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Cool Additives Technology

# **Surface Enrichment with Colloidal Silica; A Sustainable Drop-In Solution for Dirt-Pickup Resistance**

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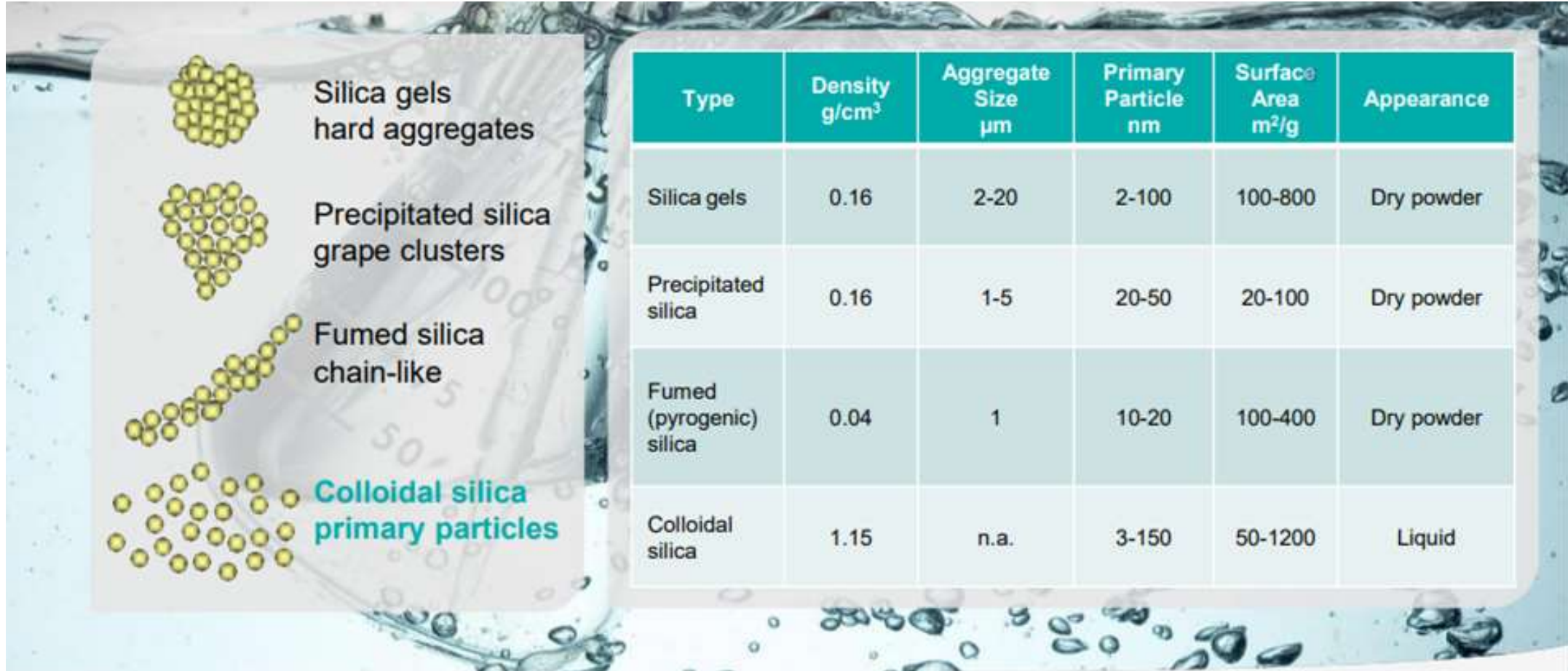
- Headquartered in Houston, Coadtech offers more than 30 years of experience in the specialty chemicals distribution business.
- Coadtech specializes in highly reflective exterior coatings (roof, wall, and pavement) and serves North American CASE manufacturers with climate-resilient and sustainable technologies.
- Proud member of the ACA and the CRRC



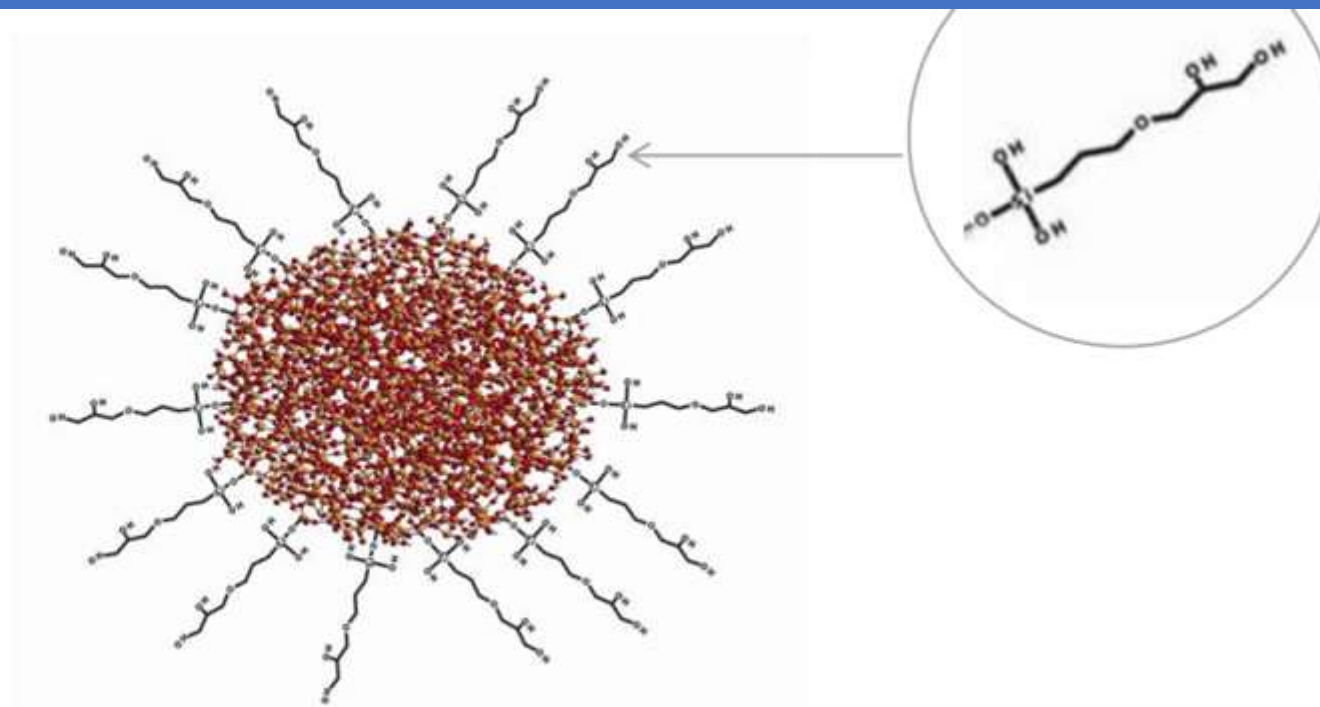
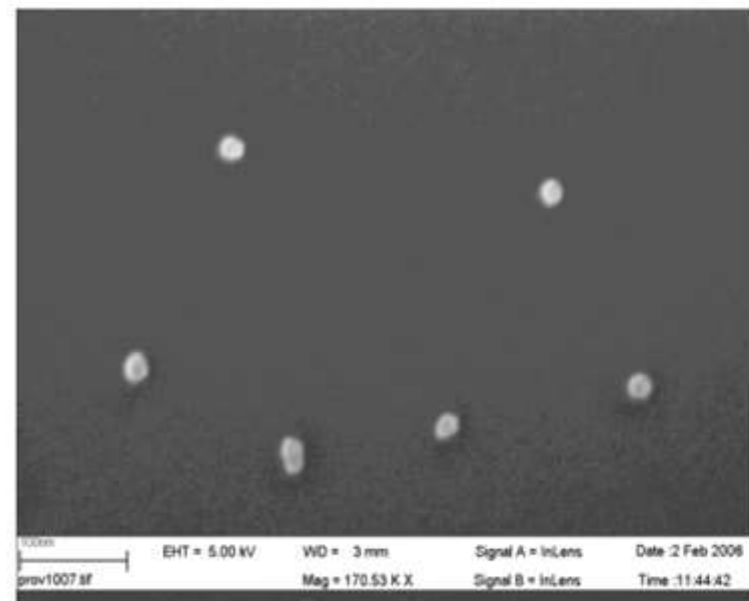
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# What Is *Colloidal* Silica?



