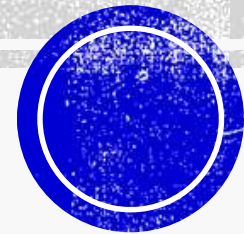


# **1-K Silicate Binder- Based Systems**

**Brigitte Emmons, R.D.S.**



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# Overview

- Acrylic Based Resin Binders
- Inorganic Binders
- 1K-Silicate Binder-Based Systems
- Testing



# Acrylic Based Resin Binders

- Defined
- Thermoplastic vs. Thermosetting
- Advantages vs. Disadvantages



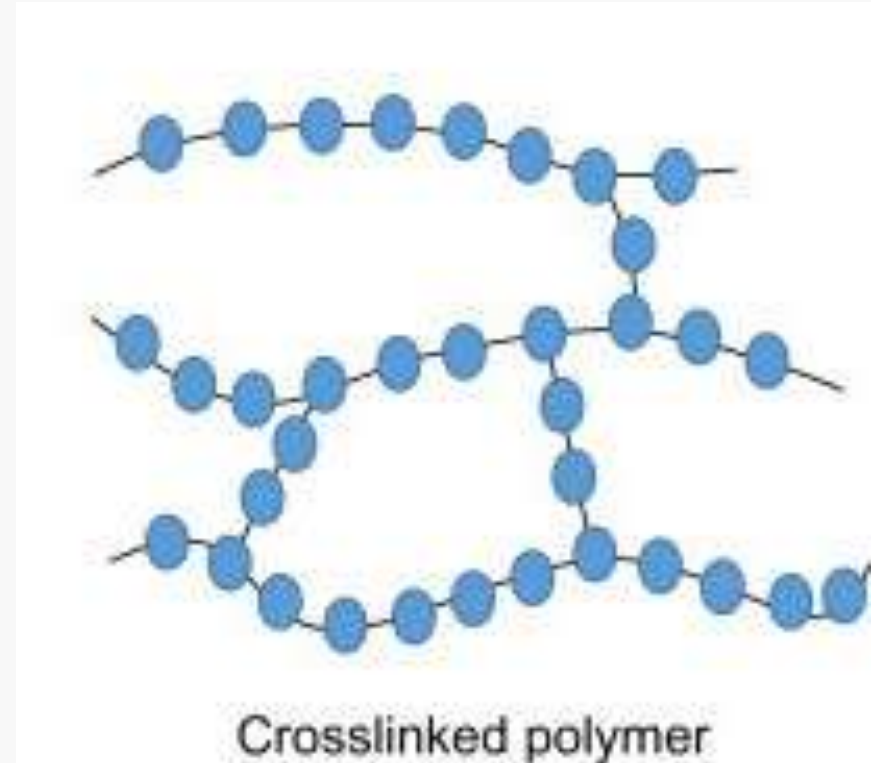
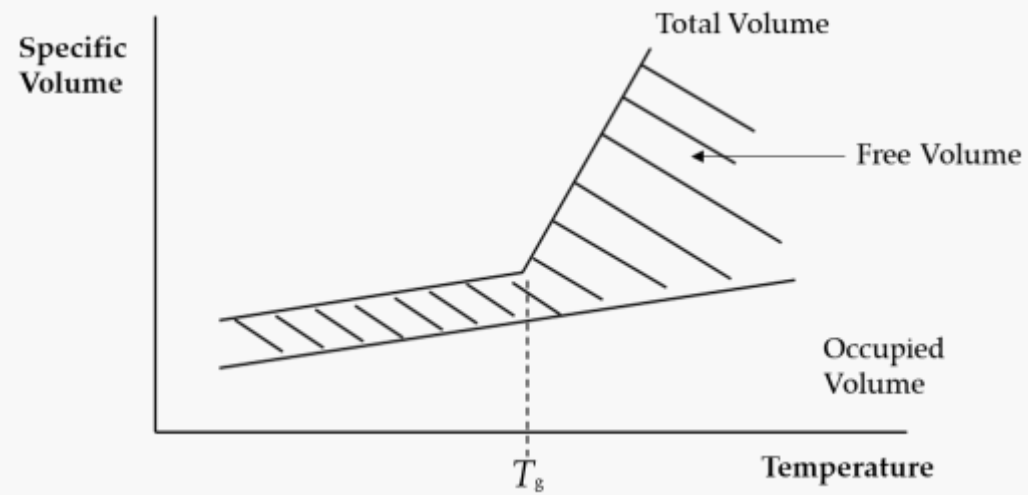
# INORGANIC RESIN BINDERS

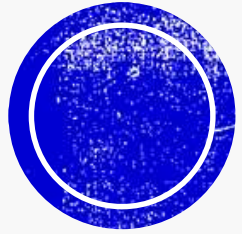
- Defined
- Examples
- Advantages and Disadvantages



