

The logo for GAR Minerals features the letters 'GAR' in a bold, blue, sans-serif font. The letter 'A' is stylized, with a white outline and a red triangle inside. To the right of 'GAR', the word 'Minerals' is written in a blue, sans-serif font.

# **GAR Minerals**

**AN INTRODUCTION TO PUMICE FOR  
PAINTS AND COATINGS**

**CR Minerals** is a privately held company, that specializes in the commercial mining and milling of pumice and pozzolan deposits in the United States. Our history in New Mexico mining dates to 1948, where we have been mining the Rocky Mountain Mine for white pumice. **CR Minerals** pumice is known for its bright white color, consistent chemistry, low density and tightly controlled particle size distribution.

**CR Minerals** state of the art processing plant and lab was commissioned in early 2007, located in Espanola, New Mexico. **CR Minerals** employs the latest in process control and rigorous milling specifications throughout the manufacturing process ensuring the highest quality and consistent pumice products on the market.

**CR Minerals** pumice products line include **Navajo Brand®**, **SafSil®**, **PFM®**, **Tephra®** & **Mine Grade Products**.



# What is Pumice? Is it an Igneous rock?

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Pumice is derived from the Latin word pumex, or foam. Although its origin was initially thought to be hardened sea foam. This is partly attributed to the large rafts of pumice that would reach the Italian shoreline. Much later discovered forming from underwater volcanic eruptions. Pumice is a light-colored, highly vesicular igneous rock that forms during explosive and pressurized lava eruptions. As the atoms present in the mix cool so rapidly pumice is a mineraloid of amorphous glass typically high in silica and alumina.



# How does Pumice form?

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Pressurized gas rushes from deep within the earth and reaches the caldera of the volcano, the vent shreds violently and the supercharged magma blows out as a gas filled molten froth. The froth rapidly solidifies as it flies through the atmosphere while also rapidly cooling as it falls back to Earth. Large and violent eruptions can result in Pumice particles the size of a small car to less than a micrometer. Pumice is not to be confused with volcanic ash or Pumicite.



# Physical Properties of Pumice

## Amorphous Aluminum Silicate

### Low Refractive Index

§ 1.50

### Ultra Low Soluble Salt Content

§ <3,000 ohm-cm

§ Heavy metal free

### Hard and UV Resistant

§ 5.5-6.0

§ Naturally calcined

### Alkaline

§ pH- 9

### Ultra Low Crystalline Silica

§ Non-Crystalline Structure

§ <0.1% Respirable (less than 10 Micron)

### Lightweight and Low Oil Absorption

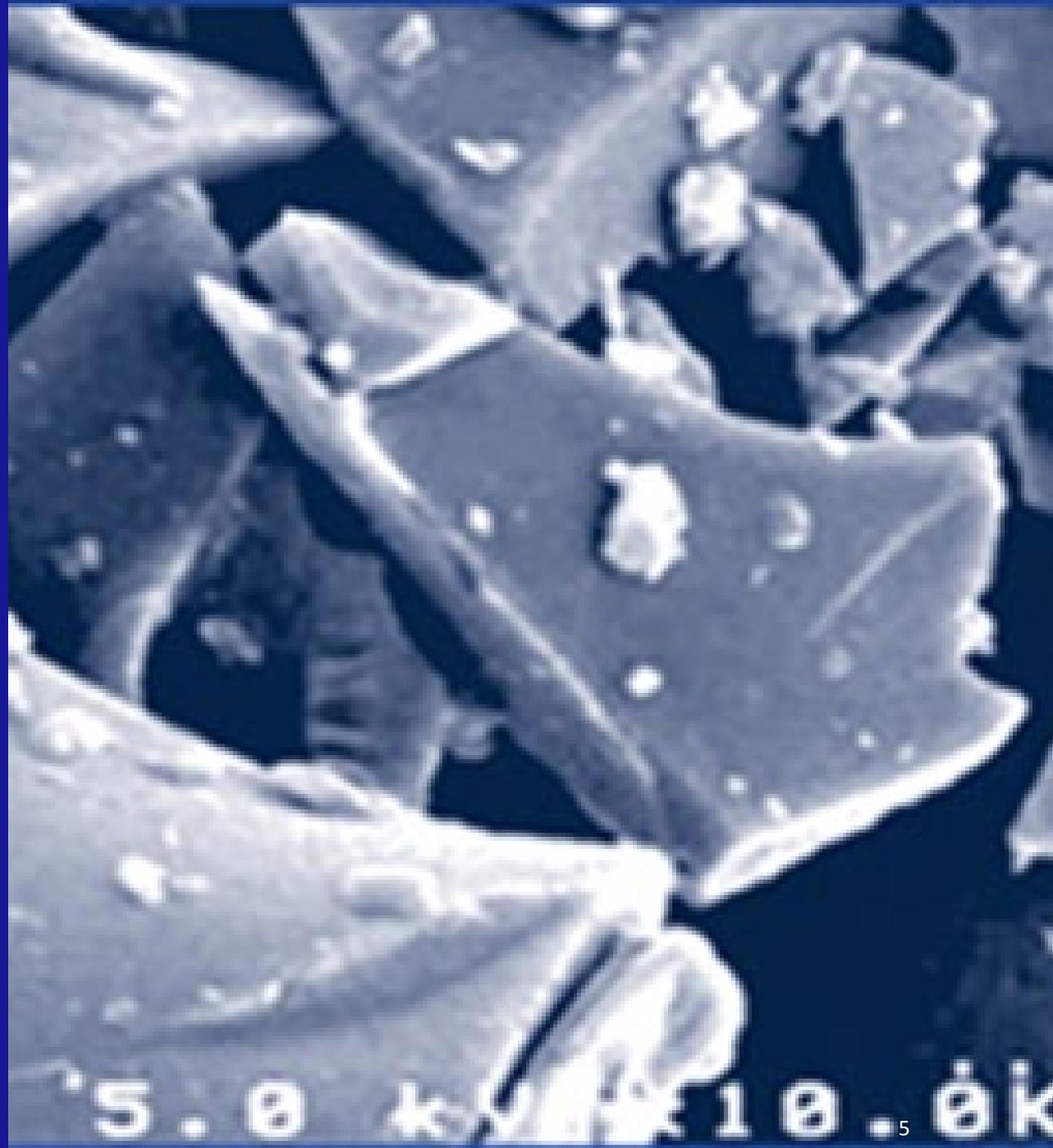
§ Low specific gravity: 2.34

§ 25-28

### Unique Amorphous Morphology

§ Irregular platy particle shape due to glass structure

§ High purity and consistent chemistry





# SafSil® for Paints and Coatings

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CR Minerals' **SafSil®** product line of pumice is available for all coating applications in three tightly controlled particle sizes, 12, 7 and 5 microns MPS. **SafSil** is used as a high performance micronized functional filler, that contains less than 0.1 % respirable crystalline silica <10micron, Amorphous Silica and Alumina in a non-crystalline structure. **SafSil®** offers formulators a high purity naturally calcined mineral with low density and a refractive index of 1.5. With a Mohs hardness of 6, **SafSil®** imparts great interior and exterior durability and abrasion resistance to dry films. **SafSil®** has a pH of 9 that contributes to the minimizing of base (Alkaline), easy to disperse (can be added in the letdown for gloss control) and wet out

**SafSil®** is recommended for use in all coating applications requiring a mineral filler.



# Navajo® Pumice for Paints and Coatings

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CR Minerals' **Navajo**® product line ranges in particle size from U.S mesh 6 to 5 microns. Formulators in the coatings industry have incorporated pumice into water-borne, solvent and UV cure applications benefiting from the chemical inertness and durability of pumice. **Navajo**® pumice is a naturally calcined resulting in a low-density, high brightness amorphous silica that has a unique particle morphology. **Navajo**® pumice imparts many desirable properties formulators are looking for to optimize formulations with a high-performance chemical resistant mineral filler.

**Navajo**® brand is recommended for texture applications, anti-skid, fire retardant, insulating and other specialty coatings that require larger particle sizes.