# Getting A Closer Look



7 nanometer diameter



# Colloidal Silica As A Sustainable and Climate- Resilient Solution

Bridging The  
Waterborne-  
Solventborne Gap

Helping Solar  
Reflective Coatings  
Stay Clean



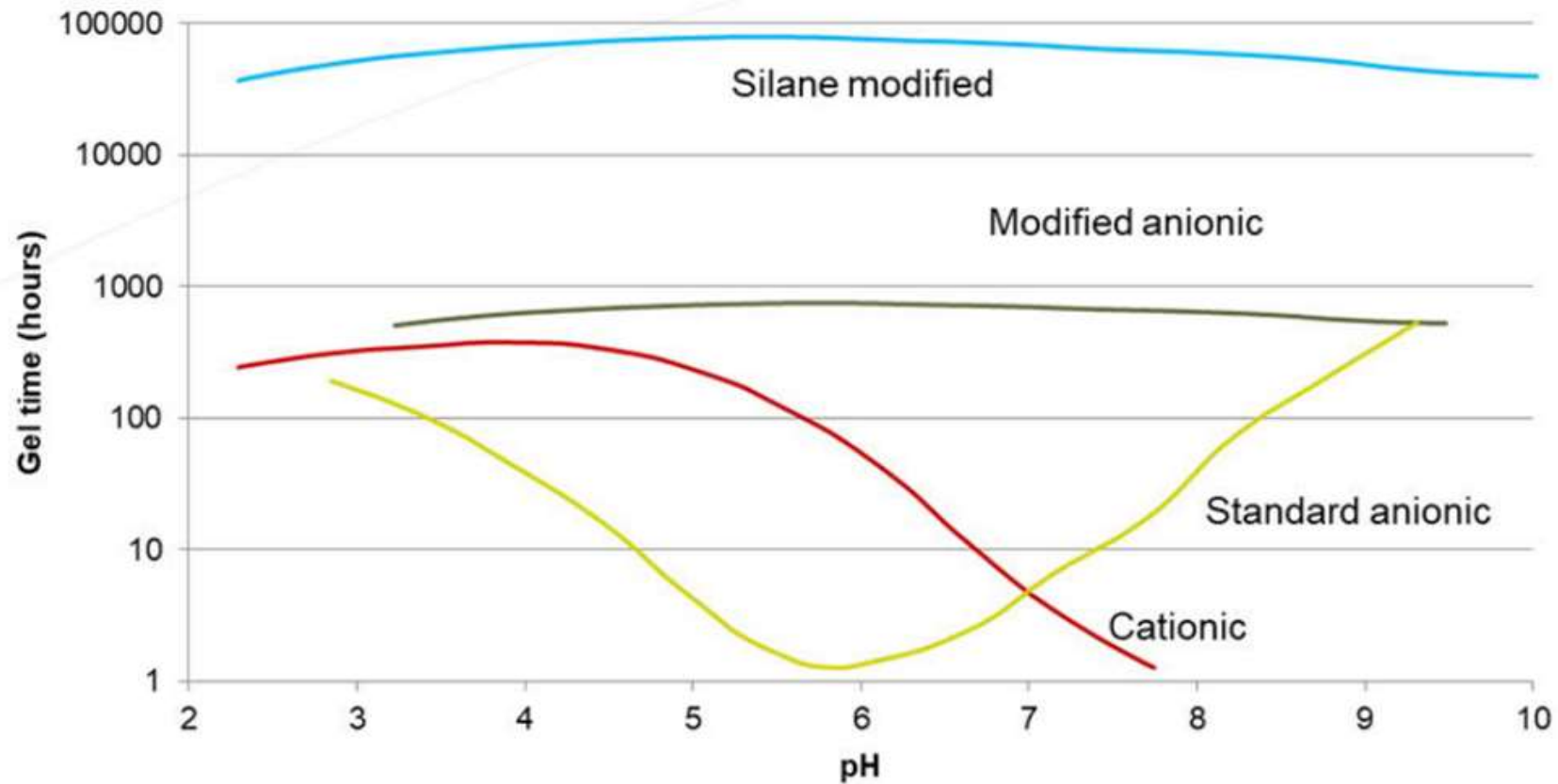
# Multipurpose Additive

- Used in many applications, colloidal silica brings valuable properties to an array of products.
- Until recently, colloidal silica has been limited in architectural and industrial coatings.
  - Unsuitable pH

Functions	Applications
Abrasion & Scratch Resistance	Coatings
Adhesion	Adhesives, coatings, sealants
Anti-blocking	Coatings, plastic films, textiles
Anti-soiling	Coatings, cleaners, textiles
Binding	Precision Investment Casting (PIC), refractory materials, coatings, catalyst, well cementing, plastic films
Dispersing	Pigments, inks, resins
Flocculation	Beverage, water treatment, refractory materials
Frictionizing	Paper, plastic films, textiles
Gelling	Batteries, ground consolidation
Polishing & Planing	Semiconductor materials, sapphire, glass and metal, optical lenses, cement and stone polishing
Printability	Paper, plastic films, inkjet and photo
Strength & Stability	Concrete, well cementing