# Film Forming Mechanisms:

## Crosslinking Polymers





# 1K-Silicate Based Binder Systems

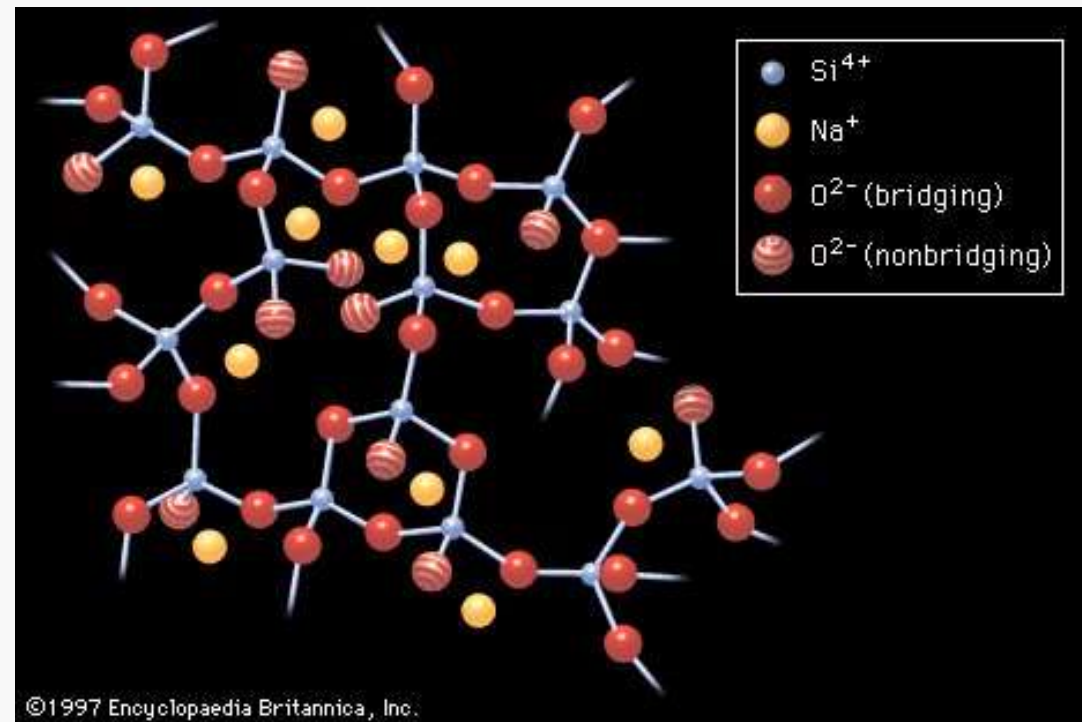
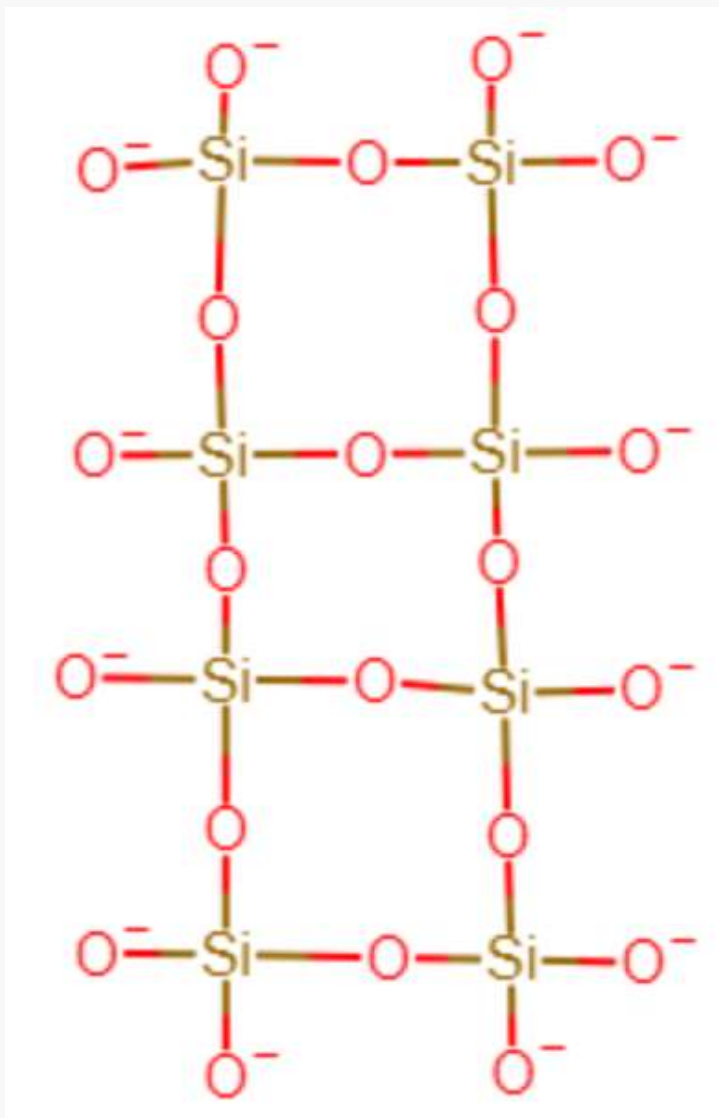
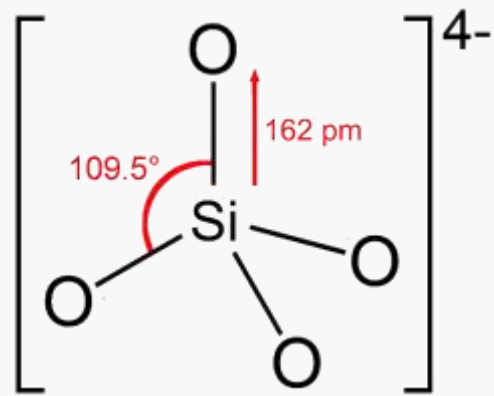