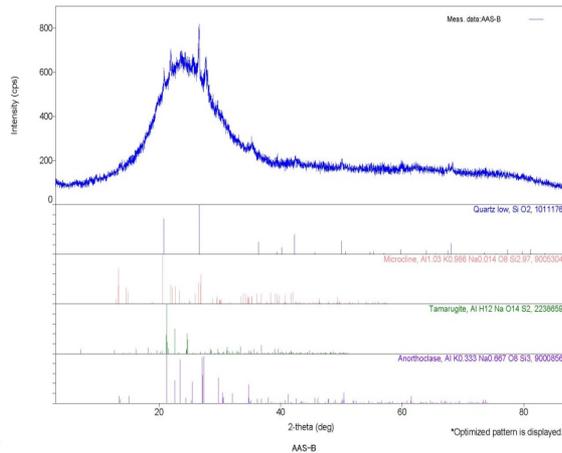
# Key Mineral Properties for Coating Applications

MINERALOGY- CHEMISTRY  
AND CRYSTAL STRUCTURE

PHYSICAL PROPERTIES-  
MOHS HARDNESS, OIL  
ABSORPTION, PH,  
REFRACTIVE INDEX,  
SOLUBLE SALT CONTENT

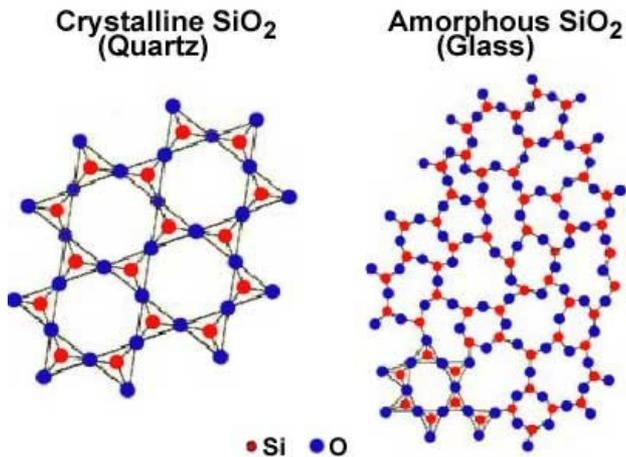
PARTICLE SIZE AND  
PARTICLE SIZE  
DISTRIBUTION





# Geochemistry of Pumice

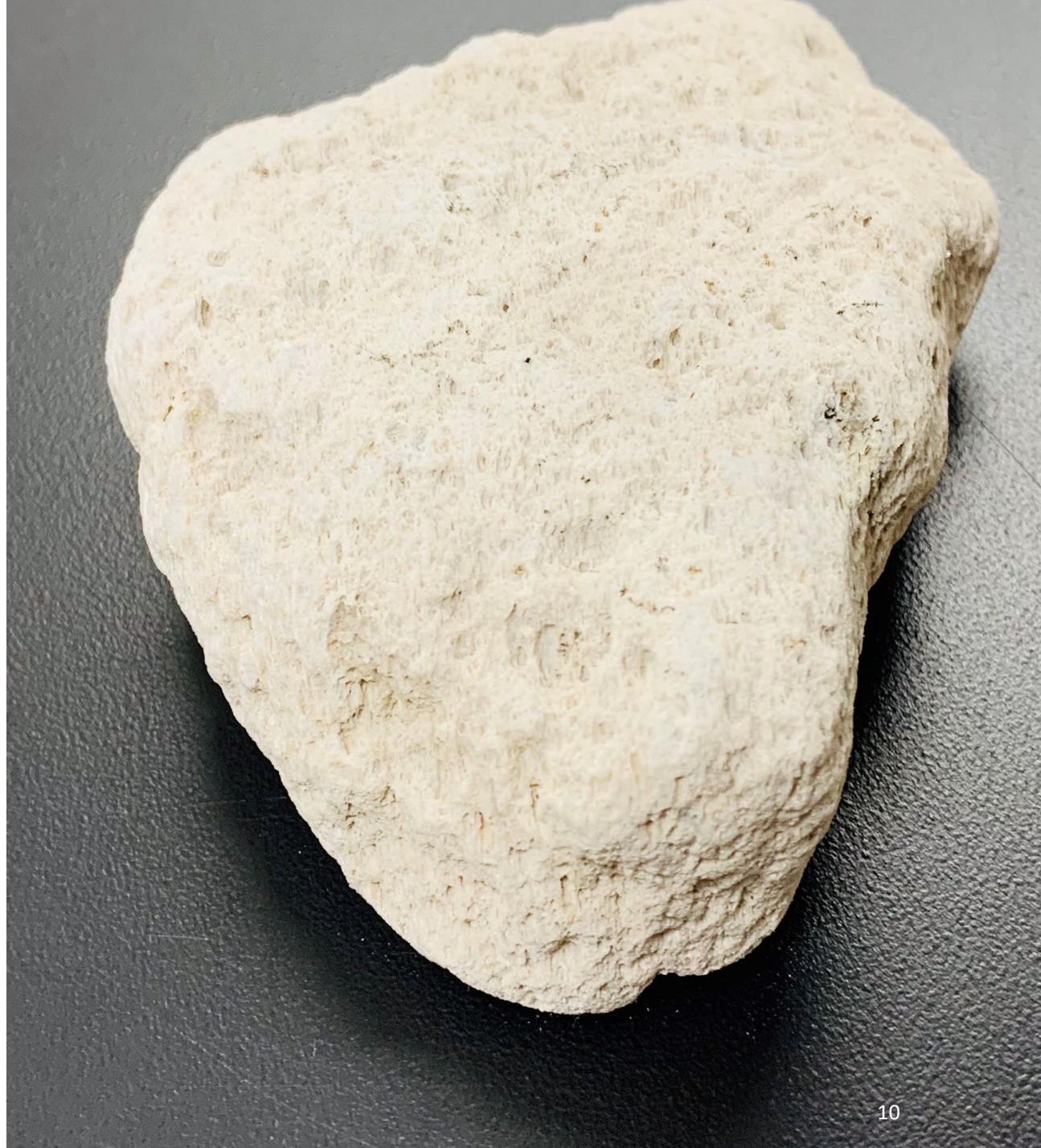
- Pumice is a mineraloid or felsic glass with an SiO<sub>2</sub> content greater than 65%. Pumice is commonly called, Amorphous Aluminum Silicate, with the mineralogy controlled by the source magma.



# Chemical Composition of Pumice

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<u>Chemical Name</u>	<u>Formula</u>	<u>Percent</u>
Silicone Dioxide	SiO <sub>2</sub>	73
Aluminum Oxide	Al <sub>2</sub> O <sub>3</sub>	12
Potassium Oxide	K <sub>2</sub> O	<4
Sodium Oxide	Na <sub>2</sub> O	<4
Calcium Oxide	CaO	<2
Magnesium Oxide	MgO	<2
Titanium Dioxide	TiO <sub>2</sub>	<2
Ferric Oxide	Fe <sub>2</sub> O <sub>3</sub>	<2
Water	H <sub>2</sub> O	<1

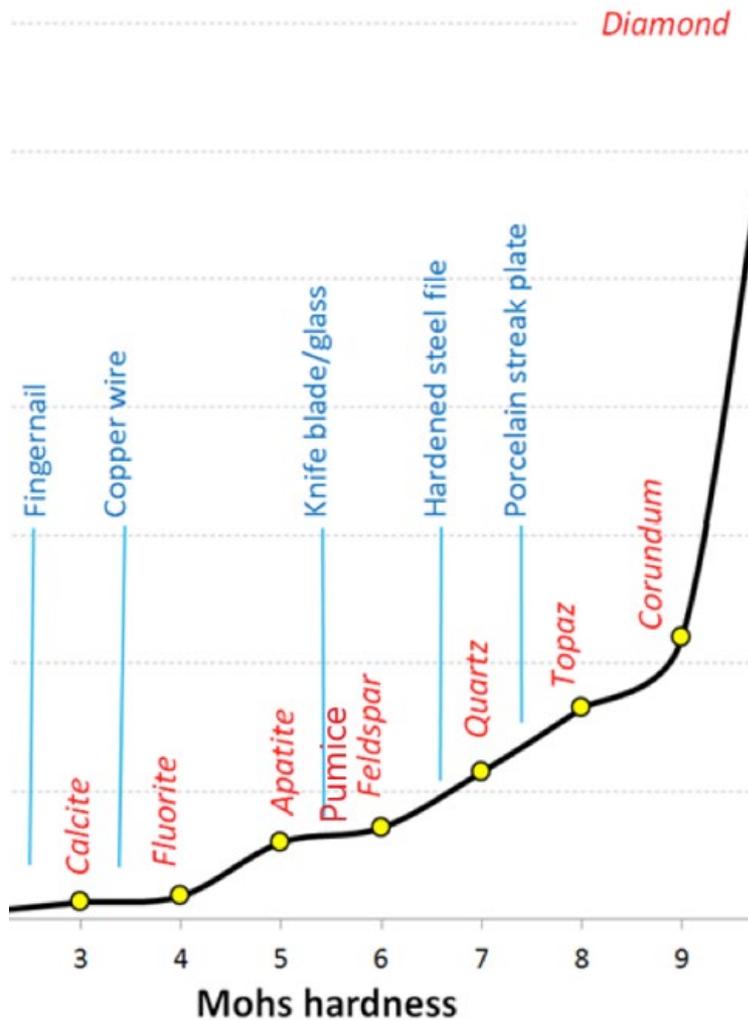


# Oil Absorption of Pumice

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Filler	Typical Oil Absorption (g/100g)
Barium Sulfate	8-15
Calcium Carbonate	15-20
Wollastonite	20-40
SafSil	25-30
Nepheline Syenite	20-40
Talc	20-45
Mica	30-80
D.E.	120-160

Oil absorption of a mineral filler is calculated by the amount of Linseed oil the mineral will absorb (ASTM D281). Particle size, surface area and density of the mineral are key factors for oil absorption. The greater the oil absorption, the more resin the mineral will absorb in the coating leaving less free binder.