# Effect of pH on Colloidal Silica



# How Colloidal Silica Works in Coatings

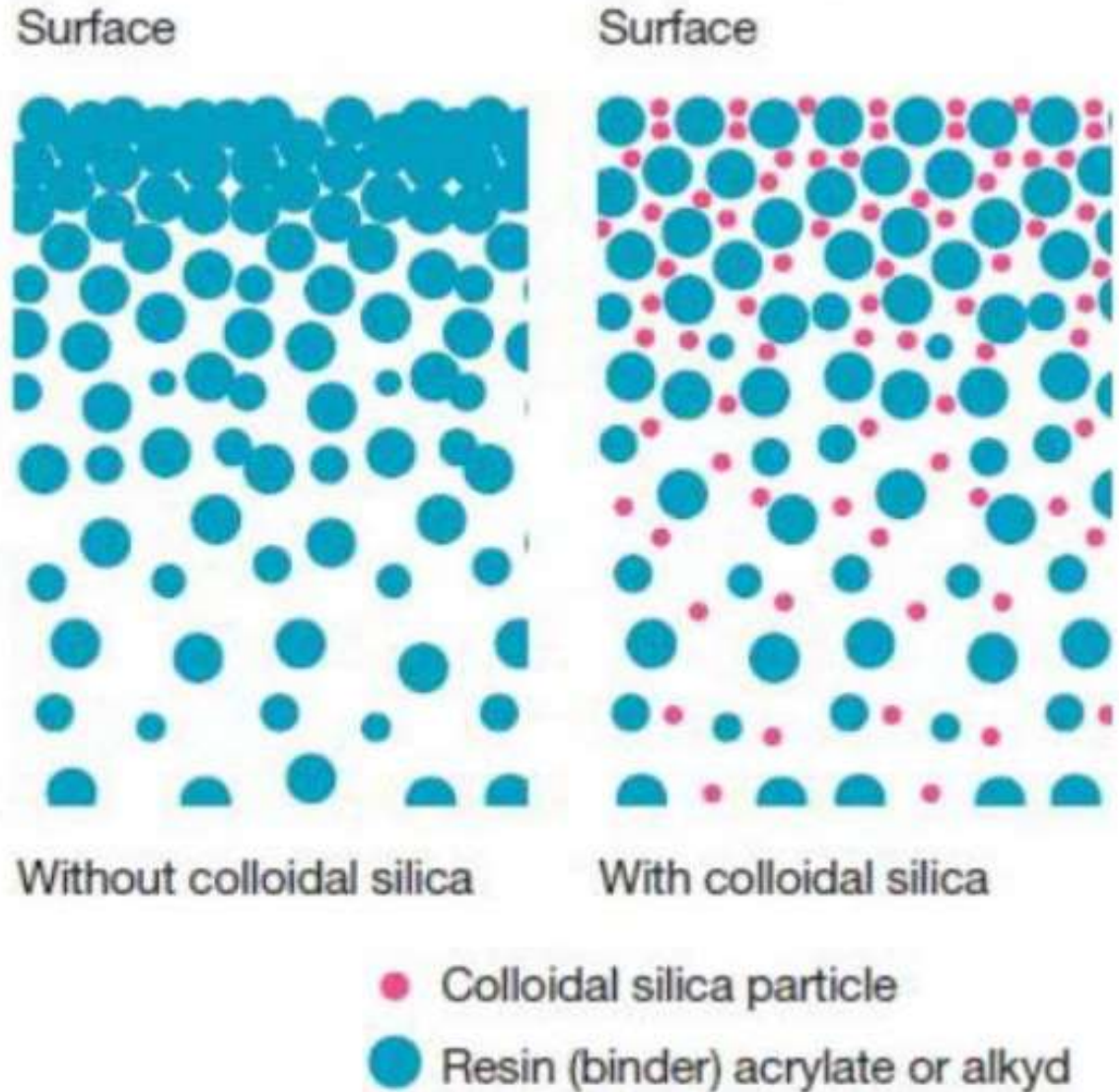
- **Dispersing Agent**
  - ❑ Carries a charge and is capable of reducing surface energy of the overall formulation
- **Adhesion Promoter**
  - ❑ Open silanol groups and additional functional groups grant chemical and physical adhesion to a broad range of substrates
- **Surface Modifier**
  - ❑ Silica particles migrate to both surfaces of the coating.





# Surface Migration

Colloidal silica particles are charged and **very** hydrophilic. This causes particles dispersed evenly throughout the formula to migrate to and congregate at the substrate(s) and open air interfaces.



# Corrosion Resistance for Industrial Coatings

- By improving the adhesion, colloidal silica can drive up the coatings' anticorrosion performance.
  - Cr III passivation film containing colloidal silica at 1% SiO<sub>2</sub> (~6% w/w)



A: CrVI passivate film on zinc



B: CrIII passivate film on zinc



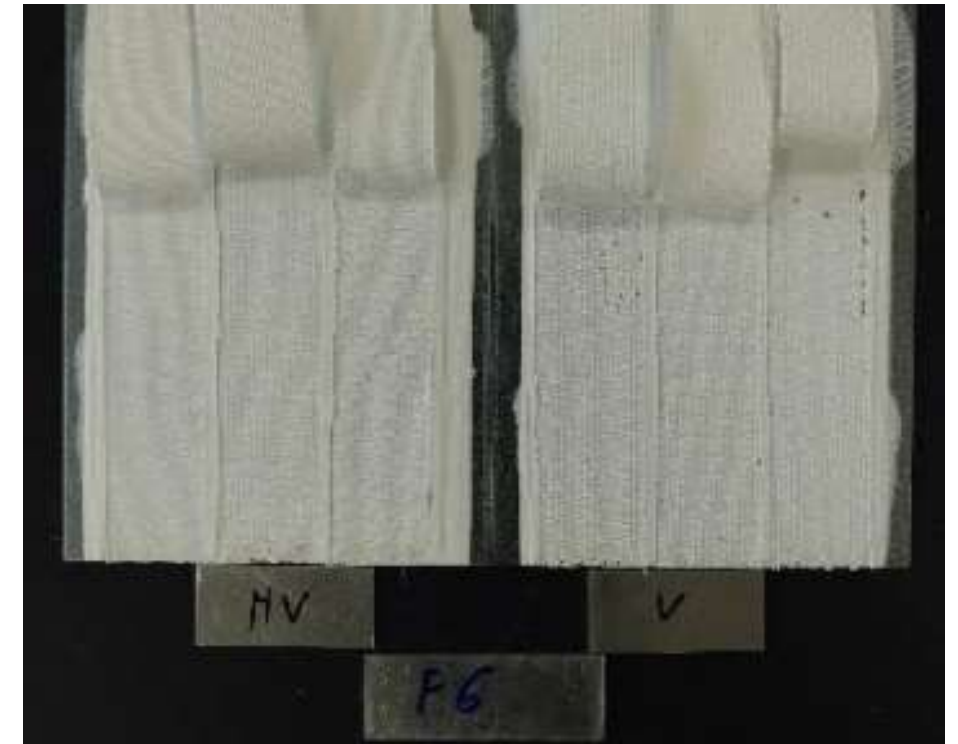
C: CrIII + silica passivate film on zinc

Corrosion test : 168 hours salt spray to cross-scored to substrate

# Wet And Dry Adhesion ASTM D903 // C794

Sample	Adherence (dry) N/m	Adherence (wet) N/m
Reference	753	256
Ref. + 0.3% SiO <sub>2</sub>	780	500
Ref. + 0.4% SiO <sub>2</sub>	890	879
Ref. + 0.5% SiO <sub>2</sub>	904	842
Ref. + 0.6% SiO <sub>2</sub>	968	948

- Application by brush on galvanized steel in two layers with the cloth strip in between DFT = 500  $\mu$ m
- drying time 14 days @ 23°C/50% HR traction rate= 50 mm/min angle = 180°
- Submersion in tap water during for 168h prior to testing for wet adhesion



# Experimental Formulations

Roof Coating
Material
Water
Tegofomex
Orotan
CaCO <sub>3</sub>
TiO <sub>2</sub>
Primal EC-1791
Texanol
Propylene Glycol
Hisol CR100
Hisol D201
Ammonia

Interior Paint
Material
Water
Tegofomex
Orotan
CaCO <sub>3</sub>
Kaolin Clay
TiO <sub>2</sub>
Primal EC-1791
Texanol
Propylene glycol
Hisol CR100
Hisol D201
Ammonia

Exterior Paint
Material
Water
Tegofomex
Orotan
CaCO <sub>3</sub>
Kaolin Clay
TiO <sub>2</sub>
Primal EC-1791
Texanol
Propylene glycol
Hisol CR100
Hisol D201
Ammonia

