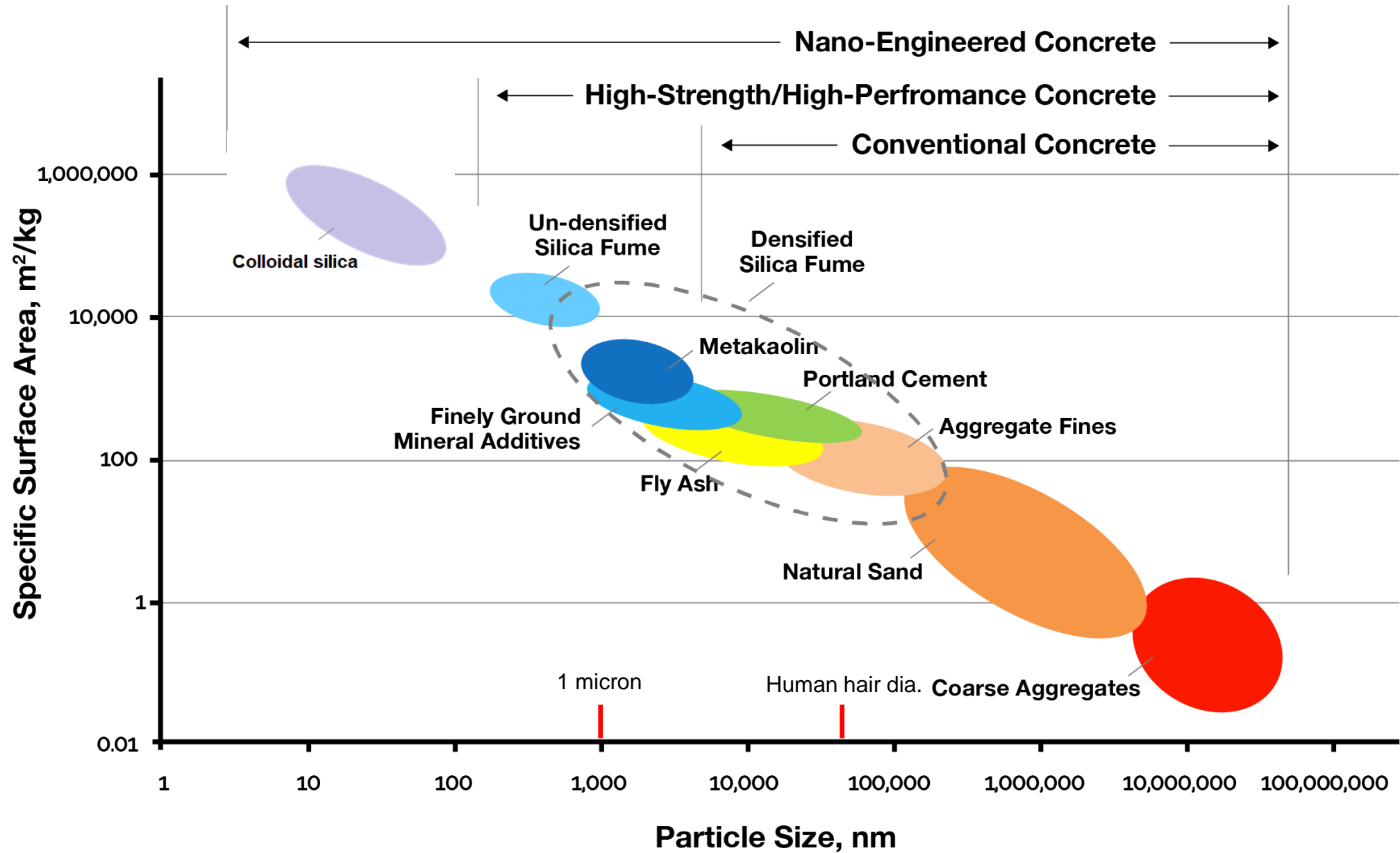


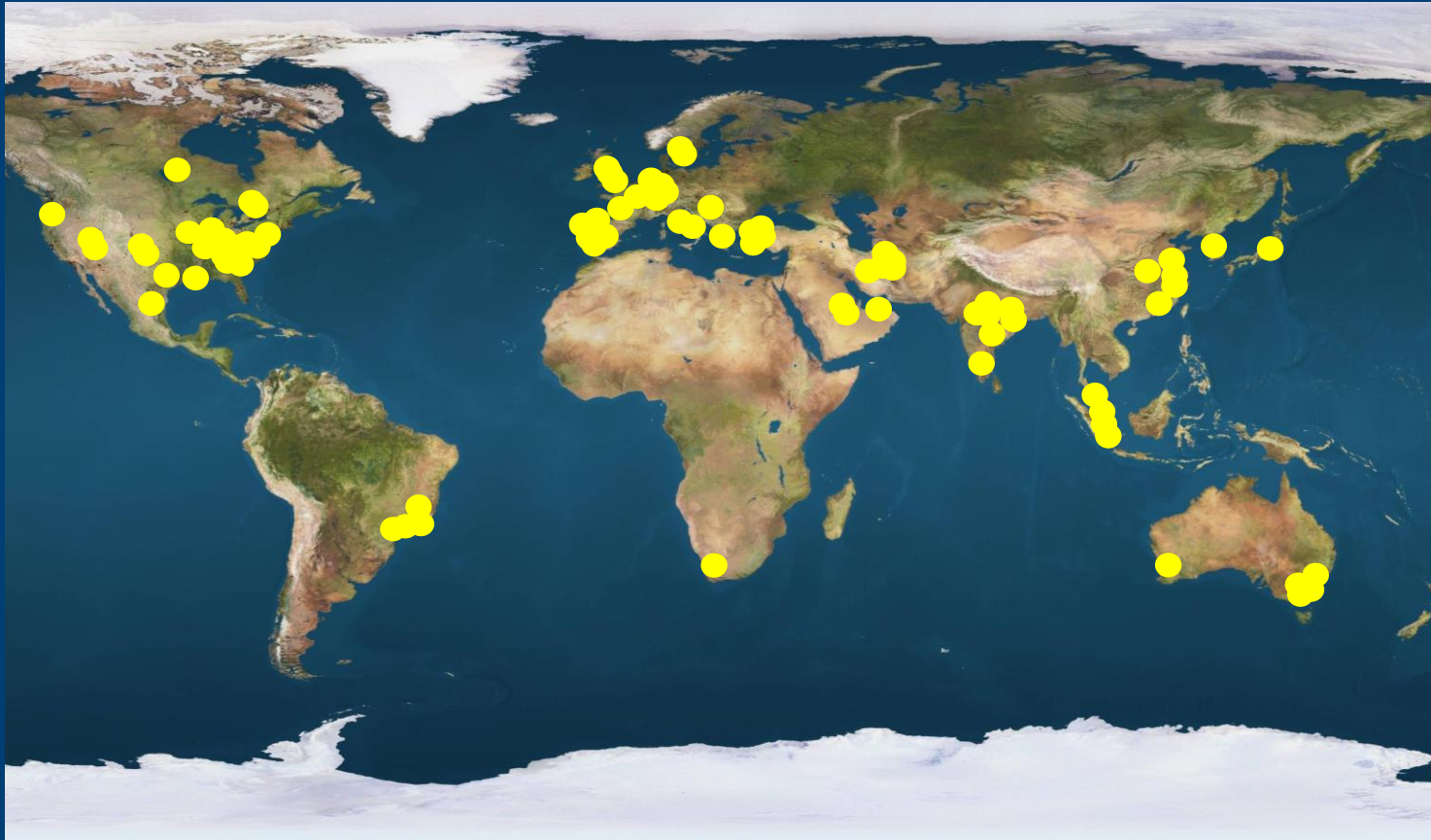
So small gravity does not cause it to separate



Colloidal silica can access most of the interconnected pore structure in concrete due to its size.







Since 2000, more than 50 research teams spanning over 100 papers have published results demonstrating the improved properties of concretes containing CS.

ASTM has two current working groups assigned to colloidal silica specifications.

ACI 241 Nanomaterials in Concrete addresses colloidal silica at length

Colloidal Silica in Concrete Science



How is CS introduced to concrete?

AS AN ADDITIVE AT TIME OF MIXING

- Treats entire load of concrete.
- Added at the batch plant into mixer trucks.
- Stays in the concrete until calcium hydroxide becomes available from the cement/ water hydration process then reacts. Permeability is significantly reduced.
- Some void space still present – capillaries and bleed water channels still form.