# Mohs Hardness of Pumice

- Mohs Hardness is a relative measure of the abrasion resistance of a mineral. Of the minerals typically formulated into coatings, Talc is the softest and Silicon Carbide is the hardest. A general rule of thumb when formulating suggest that the harder the mineral the better scrub (durability) and burnish resistance (change in sheen) the coating will have.

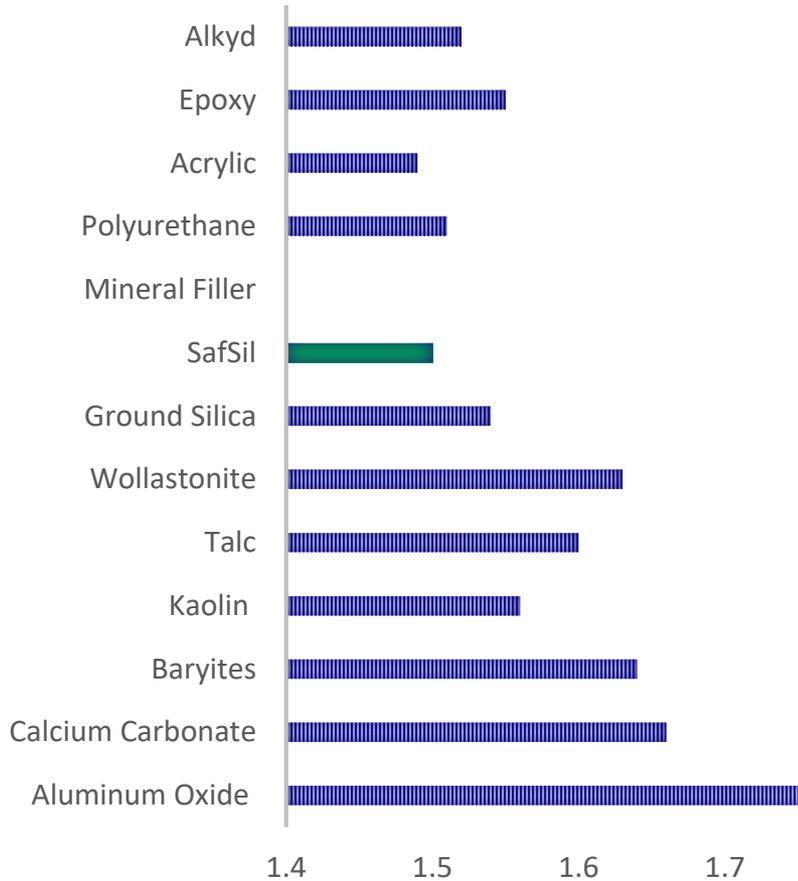


## Water-Soluble Salts in Mineral Fillers (ASTM D2448)

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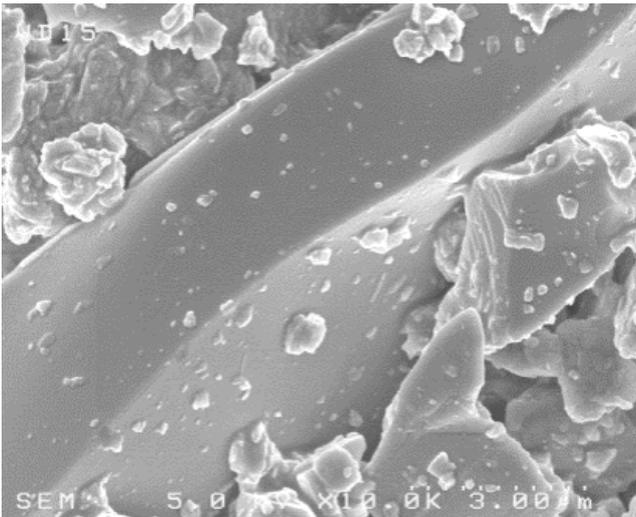
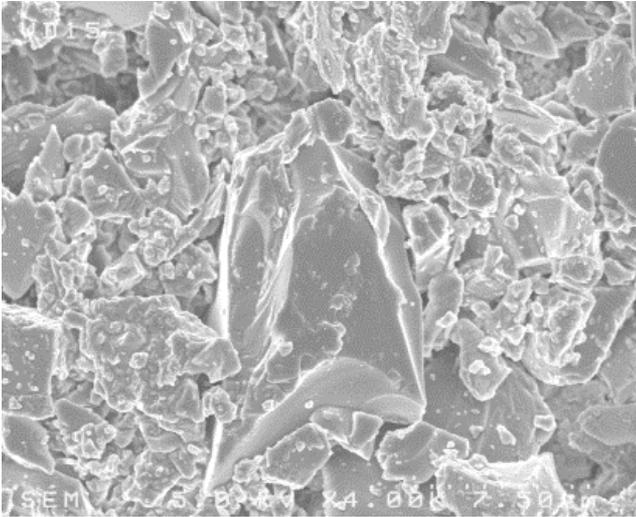
- Water-soluble salts in mineral fillers, can adversely affect the corrosion resistance of the coating and drastically increase the blistering of the paint film. Pumice has a soluble salt content less than 3,000 ohm-cm, that lends towards better stability of the coating. In exterior coating applications, higher soluble salt content can attribute to blistering, decreased corrosion resistance, poor in-can stability.

## REFRACTIVE INDEX VS TYPICAL RESIN SYSTEM



## Refractive Index of Pumice

- In optics, refractive index of a material is described how light travels or bends through a medium in a vacuum. Pumice has a relatively low refractive index of 1.50, like many commercially available resins. Clarity can be achieved, with proper formulation of resin refractive index and pigment refractive index when they mirror each other.