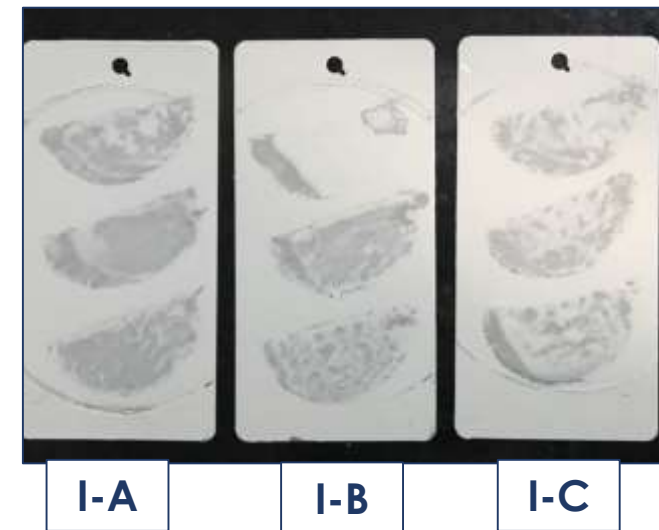
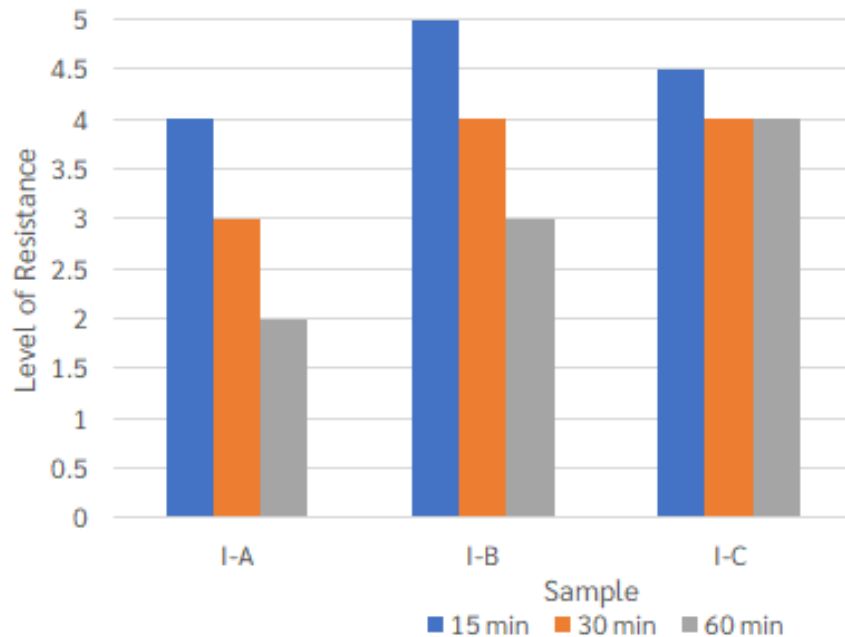
# Properties Tested (Roof Coating)

- Early Rain Resistance
- Dirt Pick Up Resistance
- Wet Scrub Resistance

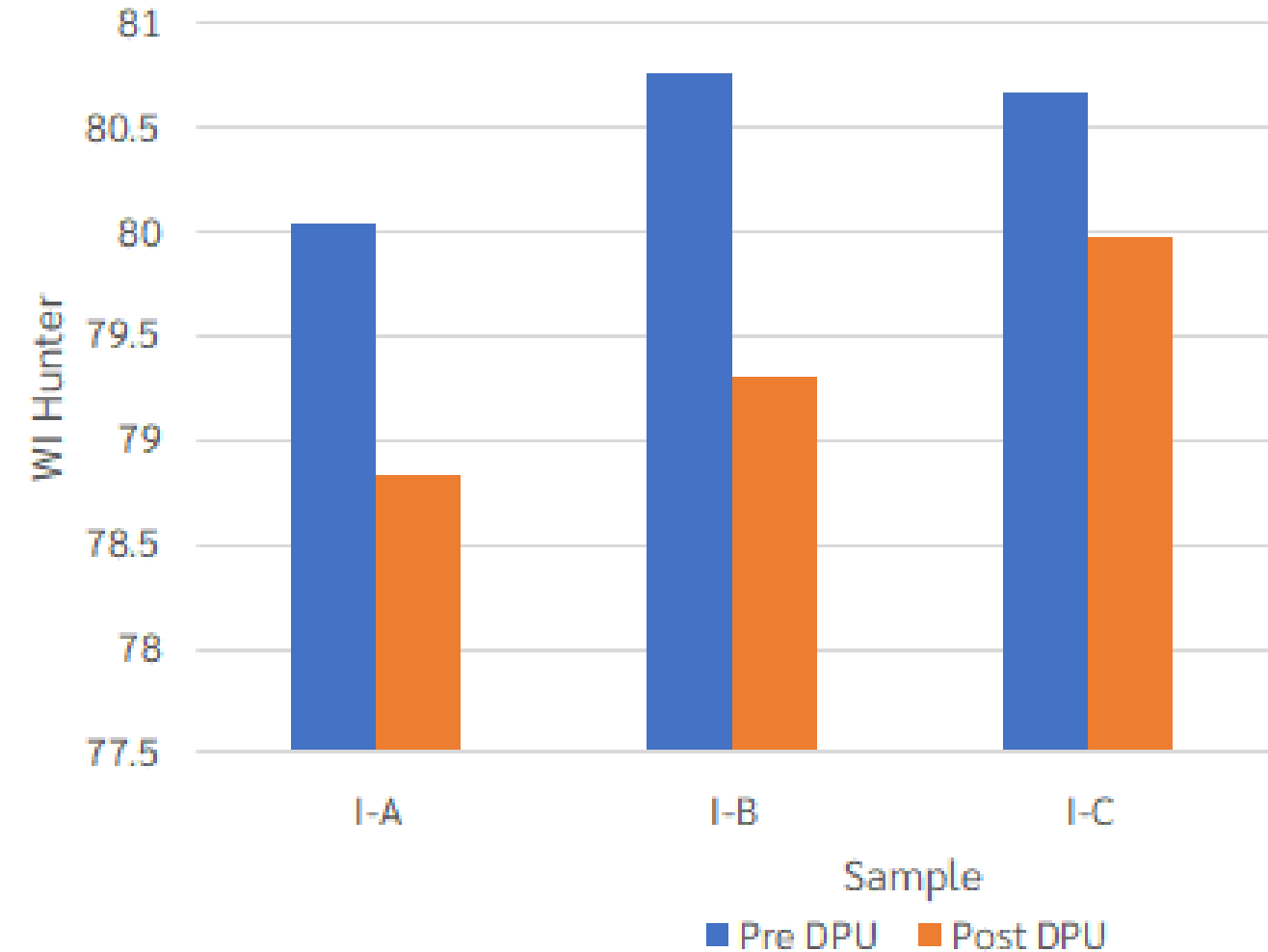


# Early Rain Resistance

- Tested with ISO 2812-3
- Resistance to water submergence after 30 min of drying