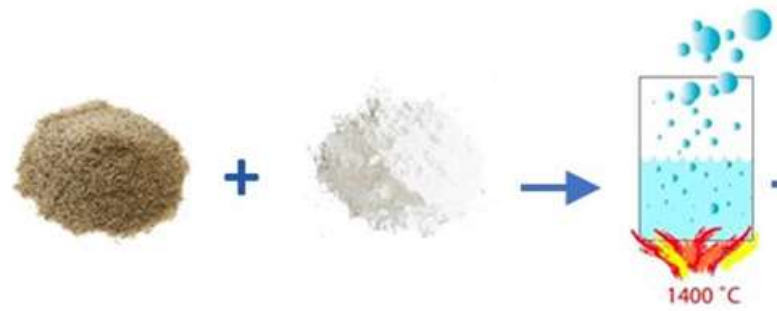
# History

- Been in use since late 1900's
- 2-K Silicate Systems
- Adolf Keim credited with invention









QUARTZ SAND

CARBONATE

CO<sub>2</sub>



SILICATE



WATER



HEATING  
UNDER  
PRESSURE



MANUFACTURER'S  
TECHNOLOGY



UNIQUE  
SILICATE  
BINDER



**Low  
Molar  
Ratio**

**High  
Molar  
Ratio**



- Binding Power
- Alkalinity
- Drying time
- pH
- Water solubility

- Adhesion Strength
- Chemical Resistance
- Curing Speed
- Dried Strength
- Drying Speed
- Tack



# Standards Defining 1K Silicate Emulsion Stains



DIN 1062-1

DIN 18363



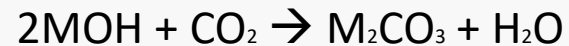
# Silicification Mechanism

## 1K-Silicate Binding

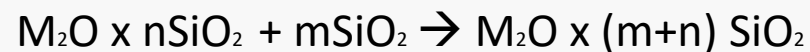
Curing with exposure to atmospheric CO<sub>2</sub>:



Silicification Curing Reaction with Substrate's free lime:



Curing by contact with free silica:



TOP LAYER  
0.1-0.3mm

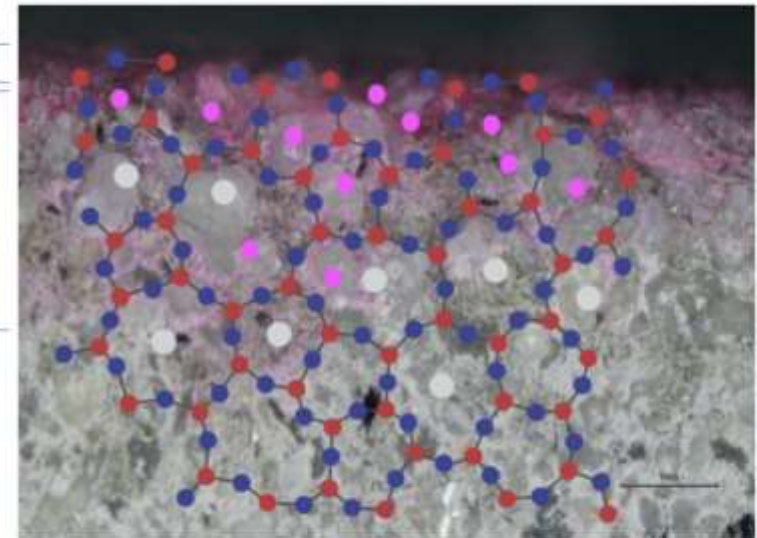
SUBSTRATE  
PENETRATION  
1-2mm

Pigment  
particles

Calcium

Oxygen

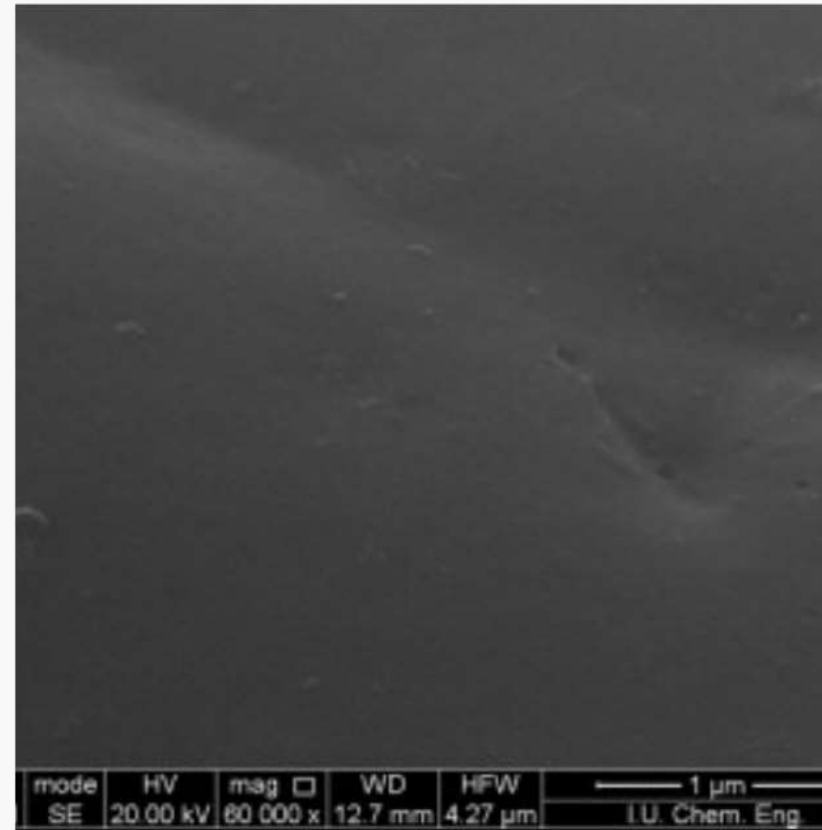
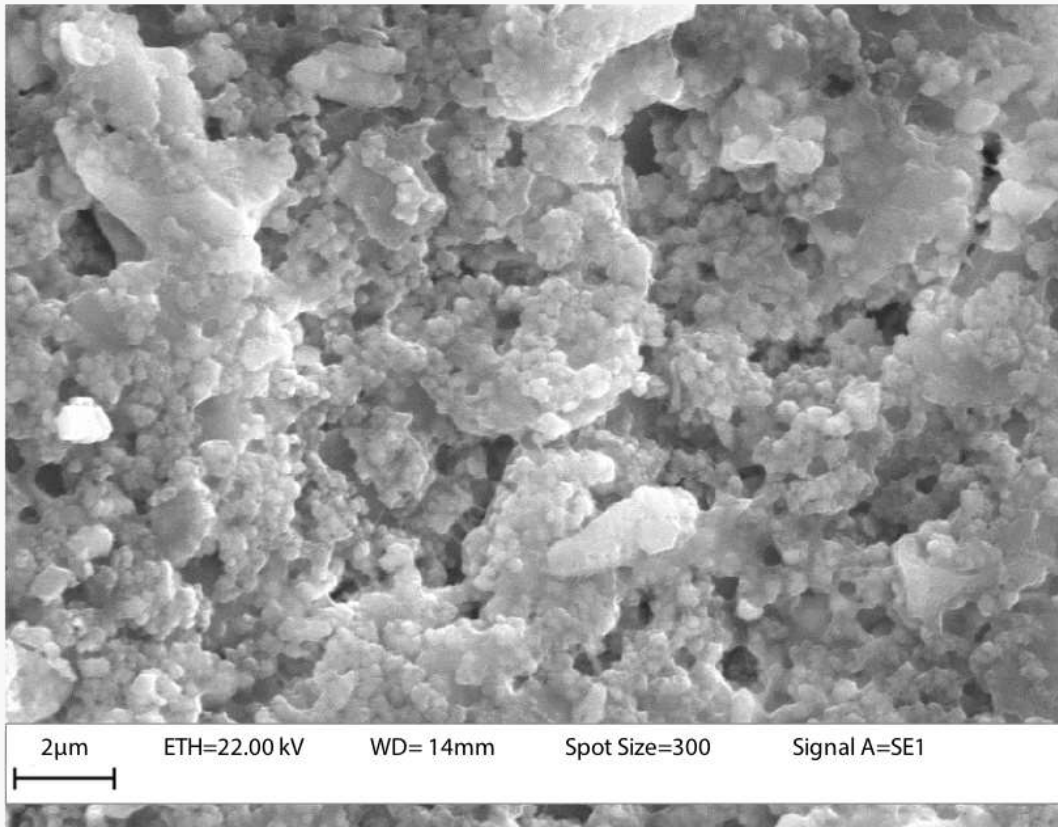
Silicon