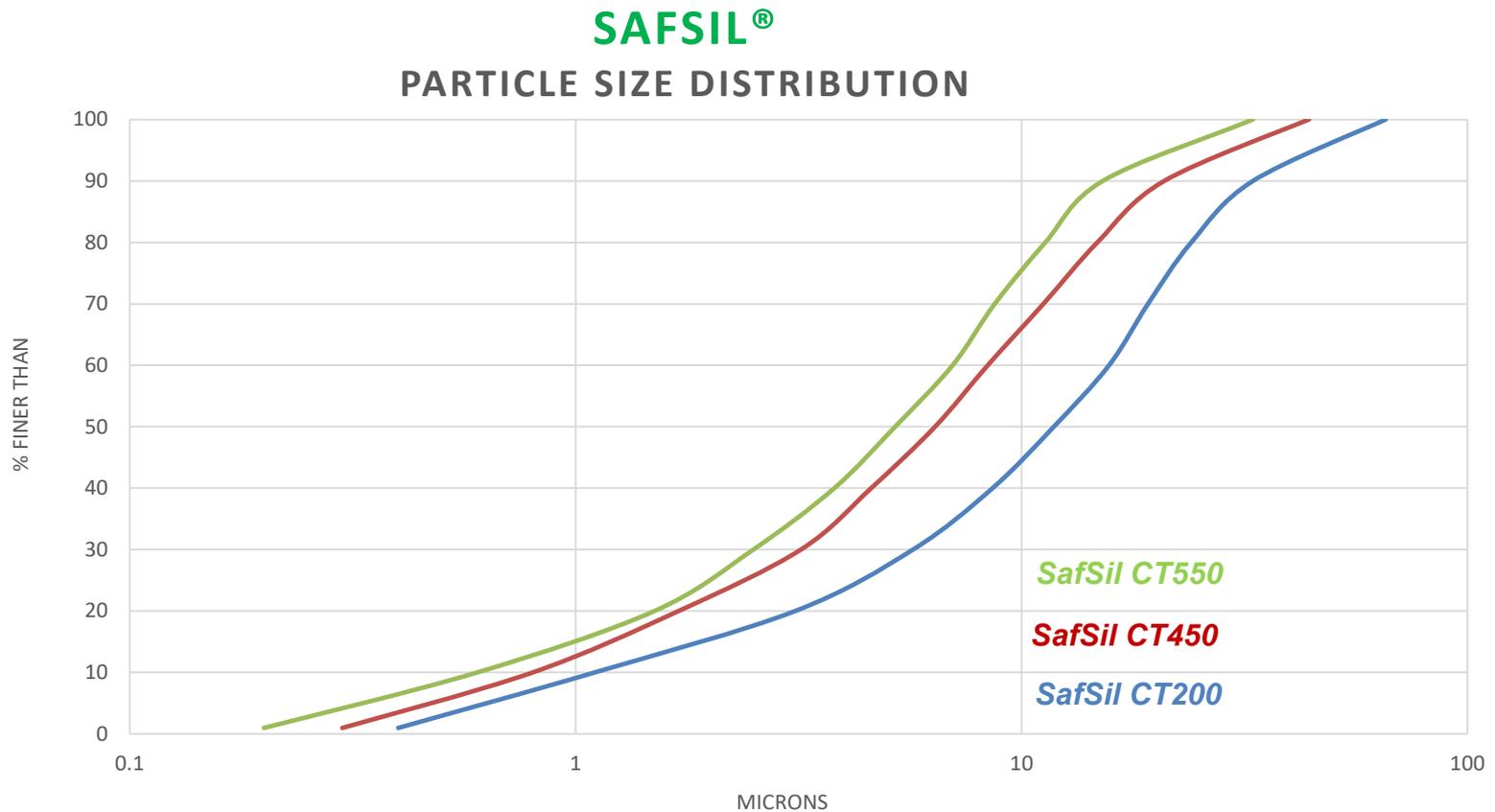


## Particle Shape of Pumice

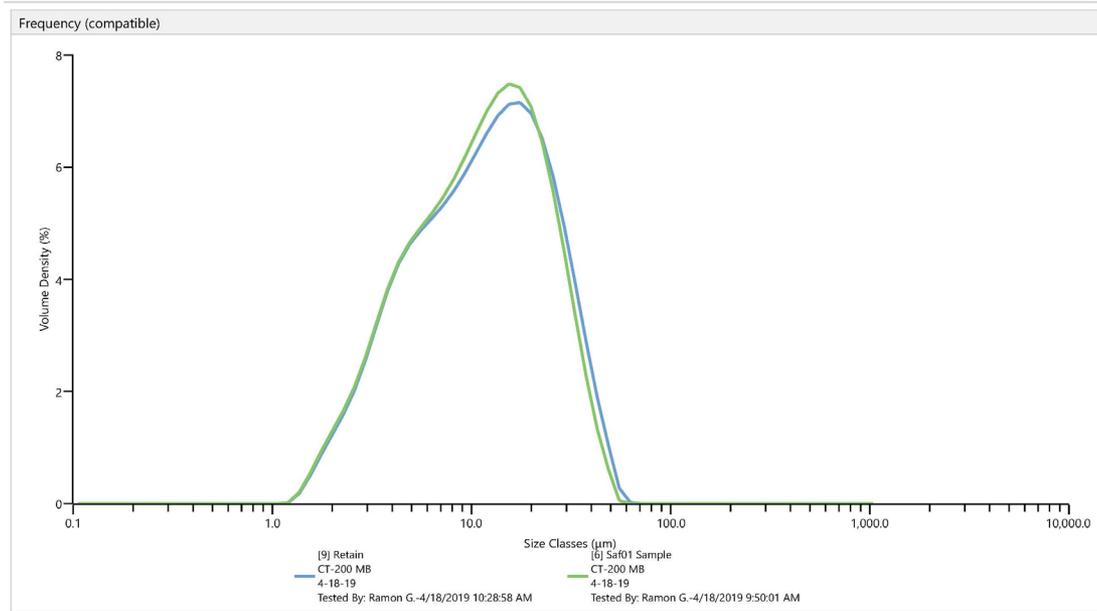
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- SafSil® is a micronized volcanic glass with an irregular and angular or semi-platy shape. Minerals are classified by screen analysis but not all particles are spherical. So careful consideration must be made when selecting different minerals for only median particle size.

# SafSil<sup>®</sup> Particle Size Distribution by RoTap<sup>®</sup>



## Result overlay



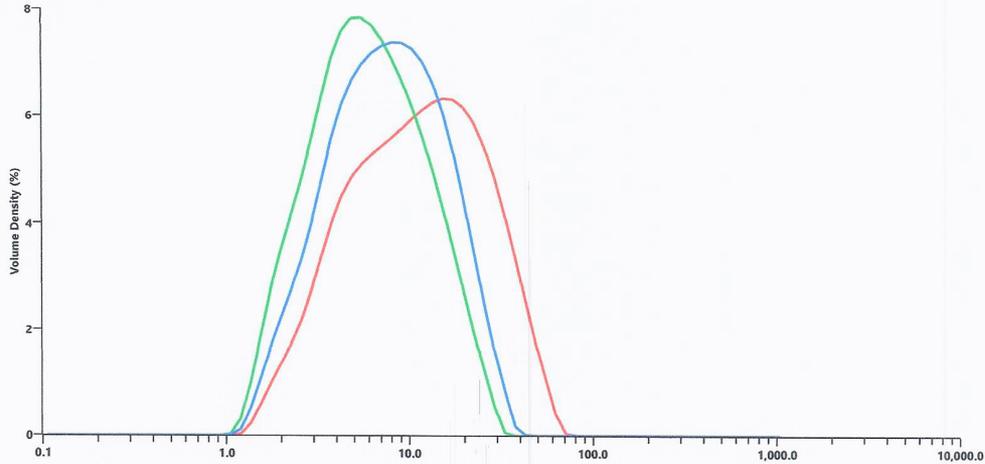
Trend

	Record Number	Sample Name	Dx (10) (µm)	Dx (50) (µm)	Dx (90) (µm)
	9	RetainSample CT-200 MB 4-18-19 Tested By: Ramon G.	3.54	11.7	29.5
	6	Saf01 Sample CT-200 MB 4-18-19 Tested By: Ramon G.	3.48	11.3	27.4
	<b>Mean</b>		<b>3.51</b>	<b>11.5</b>	<b>28.5</b>
	<b>1xStd Dev</b>		<b>0.0436</b>	<b>0.267</b>	<b>1.49</b>
	<b>1xRSD (%)</b>		<b>1.24</b>	<b>2.32</b>	<b>5.25</b>

# Laser Diffraction Analysis by Malvern SafSil® CT200 and SafSil® CT200PC

## Result overlay

Frequency (compatible)



— [30] T000029 (29)  
 CT-200-1000-LBS  
 006280/010720  
 Tested By: Jesus Delacruz-1/8/2020 1:12:54 AM

— [303] T000001 (1)  
 CT-550-50-LBS  
 005851/010419  
 Tested by: Jose Gonzalez-1/4/2019 6:17:20 AM

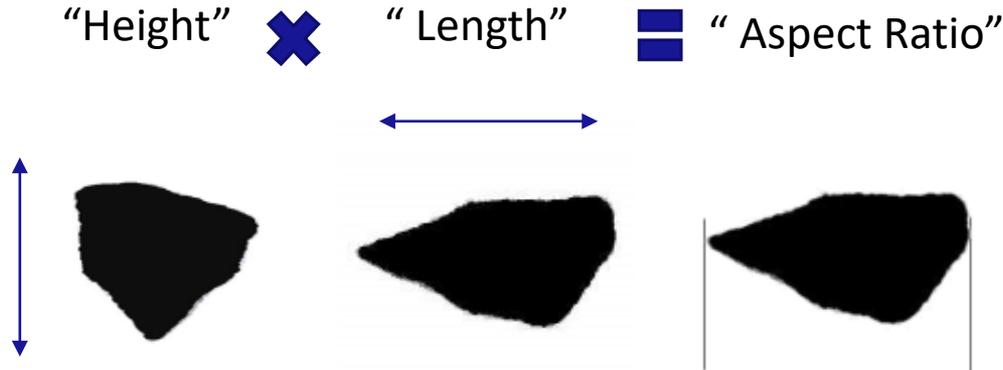
— [8] T000230 (5)  
 CT-450-50-LBS  
 006212/102919  
 Tested By: Jose Gonzalez-10/29/2019 3:41:44 PM

Trend

Record Number	Sample Name	Dx (10) (µm)	Dx (50) (µm)	Dx (90) (µm)
30	T000029 (29) CT-200-1000-LBS 006280/010720 Tested By: Jesus Delacruz	3.41	11.3	32.4
303	T000001 (1) CT-550-50-LBS 005851/010419 Tested by: Jose Gonzalez	2.31	5.87	15.4
8	T000230 (5) CT-450-50-LBS 006212/102919 Tested By: Jose Gonzalez	2.79	7.61	19.1
Mean		2.84	8.27	22.3
1xStd Dev		0.552	2.79	8.92
1xRSD (%)		19.4	33.7	40.0

# Laser Diffraction Analysis by Malvern SafSil®

# Defining the Size of Pumice



- Aspect ratio refers to the critical lateral dimension to the height of a given particle or microstructure.
- Cubes and Spheres have a 1:1 ratio
- Blocks are typically 2:1 -4:1 ratio
- Plates and Flakes are 20:1 to 200:1
- SafSil depends on the size of the particle by both laser and sieve analysis

# SafSil® Key Benefits Summary

## Ultra Low Crystalline Silica

- less than 0.1% respirable crystalline silica

## Abrasion and Scratch Resistance

- Mohs Hardness of 6 improves wet-scrub of interior coatings

## Inert

- Acid and chemical resistance

## Low Soluble Salt

- Exterior durability-weathering, chalking and frost resistance

## Sheen Uniformity

- Reinforces and creates tighter film for gloss control

## Touch-Up

- Improves pigment orientation to enhance touch-up properties

## Stain Removal

- Improved hardness of film and washability properties

## Heat Resistance

- Specialty coatings and powder coating applications

# SafSil® Key Benefits Summary Continued

## Low Oil Absorption

- 25-28 per ASTM D281

## Tint Retention

- Naturally Calcined for superior UV resistance and weatherability

## Block Resistance

- Non-stick mineral properties allow for faster re-coat time

## Clarity

- Refractive index of 1.50 allows for transparency in certain binder systems

## Ease of Dispersion

- Low Van der Waals forces, allows for post addition or low shear dispersion

## Burnish Resistance

- Low change in sheen does not become polished after abrasion

## UV Curing Capability

- Being transparent does not block the curing mechanism

## Sandability

- Glass like chemistry allows for great sandability and provides “tooth” for the topcoat



**SafSil®**

**INTERIOR WALL PAINT BENEFITS  
QUALITY FLATS & SATIN PAINTS**

# SafSil® Interior Wall Paint Value Added Solutions

## Ø Improve Flatting Efficiency

- Ø With a tightly controlled particle size distribution, SafSil diffuses light from the dry film giving a smooth and deep matting effect

## Ø Improve Scrubability

- Ø SafSil with its glassy matrix and Mohs Hardens imparts a durability in the paint film that will considerably increase the wet scrub and abrasion resistance of the coating.