# Dirt Pick Up Resistance



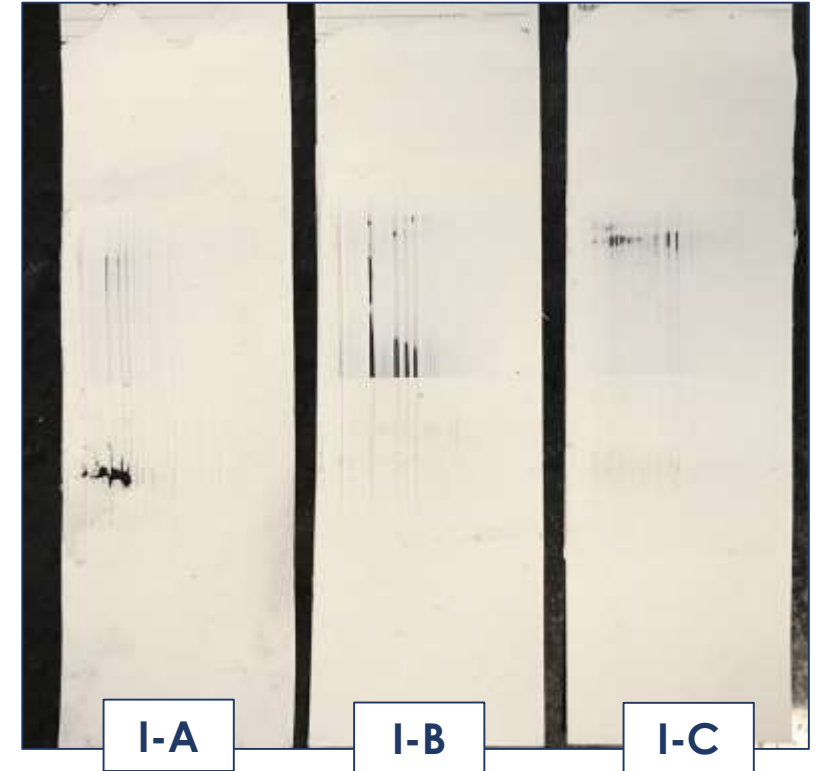
Tested with NMX-U-125-SCFI-2016

- Red oxide dispersion

# Wet Scrub Resistance

- Tested with ASTM-D2486
- Rounds of 400 cycles

Sample	Rounds (400 cycles)	Total Cycles
I-A	1.25	500
I-B	2	800
I-C	3.88	1552



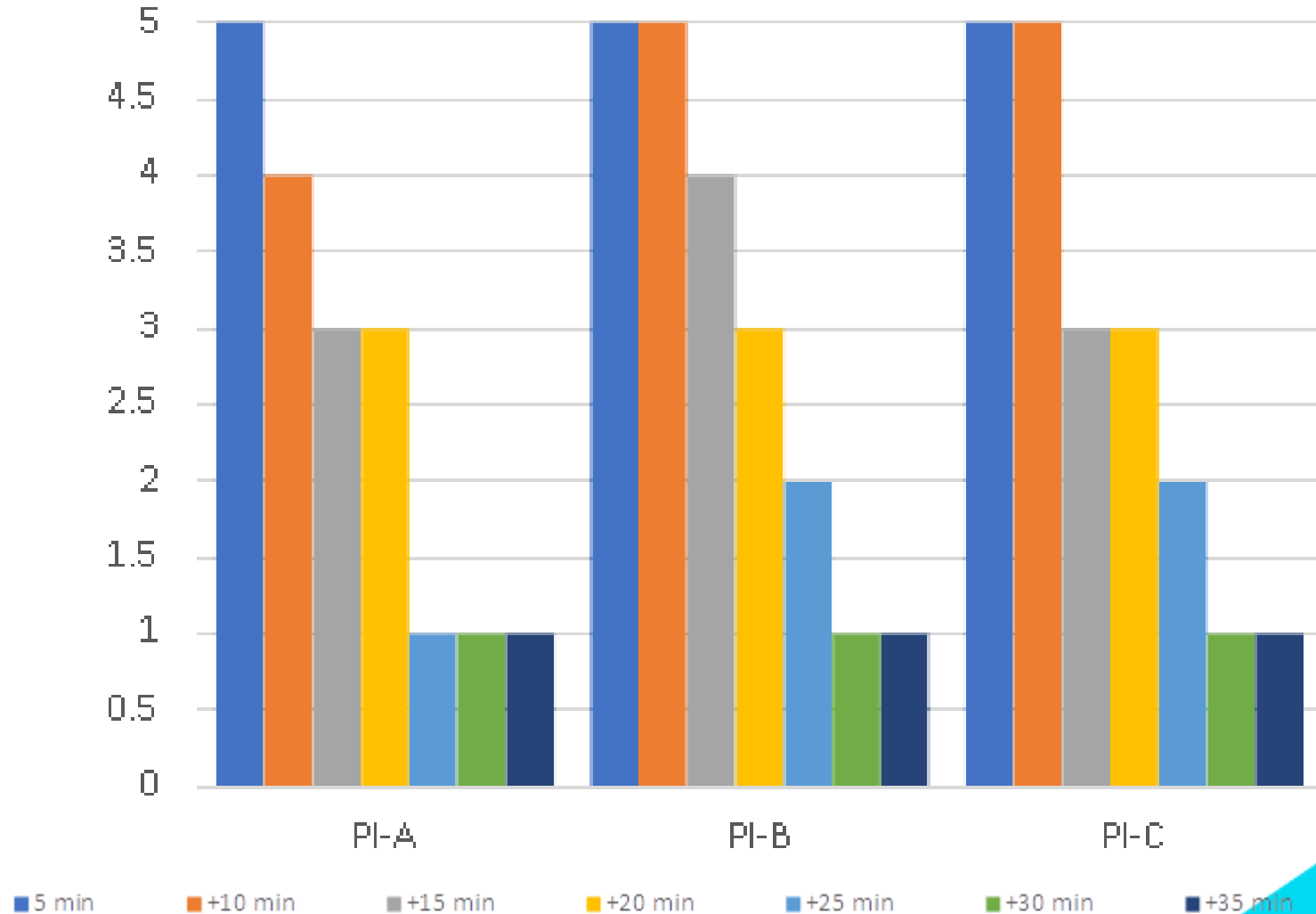


# Properties Tested (Interior Paint)

- Open Time
- Drying Time
- Stain Resistance
- Wet Scrub Resistance

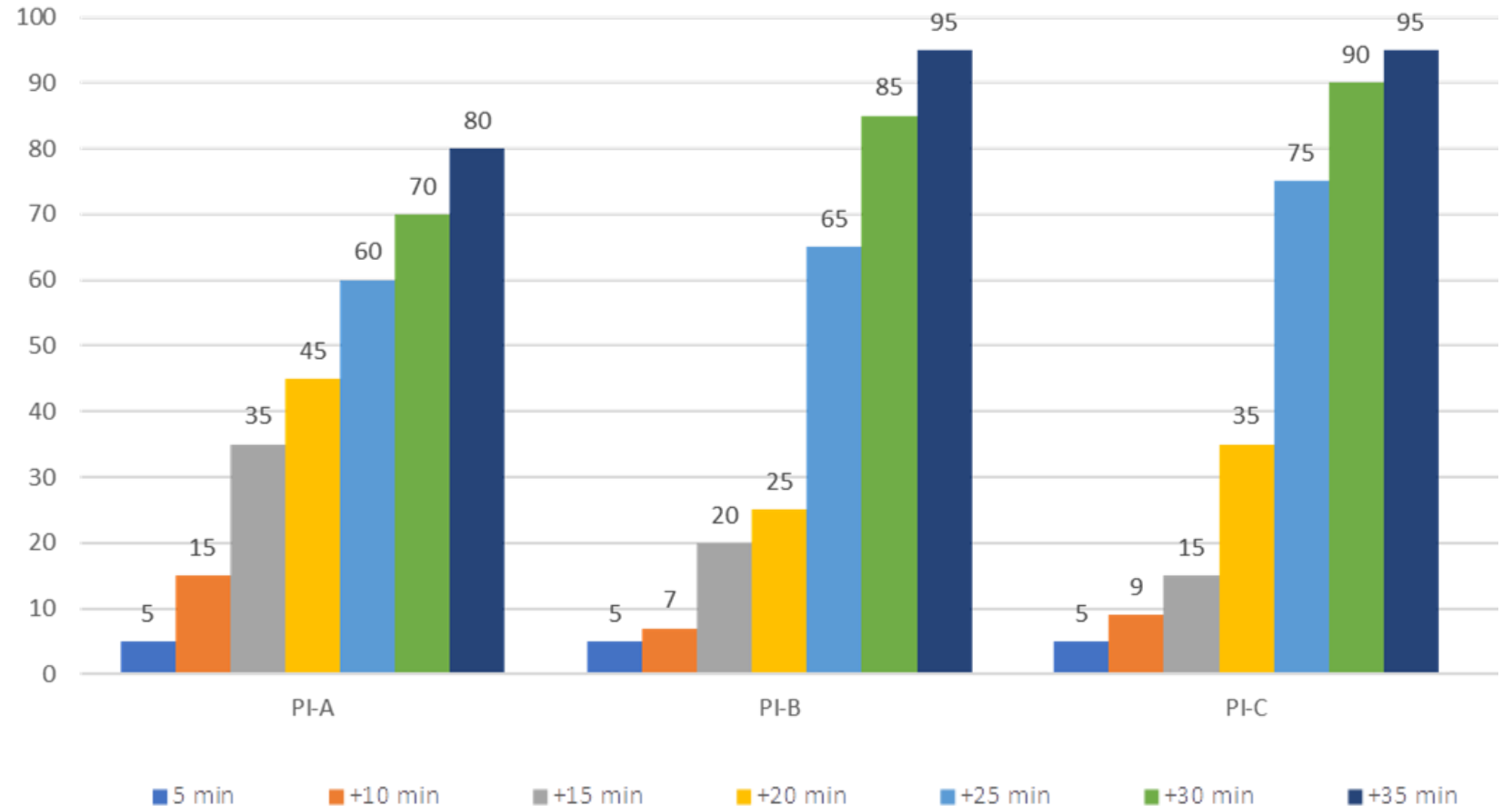