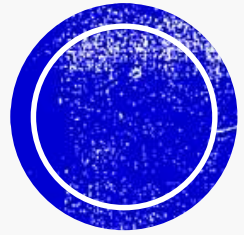
CROSS SECTION VIEW – BINDER WITH DYE



# Film Forming Mechanisms (cont.)





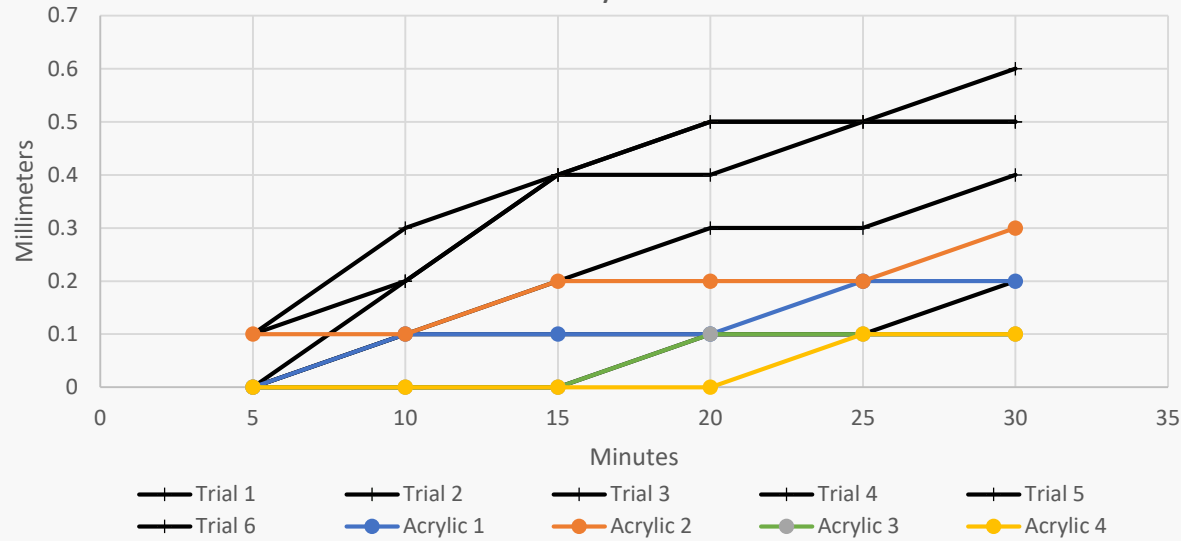


# Testing Data

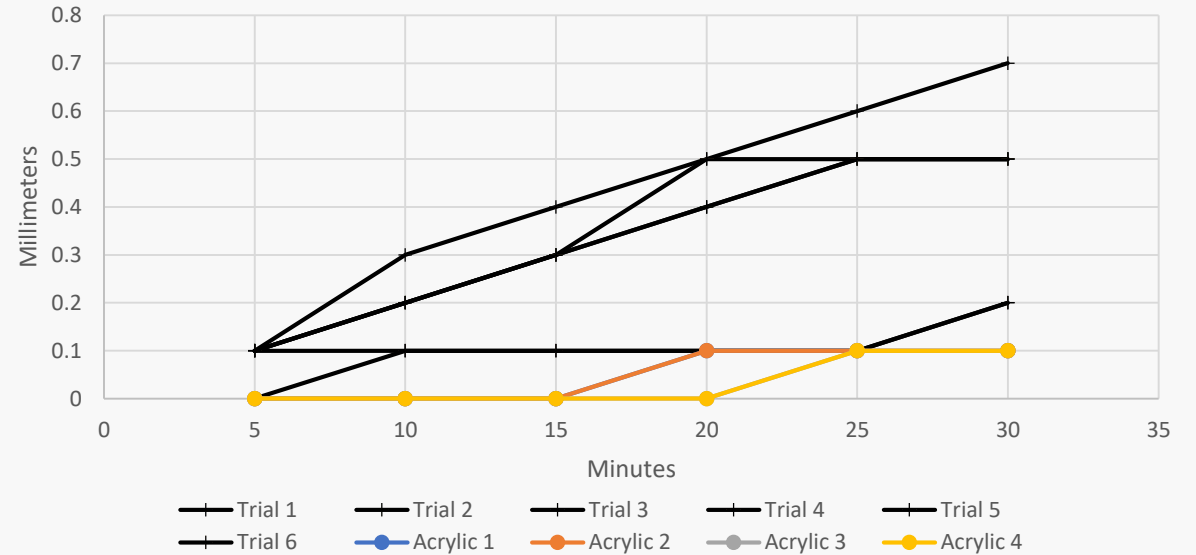