## Ø Stain Blocking and Tighter Film formation

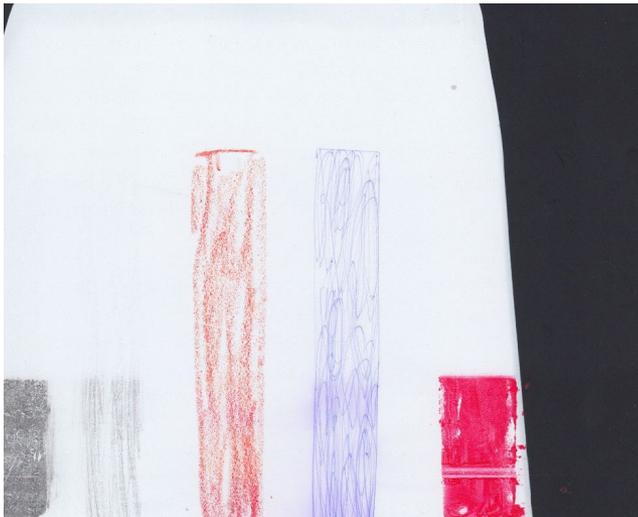
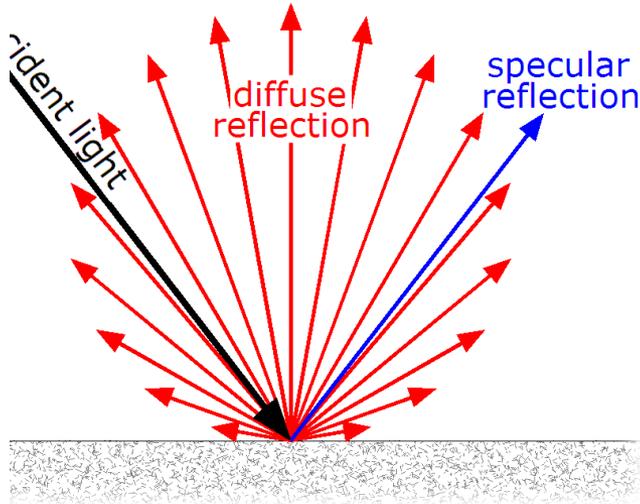
- Ø The irregular and angular particle shape of SafSil creates a physical particle packing barrier that will help pass MPI specs for stain removal

## Ø Tighter Film Formation

- Ø SafSil is excellent for reducing the mud-cracking or crack propagation in the film

## Ø Increased Burnish Resistance

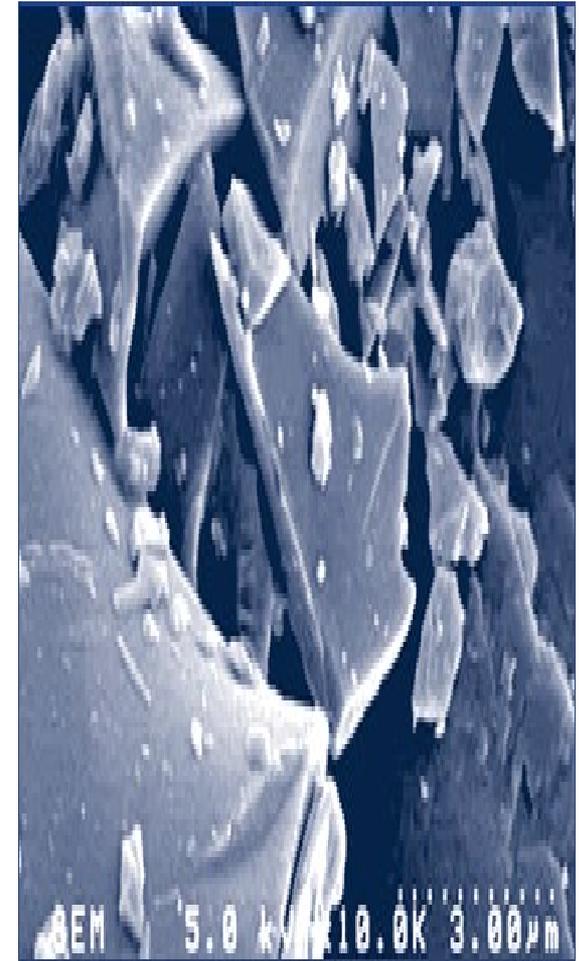
- Ø SafSil does not polish or become shiny (change in sheen) when rubbed.



# SafSil<sup>®</sup> Grades for Coatings Applications

## Typical Physical Properties

	CT200	CT450	CT550
Median Particle Size (Microns)	12	7	5
Hegman Grind	2	4.5	5.5
Oil Absorption (ASTM D281)	26	27	29
GE Brightness	77	78	80
Specific Gravity	2.34	2.34	2.34
Wt./Gal	19.5	19.5	19.5
Hardness, Mohs Scale	5.5 - 6.0	5.5 - 6.0	5.5 - 6.0
Refractive Index	1.5	1.5	1.5
pH (10% in Water)	9	9	9
Moisture Content	<1%	<1%	<1%



## SafSil® Minerals Properties Comparison

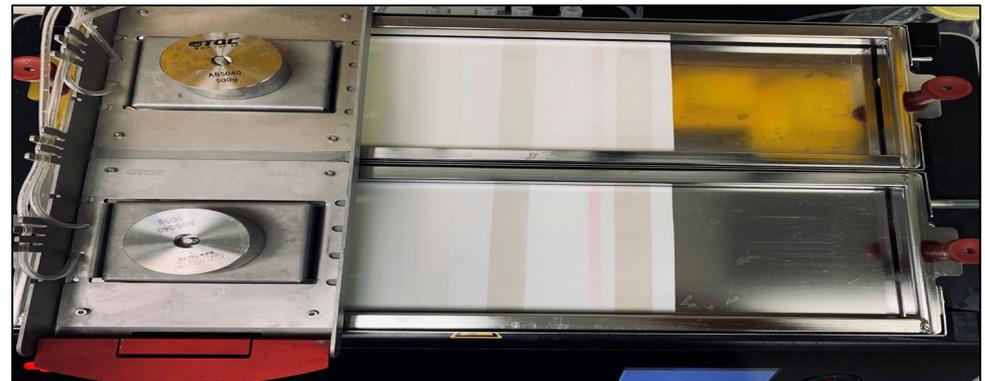
	pH	OA	REF.	LBS/GAL	MOHS	RI	INERT
BARYTES	8 - 8.5	9 - 14	80 - 95	36.6	3	1.64	YES
CALCIUM CARBONATE	9 - 10	8 - 18	91 - 95	22.6	3	1.66	NO
KAOLIN	4 - 5.5	30 - 45	80 - 92	21.9	2	1.56	YES
TALC	9.4	25 - 55	80 - 90	23.7	1 - 1.5	1.6	YES
WOLLASTONITE	9.8	20 - 30	85 - 93	24.2	4.5	1.63	NO
<b>SafSil®</b>	<b>9</b>	<b>26 - 29</b>	<b>77 - 81</b>	<b>19.5</b>	<b>5.5 - 6</b>	<b>1.5</b>	<b>YES</b>
GROUND SILICA	6 - 8	18 - 42	80 - 92	22.1	6.5 - 7	1.54	YES
FELDSPAR	8 - 9	19 - 28	89 - 94	21.6	6 - 6.5	1.53	YES
NEPHELINE SYENITE	9 - 10	22 - 34	86 - 90	21.7	5.5 - 6	1.55	NO
DIATOMITE	9 - 10	120 - 160	85 - 90	19.2	5.5 - 6	1.48	YES