# Open Time in Interior Paints



# Drying Time in Interior Paint

- ASTM D7488
- Rated 100% (Completely Dry) to 0% (Completely Wet)



# Stain Resistance In Interior Paints

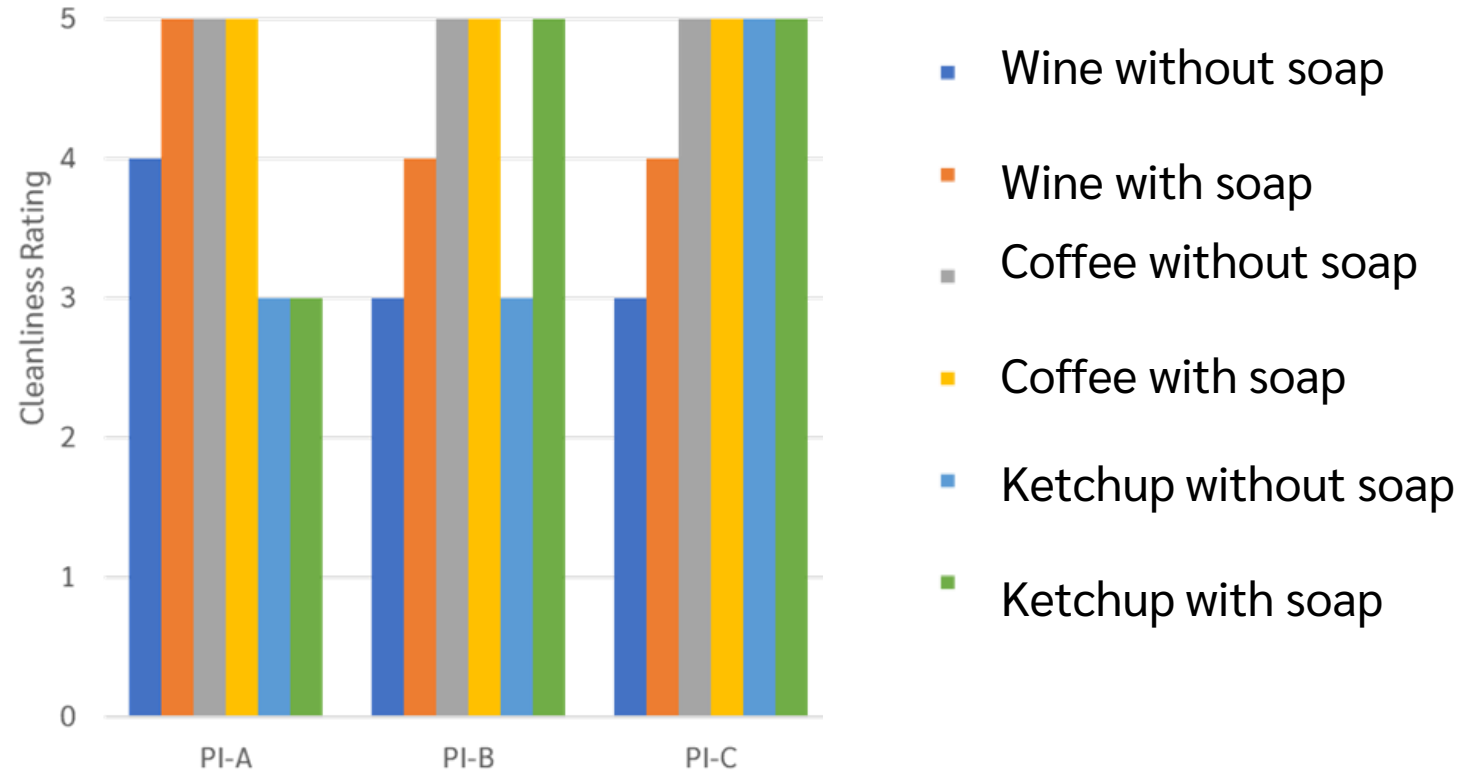
Stained with red wine, coffee, and ketchup

Washed with 10 cycles of water and water with soap

Rated for stainability

(5- clean, 0- very stained)

Overall, the ability of colloidal silica to modify the coating into a stain resistant surface is best seen with PI-C.