# Water Permeability Testing

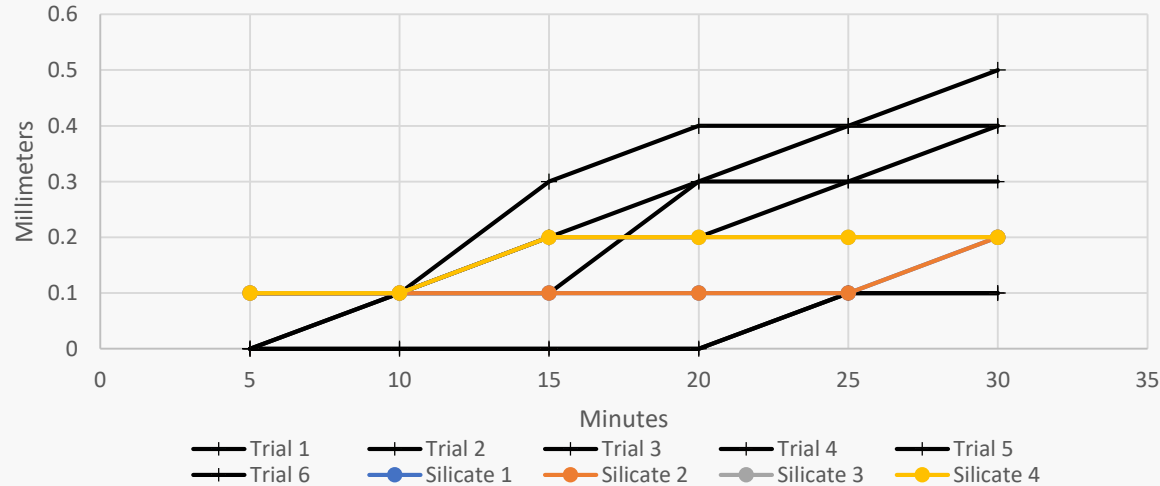
3- Acrylic #2



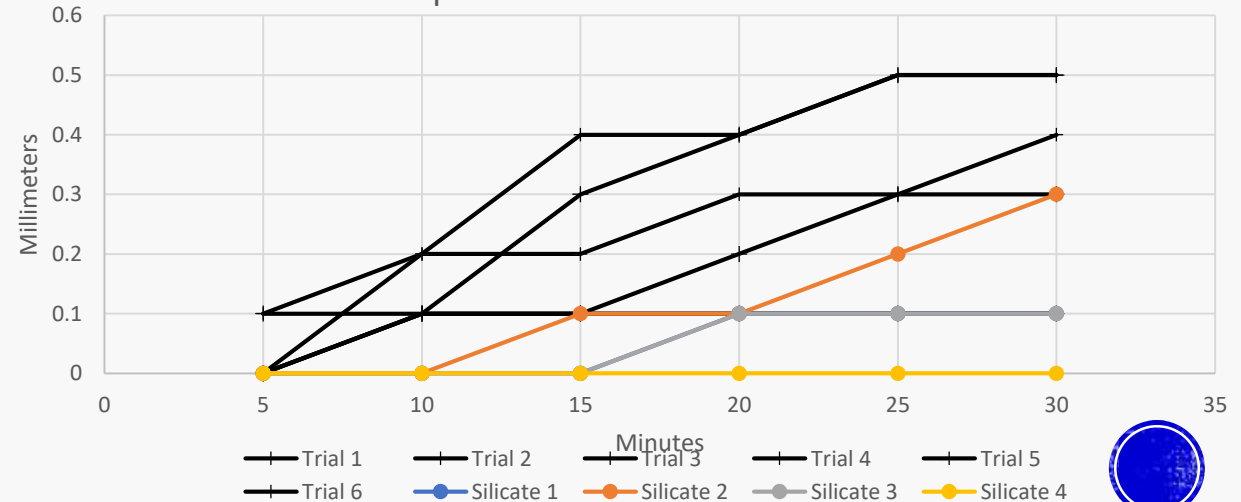
1- Acrylic #1



5- Silicate Emulsion Stain

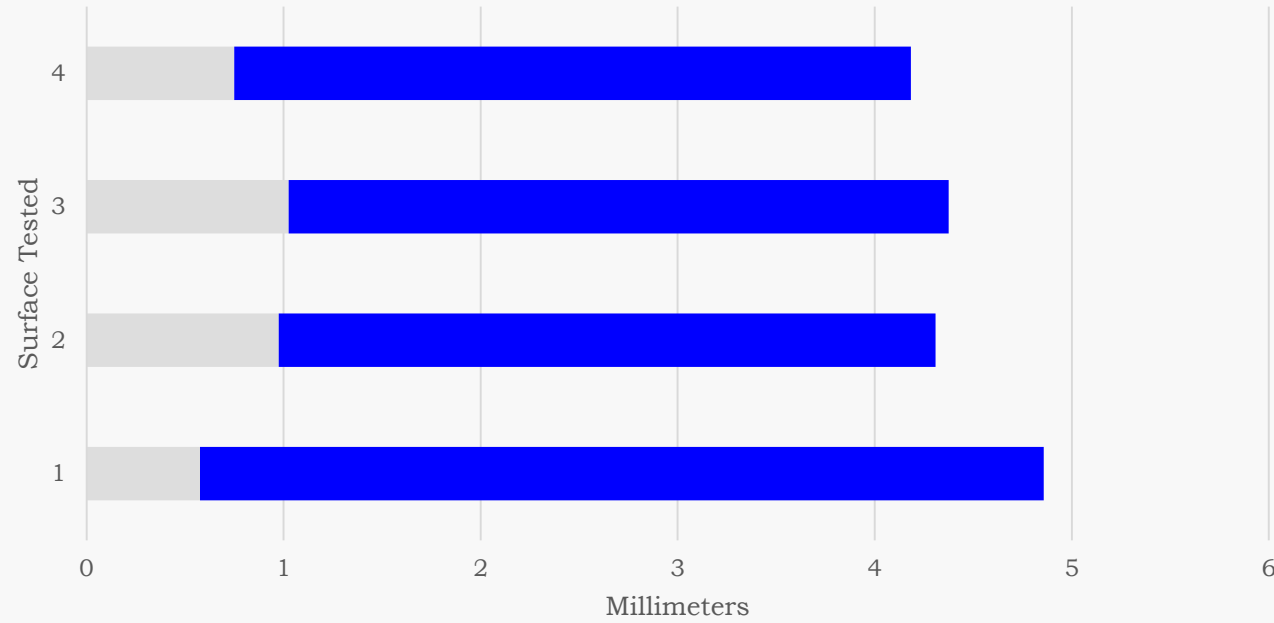


4- Dispersion Silicate Emulsion Stain