# SafSil® Properties Comparison

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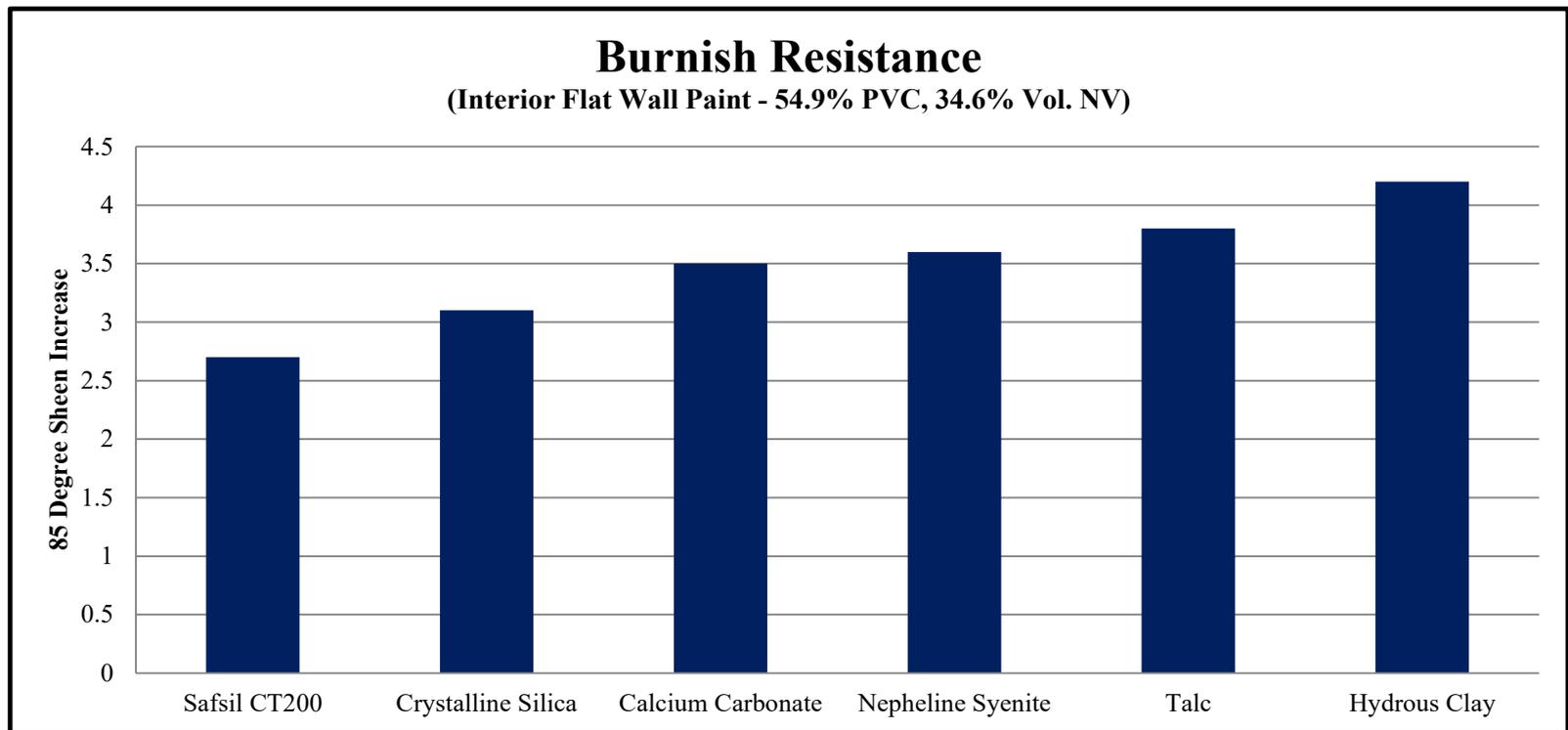
Components	Pounds Per 100 Gallons
Water	382.9
Natrosol Plus 330	7
Mergal K10N	1.5
AMP-95	2
Tamol 1124	6.2
Propylene Glycol	8.6
Drewplus L475	1.8
Triton 10	2.2
KTPP	1.0
Tronox 826	200
Iceberg	162.5
SafSil CT200	108.6
• Grind	
Rovace 9900	274.5
Texanol	4.9
Drewplus L475	3.6
Rodafac RS410	2.1
Total	1172.4
PVC	54.90%
Volume Solids	34.60%
VOC	<50g/l

# SafSil® Quality Flat with Scrubability and Burnish Properties



# SafSil<sup>®</sup> Interior Wall Paint Burnish Resistance

➤ **SafSil<sup>®</sup>** outperformed other performance mineral fillers for Burnish Resistance ASTM D-6736



Navajo®  
Quality Flat  
with 100lbs  
per 100  
gallons Grade  
3 and 4

#3

#4



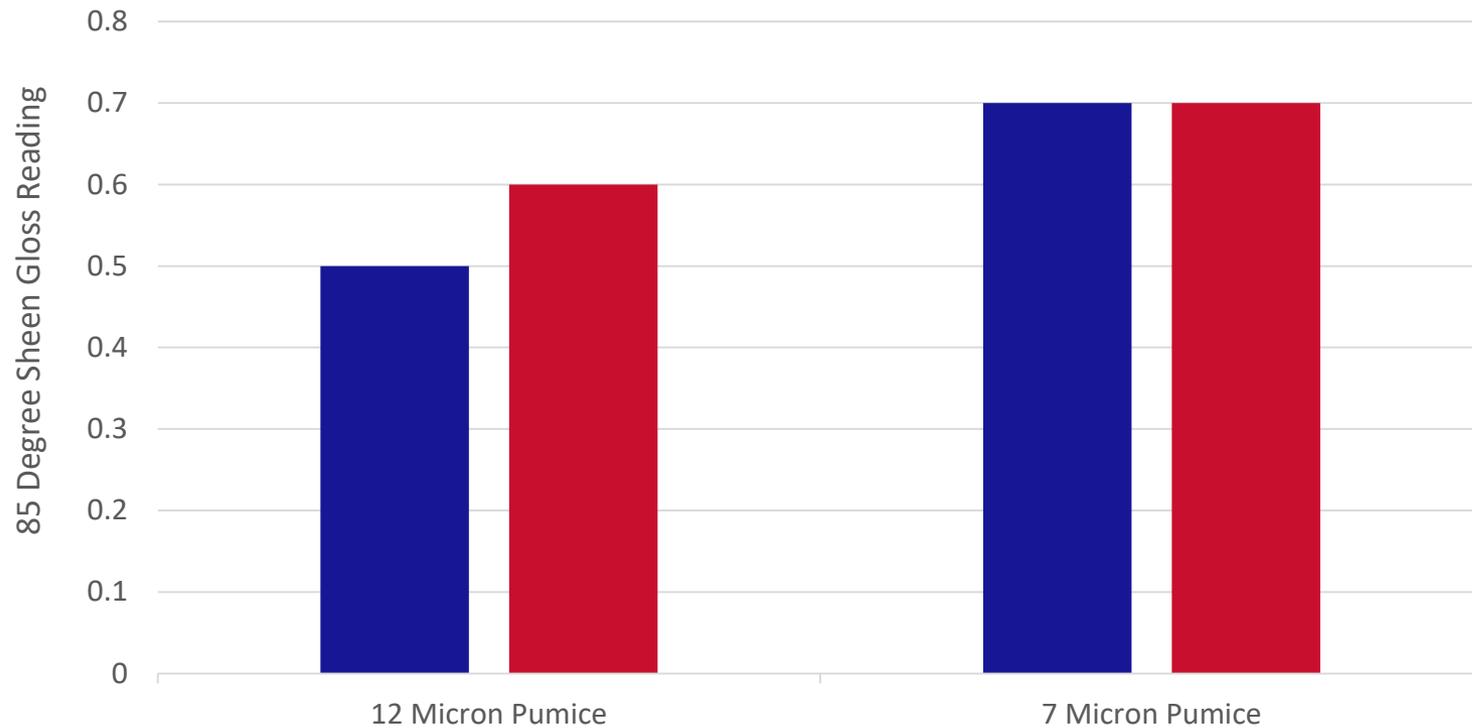
Components	Pounds Per 100 Gallons
Water	429.8
Natrosol 250 HR	3.0
Min-U-Gel 400	5.0
Superspurse 95	1.0
Tamol 1124	7.5
Mergal 758	2.4
BYK 035	1.8
Triton 10	2.3
KTPP	1.0
TR 93	125
Mattex Pro	117.4
SafSil CT200	100.0
• Grind	
Avicor 7480	100.0
Texanol	5.9
BYK 035	1.8
Acrysol DR180	8.8
Water	119
Total	1132.7
PVC	76.80%
Volume Solids	24.50%
VOC	<25g/l