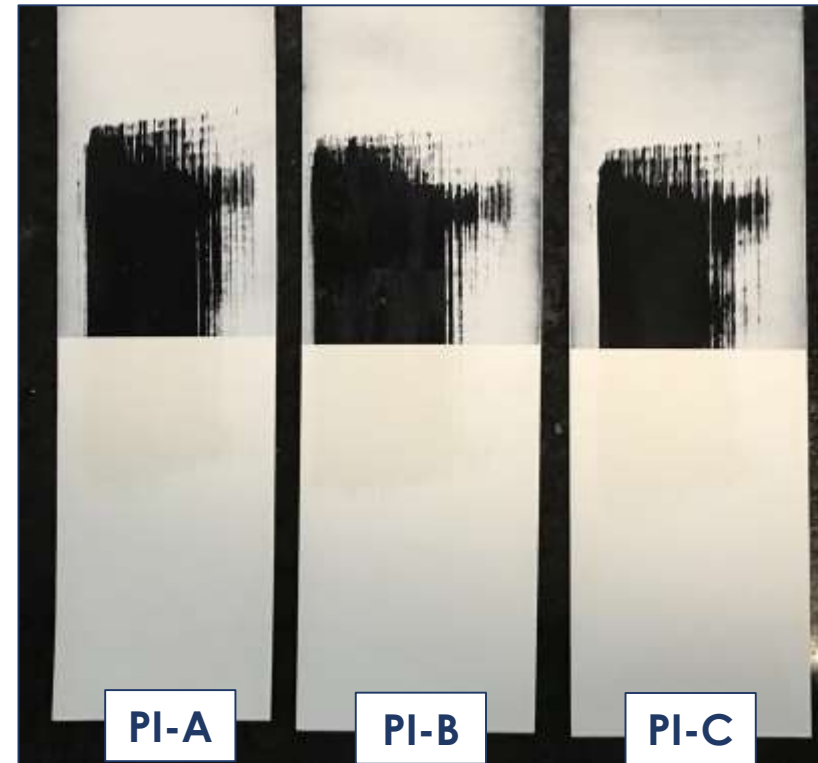


# Wet Scrub Resistance in Interior Paint

ASTM-D2486

- Rounds of 100 cycles

Muestra	Rounds	Total Cycles	Cycles Survived
PI-A	1	100	35
PI-B	1	100	40
PI-C	1	100	42

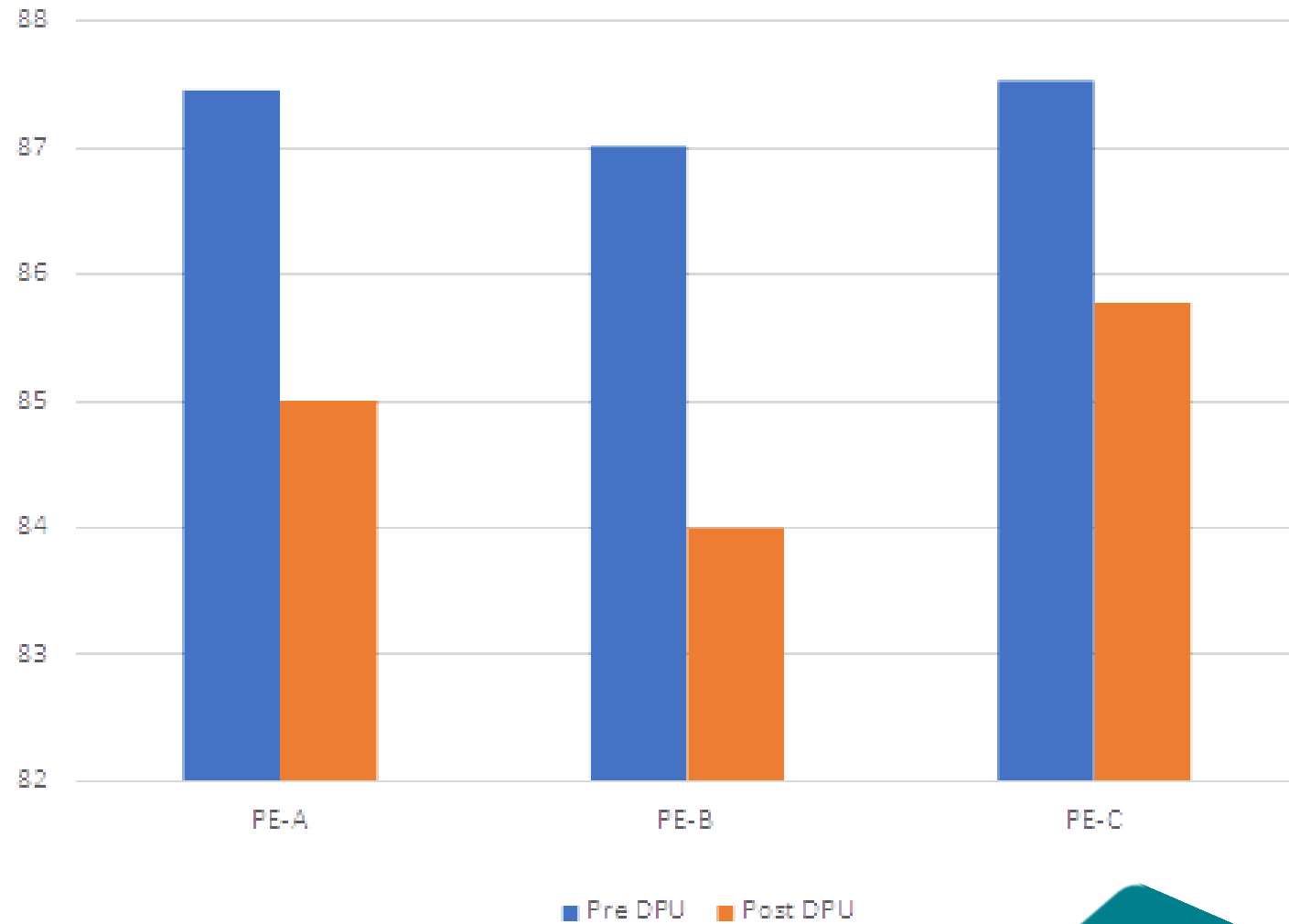


# Properties Tested (Exterior Paint)

- Dirt Pick Up Resistance
- Wet Scrub Resistance
- Early Rain Resistance

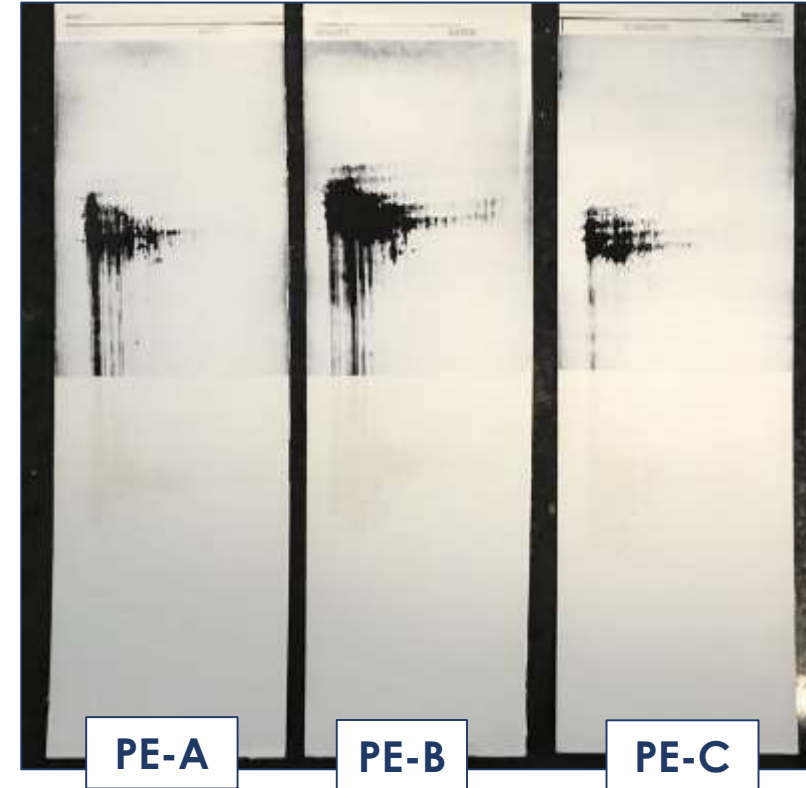
# Dirt Pick-Up Resistance In Exterior Paint