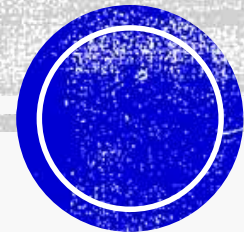




### Water Permeability 24HRS



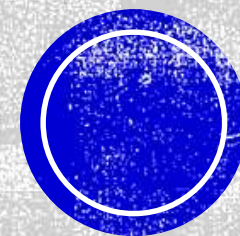
**Water  
Permeability  
Testing  
(continued)**



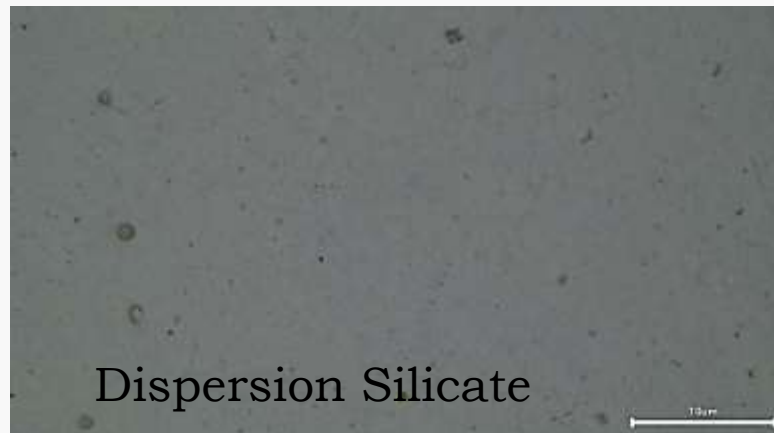
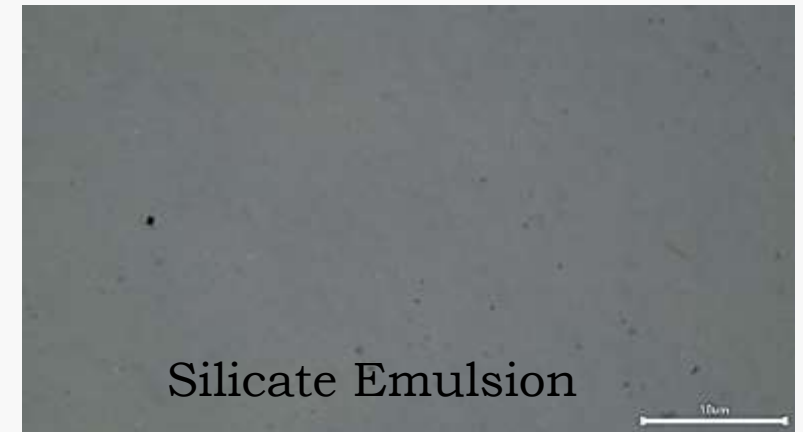