# SafSil® Contractor Flat with Good Touch-Up and Sheen Uniformity



# SafSil<sup>®</sup> Contractor Flat

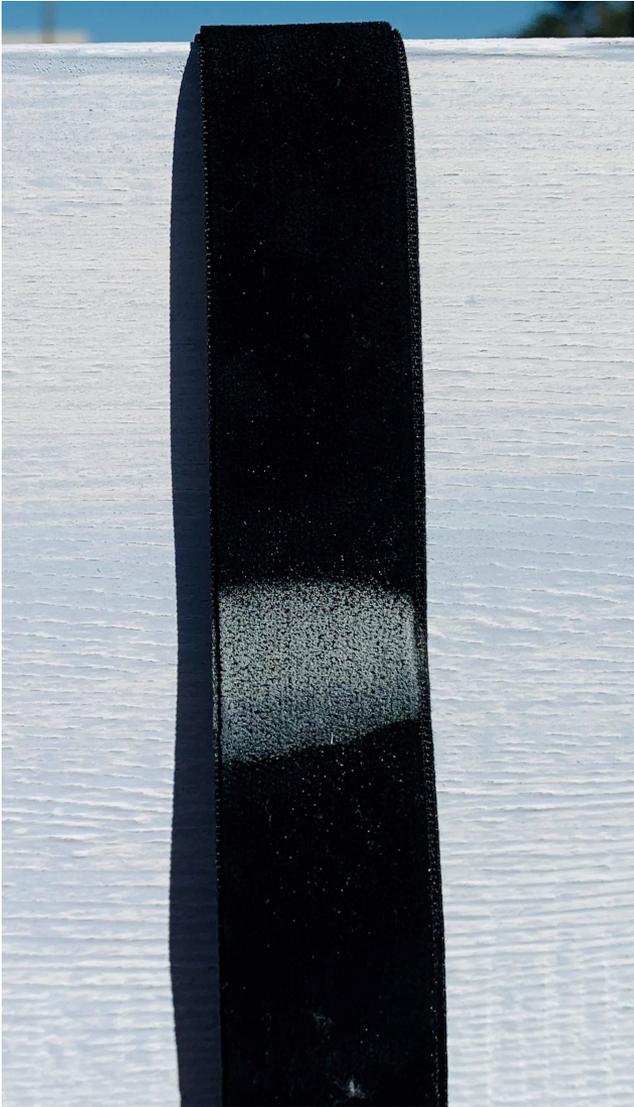
Flattening Efficiency-100lbs/100gal  
Contractor Flat 76.8% PVC 24.5% Vol NV.





SafSil®

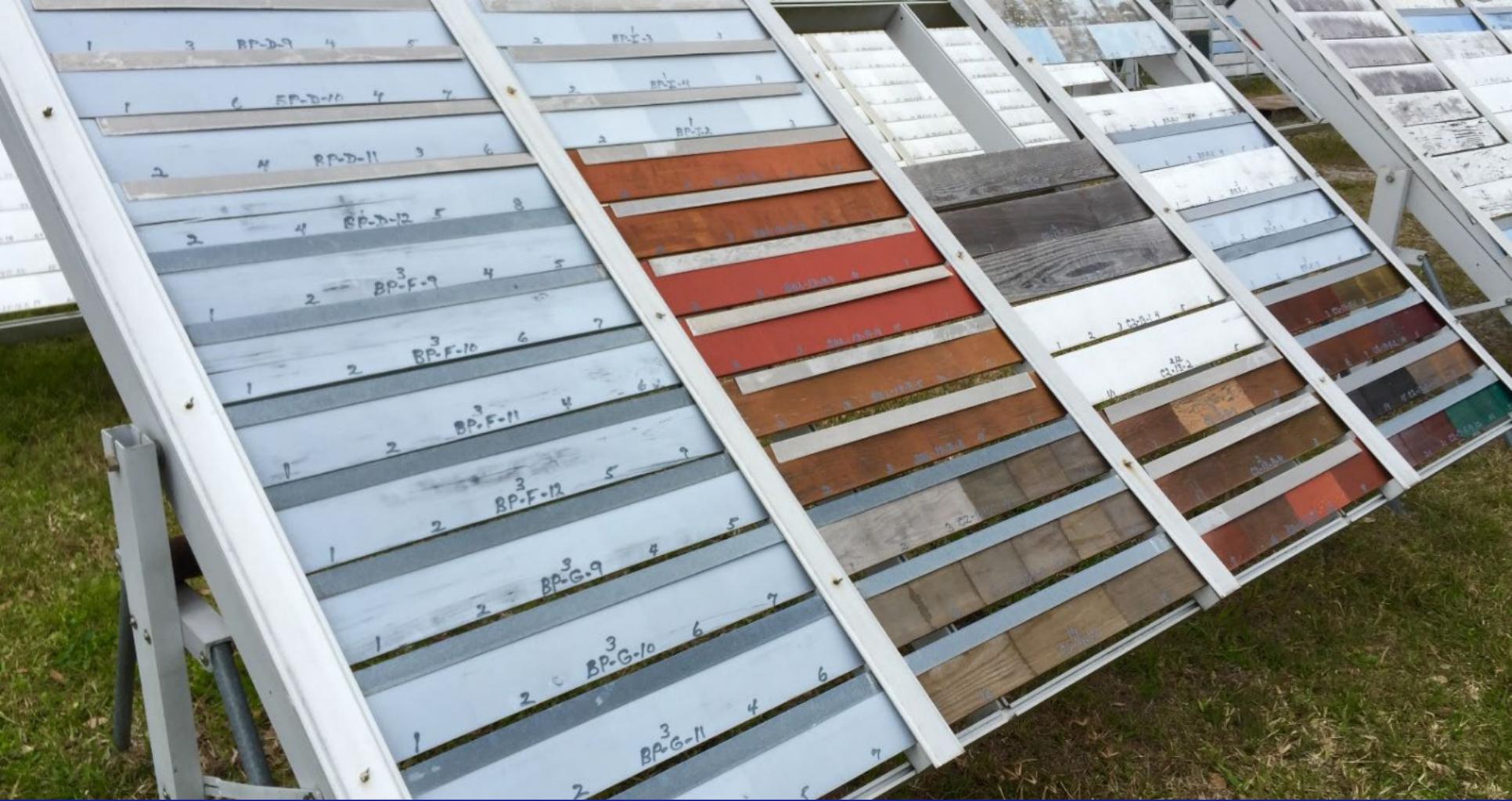
EXTERIOR PAINT & STAIN BENEFITS



## SafSil<sup>®</sup> Increase Outdoor Weatherability and Durability

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- ✓ Outstanding tint retention
- ✓ Chalking Resistance
- ✓ Improved weathering and barrier properties
- ✓ Improved film hardness & corrosion resistance
- ✓ Acid and UV resistance

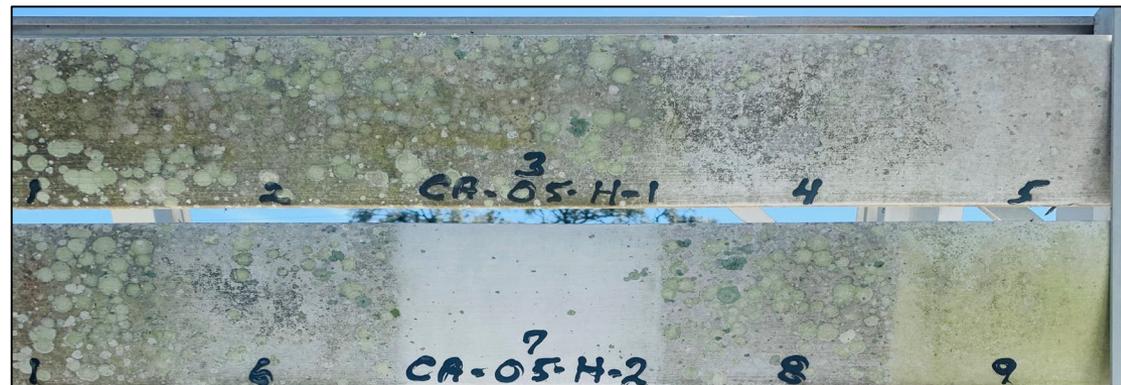


# SafSil® Exterior Paint and Stain Testing Results

EXTERIOR EXPOSURES IN SOUTH FLORIDA

Components	Pounds Per 100 Gallons
Water	325.5
Natrosol 250MHBR	5
Mergal K10N	1.5
AMP-95	2
Tamol 1124	6.2
Propylene Glycol	11.3
Drewplus L475	1.8
Triton 10	2.2
KTPP	1.0
Tioxide TR 93	170
Attagel 50	5.0
SafSil CT200	207.4
• Grind	
Rhoplex ML400	345.5
Texanol	11.1
Drewplus L475	3.6
Fungitrol 720	6.0
Strodex NB20	2.0
Total	1111.2
PVC	44.10%
Volume Solids	35.30%
VOC	<50g/l