Dirt Pick-Up test with red iron oxide and measured with WI Hunter



# Wet Scrub Resistance (Exterior Paint)

Sample	Rounds (100 cycles)	Total Cycles	Cycle at failure
PE-A	5.45	545	545
PE-B	8	800	795
PE-C	8	800	795



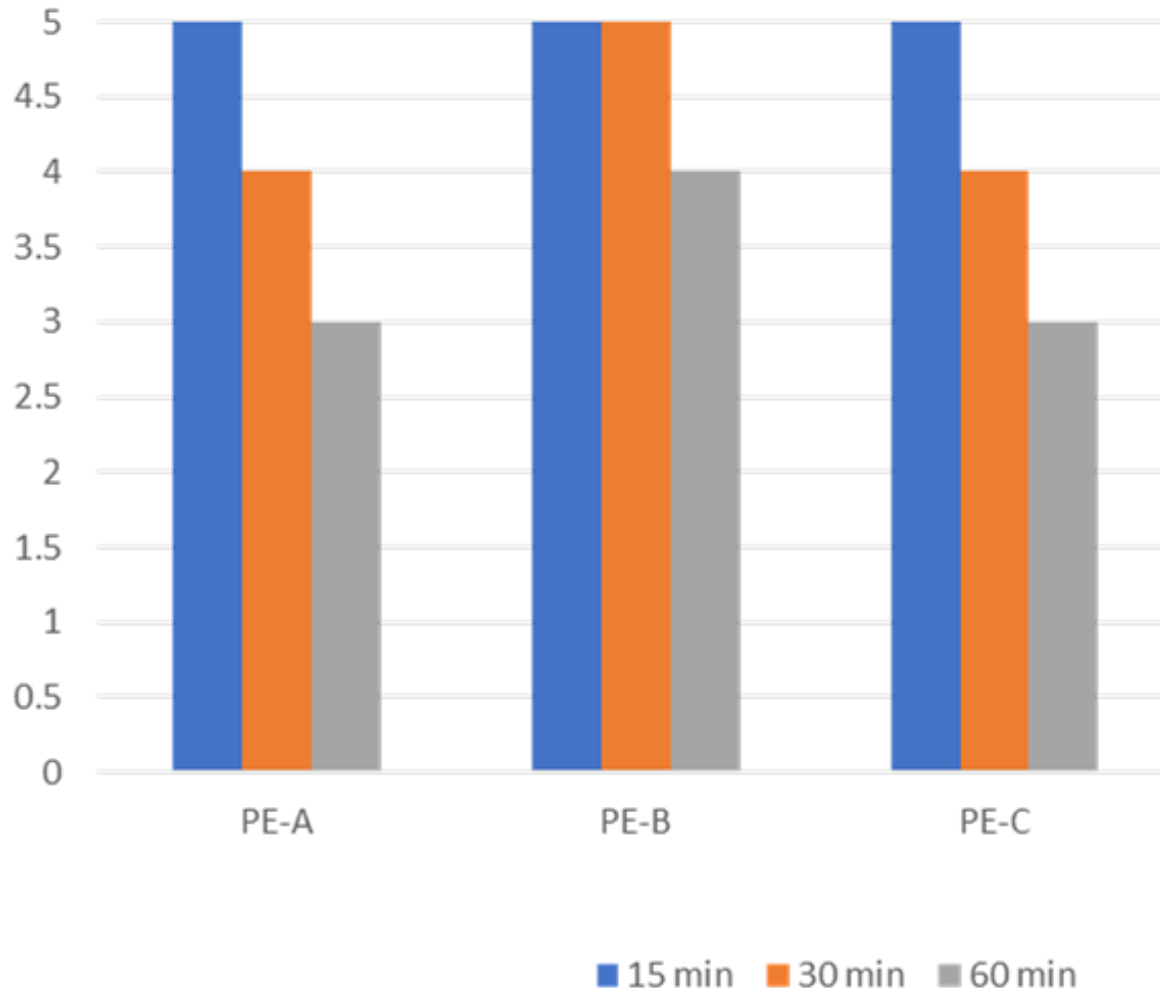


# Early Rain Resistance

ISO 2812-3

Rated from 5 (no effect) to 0 (complete failure of coating)

Samples were allowed to dry for 30 mins. A wet cloth was then applied to to sample and allowed to rest for the specified time.



PE-A

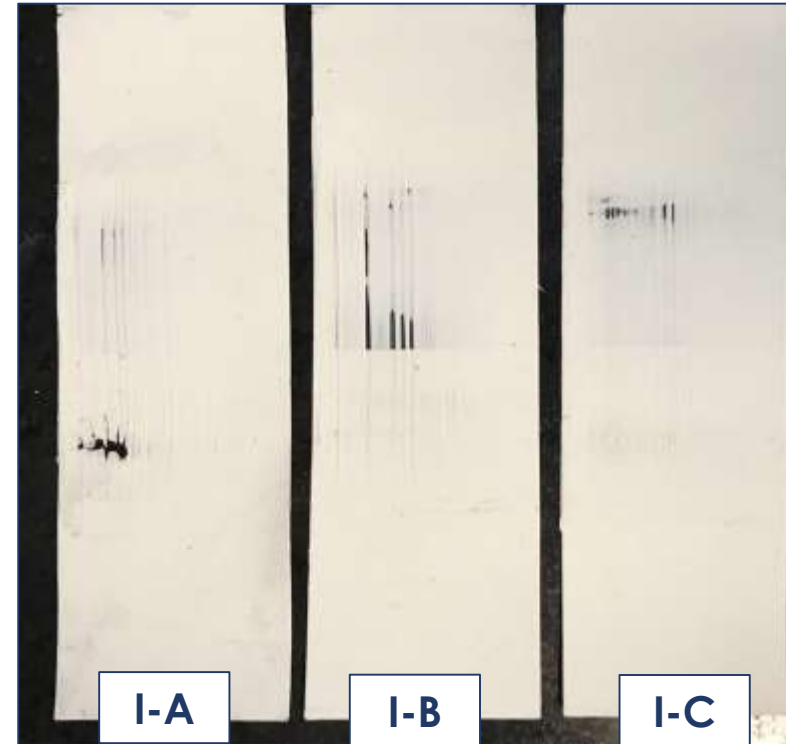
PE-B

PE-C

# Wet Scrub Resistance in Exterior Paint

- ASTM-D2486
- Round of 400 cycles

Sample	Rounds (400)	Total Cycles Survived
I-A	1.25	500
I-B	2	800
I-C	3.88	1552





# Formulation guidelines

How to incorporate colloidal silica in  
your formulation



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Selecting a Grade

Consult an Expert



Drop-In Solution

Measure, Add,  
Homogenize



Ladder Study

Start with 2% w/w  
End with 5-6% w/w

## Formulation and Evaluation Guidelines

What to watch for:

ANY change in optical properties  
(indication of going over CPVC)

Unwanted changes in mechanical  
properties (indication of going  
over CPVC)



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# Manufacturing Options

- “Let Down” addition
  - Colloidal silica is a waterborne solution, and requires minimal agitation.
  - Simply ensure a homogenous mixture; no shear needed
- “Grind” addition
  - Better dispersion of problem components (especially pigments)
  - Potentially reduced surface enrichment





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**Thank you for listening!**