SPRAY-APPLIED TO SURFACE AFTER SET

- Applied after voids have formed, so effectively closes them in the interaction zone.
- Penetration depth varies.
- Can act as a curing mechanism when applied to new concrete.
- Can also be applied to existing concrete.





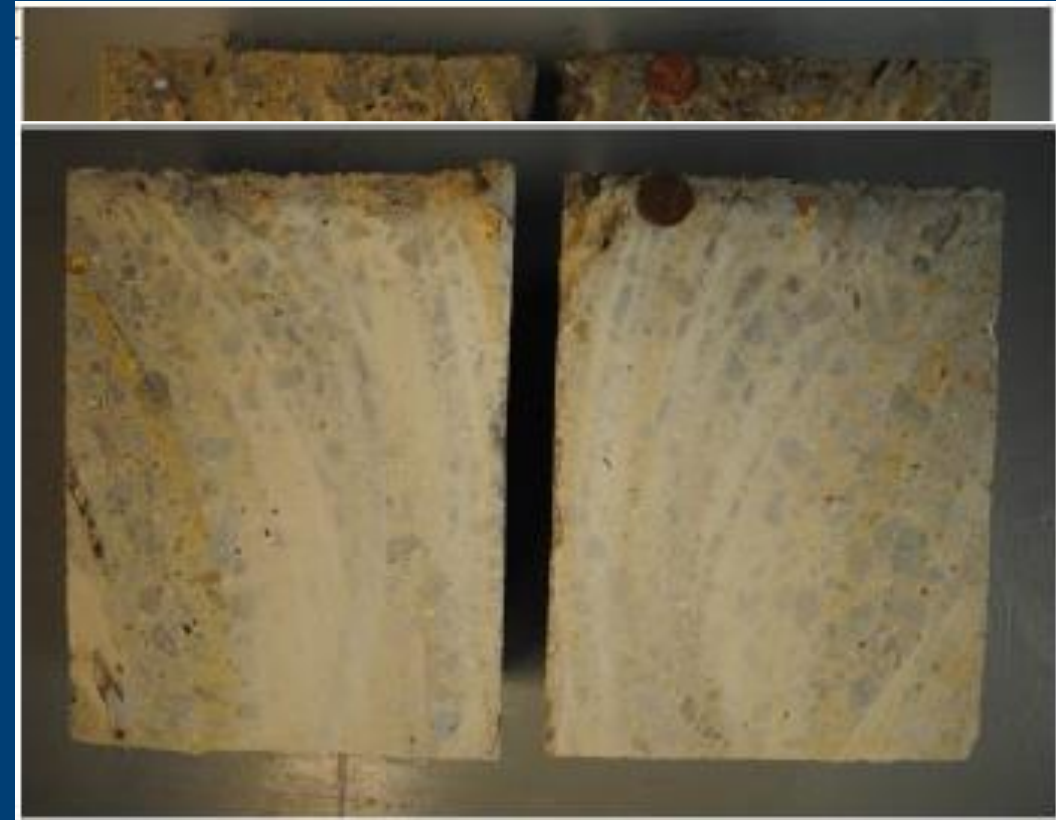
**Can be Applied on Horizontal,
Vertical, or Even Overhead
Surfaces**



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Effects on Permeability – Hydrostatic Testing

From Laboratory Testing



(DIN 1048 Testing, Middle Tennessee State University)

Treated – 72 Hours



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Real-World Project – Southeast US Bridge

Durability concerns were noted with a concrete bridge deck that was approximately 6 months old.

Bridge asset owner selected CS treatment with before and after surface resistivity readings to indicate performance.

A 25% improvement was decided upon as the benchmark for success based on the asset owner's design.



Results

Testing Background

4-Point Wenner Probe testing performed by TEC, an SGS Company.

13 grid locations with five readings obtained in each grid.

Initial readings obtained, then CS treatment, then post-treatment readings obtained two weeks later.

- **Results:**

Lane 1: 62% improvement

Lane 2: 31% improvement

Treatment met bridge owner's expectations.





Questions?

Thank you

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www.concrete.org



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