# SafSil® Exterior Flat Tint Base with Tint Retention and Anti-Mold Properties



# SafSil<sup>®</sup> Outdoor Lightfastness

SAFSIL<sup>®</sup> OUTSTANDING TINT RETENTION AND ANTI-MOLD PROPERTIES 18 MONTH SF 45

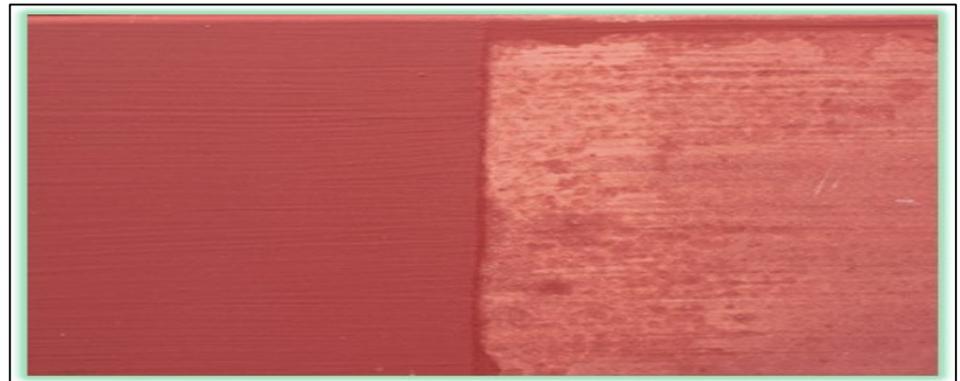


Paint 5- SafSil CT 200

Paint 6- SafSil CT 450

Components	Pounds Per 100 Gallons
Water	277.9
Natrosol 250MHBR	5
Mergal K10N	1.5
AMP-95	2
Tamol 1124	6.2
Propylene Glycol	11.3
BYK 022	1.8
Triton 10	2.2
KTPP	1.0
Tioxide TR 93	170
Attagel 50	5.0
SafSil CT200	207.4
• Grind	
Rhoplex ML200	371.8
Texanol	9.9
BYK 022	3.6
Fungitrol 720	6.0
Strodex NB20	2.0
Total	1085.4
PVC	45.20%
Volume Solids	35.30%
VOC	<50g/l

# SafSil® Exterior Flat, Deep Tint Base, with Tint Retention and Acid Resistance



# SafSil® Outdoor Lightfastness

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Exterior Deep Tint Base Acrylic Flat paints 18-month exposure South Florida 45



**PAINT#**

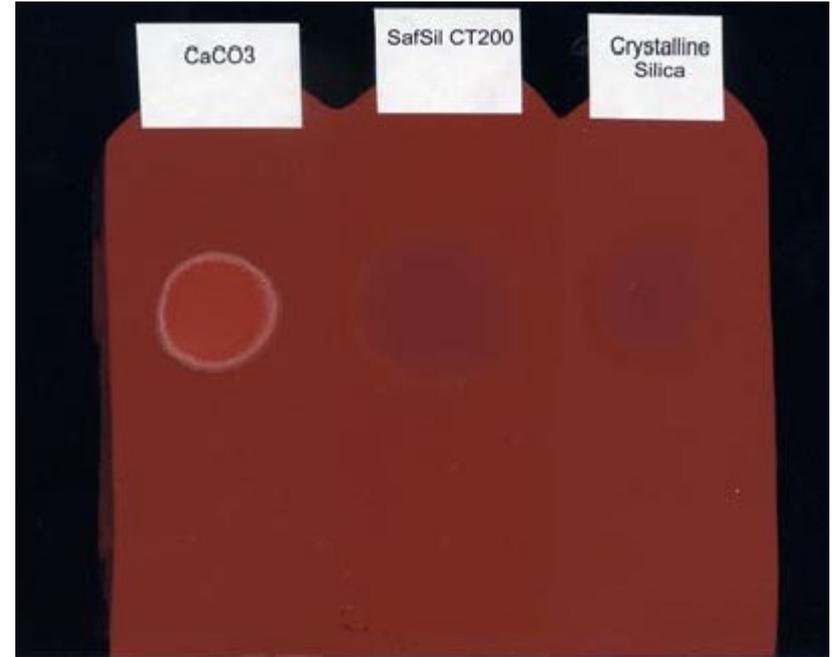
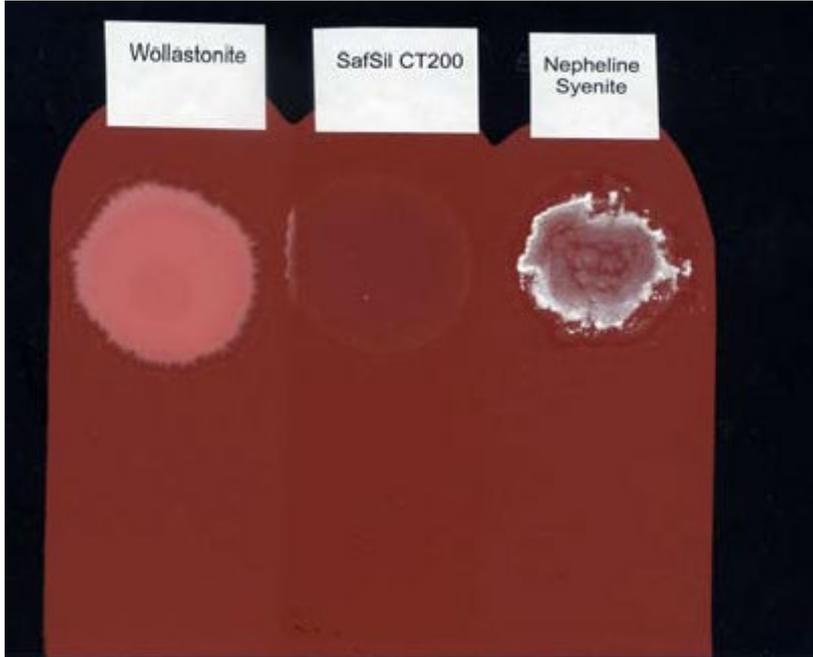
- 1. Silica – 8 $\mu$**
- 2. Pumice – 12 $\mu$**
- 3. Pumice – 7 $\mu$**
- 4. Nepheline Syenite – 7 $\mu$**

**TINTED 888-"B" 8Y / GALLON**

# SafSil® Accelerated Weathering

- 4000 Hours QUV, Exterior Enamel.





# SafSil<sup>®</sup> Acid Resistance Spot Test

TESTING WAS PERFORMED WITH 5% SULFURIC ACID ON A FULLY CURED EXTERIOR COATING.



## SafSil® Acid Resistance- Exterior Flat Deep Base- on Primed Cement Board

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# SafSil<sup>®</sup> Improves Outdoor Coatings

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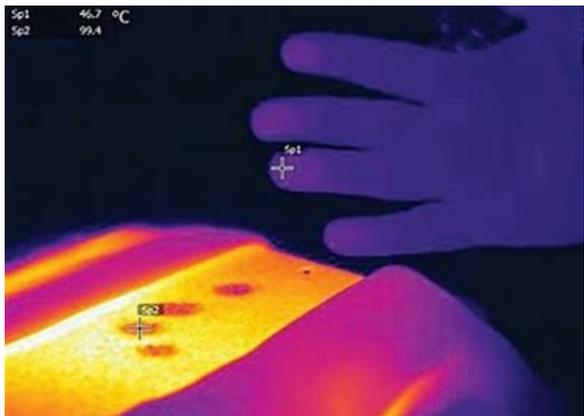
- ✓ House paints
- ✓ Wood and deck stains
- ✓ Barn paints
- ✓ Wood deck and concrete restoration paints



# SafSil<sup>®</sup> Improves Industrial Coatings

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- ✓ Chemical Resistant
- ✓ Gloss Control
- ✓ Improve Primers “tooth” adhesion
- ✓ Weatherability
- ✓ Film hardness
- ✓ Improve spray-ability



# SafSil® Specialty Coatings

- ✓ DTM and Universal Primers
- ✓ Powder Coatings
- ✓ Sound Deadening Paints
- ✓ Epoxy Coatings
- ✓ Insulative Coatings
- ✓ Pool and Deck Coatings
- ✓ EIFS
- ✓ Lightweight Fire-Retardant Coatings

# Navajo® and SafSil® Properties Summary

## Interior paints

- burnish, flattening, abrasion, touch-up, stain removal

## Exterior paints and coatings

- tint development & retention, frost resistance

## Floor, deck coatings, driveway and concrete sealers

- hardness, color development, acid & corrosion resistance, film reinforcement, weatherability

## Texture and non-skid

- many granular grades available, inert, antiskid and abrasion resistance

## Primer undercoat

- low salt content products for improve corrosion properties, excellent “tooth” for subsequent topcoat, excellent sanding qualities

## Industrial maintenance finishes

- hardness, acid & corrosion resistance, film reinforcement, abrasive qualities

## Powder coatings

- color & gloss retention, film hardness, and scratch resistance.

## Tennis Court coatings

- film reinforcement sheen control, abrasion resistance and outstanding tint retention

## Traffic paint

- Provide hardness, antiskid and abrasion resistance



**QUESTIONS?**

**Thank You**

**Fred Marschall**

Technical Director

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