# Freeze-Thaw

Acrylic 1, Silicate Stain 1, Concrete Standard, and Silicate Stain 2

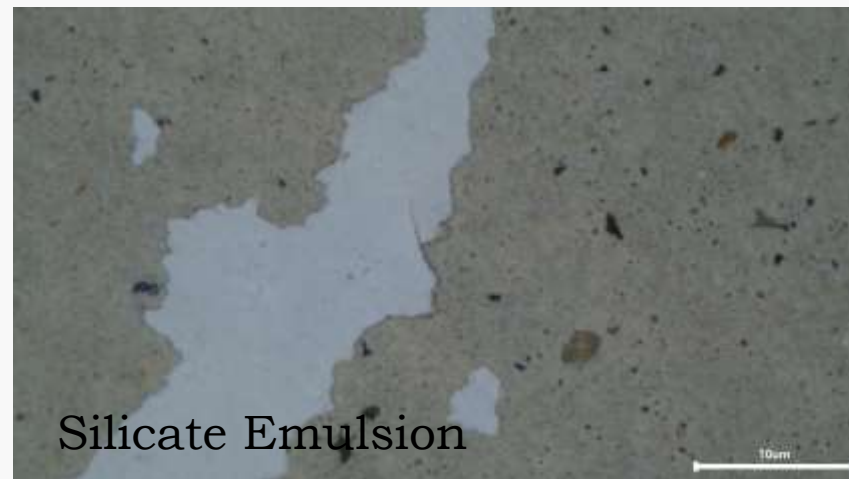
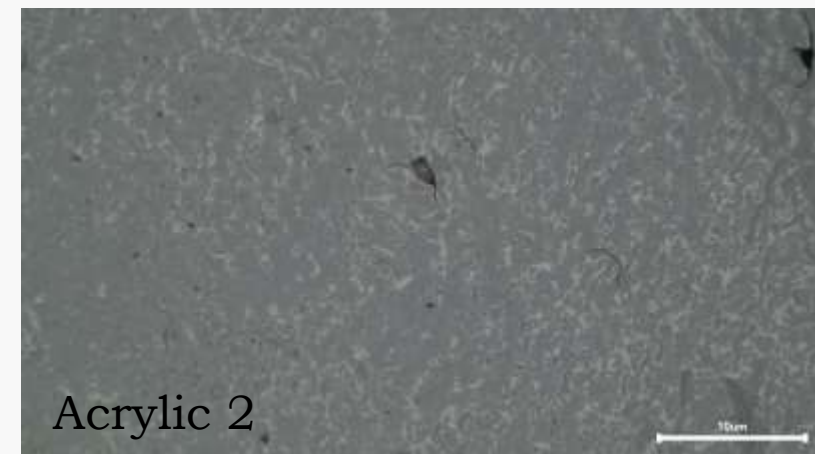
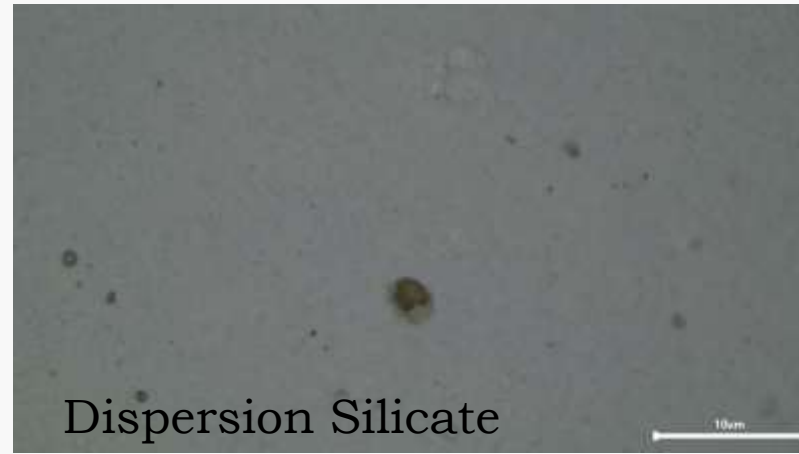


# Samples Being Tested





# 24-Hour Pull Test





# Power Washing Demonstration



# Abrasion Testing

200 ABRASIVE CYCLES

50 ABRASIVE CYCLES



- (1) Thomas, A. Waterborne Silicates Part 2: Silicate Emulsions and Impregnation Materials. *Surface Coatings Australia* **2009**, 14–22.
- (2) Thomas, A. Waterborne Silicates in Coatings and Construction Chemicals; Journal of SCAA, 2009; pp 10–18; 14–22.
- (3) Marx, K. Waterborne Silicate Coatings, 2016.
- (4) Acrylic resin for paint & coatings: Types, properties, application  
<https://coatings.specialchem.com/selection-guide/acrylic-resins-for-coatings>.
- (5) Lewarchik, R. Acrylic resin fundamentals: Coating functions and benefits  
<https://knowledge.ulprospector.com/4320/pc-acrylic-resin-fundamentals/>.
- (6) Oil & Colour Chemists' Association, Australia. *Surface Coatings: Volume 1 Raw Materials and Their Usage*, 3rd ed.; Chapman and Hall: London, England, 1993.
- (7) Poth; Schwalm; Schwartz, H. *Acrylic Resins*; Vincentz Network, 2011.
- (8) *Silicone Dispersions*; Liu, Y., Ed.; CRC Press: London, England, 2019.
- (9) *The Chemistry and Physics of Coatings*, 2nd ed.; Marrion, A. R., Ed.; Royal Society of Chemistry: Cambridge, England, 2004.

# References

