

GRACE



Enhanced Robustness & Durability: New Generation Matting Agents for Waterborne Coatings

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W. R. Grace

Grace: a leading global supplier of specialty chemicals

Photo of the Grace manufacturing facility in Lake Charles, LA, USA

A Leading Global Supplier in:

- Polyolefin Catalysts
- FCC Catalysts
- Hydroprocessing
- Hydrocracking
- Specialty Silica Gel
- Independent Polypropylene Process Technology Licensing

Grace operates as a standalone, privately-held company within Standard Industries

Originally founded in 1854 by William Russell Grace; Grace is 170 years old

Headquartered in Columbia, Maryland, USA

~4,500 employees globally

Customers in over 100 countries

Ed Sparks
Chief Executive Officer

330 R&D scientists
of which
110 are PhDs

~\$2 billion
Annual Revenue

1,400+ patents
worldwide; another
600+ patents pending

Product & services portfolio

Grace provides innovative specialty chemicals globally through four business units

Specialty Catalysts

- Polyethylene Catalysts
- Polypropylene Catalysts
- Chemical Catalysts
- Polypropylene Process Technology Licensing

Refining Technologies

- FCC Catalysts and Additives for Traditional Fuels and Petrochemical Feedstocks

ART Hydroprocessing™

A Chevron and Grace joint venture

- Hydroprocessing Catalysts and Additives for Clean Fuels

Materials Technologies

- Specialty Silica and Fine Chemicals
- Pharma/Nutra Ingredients, Processing Aids, and Fine Chemicals
- Coatings Ingredients
- Industrial Additives and Processing Aids
- Consumer Ingredients and Processing Aids

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Coating Trends



Aesthetic Characteristics

- Imitation of natural wood surfaces
- Market and trend dependent (regional, age, etc.)



Functional Characteristics

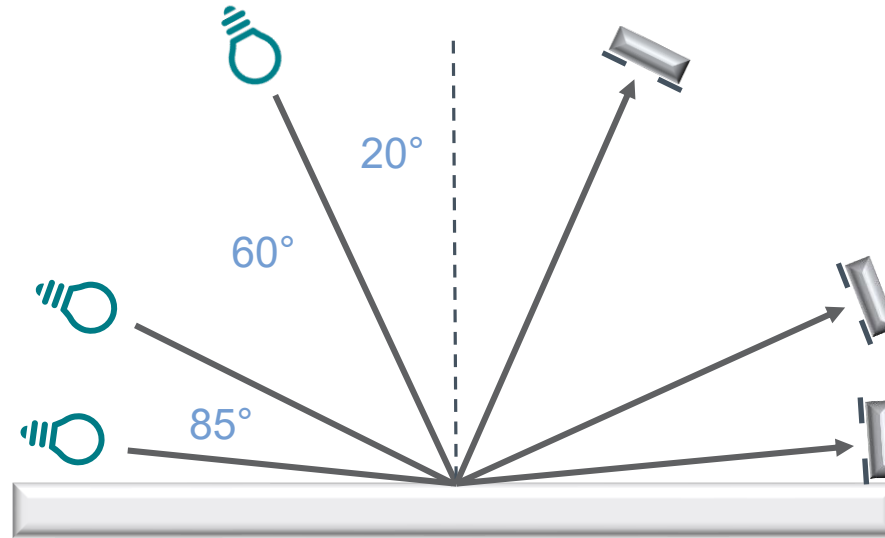
- Glare limitation on buildings, car interior surfaces

Matting in General

Directed Reflexion



Mirror Surface



Rough Surface

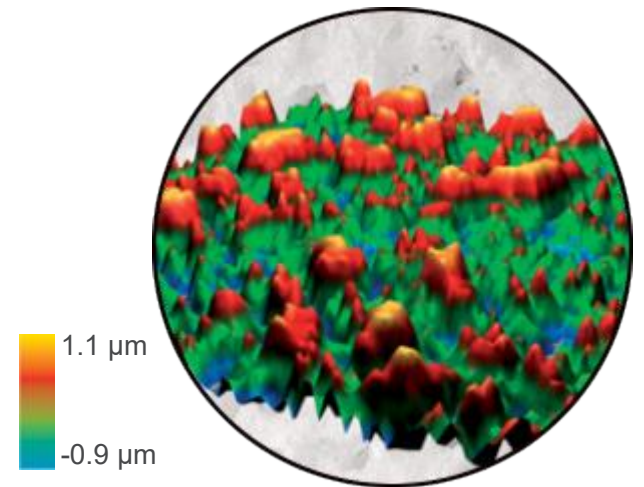
3-D surface profilometry of matte paint film

Diffuse Reflexion



Rough Surface

Gloss level	60° value	Measurement angle
High gloss	> 70	20°
Semi gloss	10 – 70	60°
Low gloss	< 10	85°



Why Use Synthetic Amorphous Silica as a Matting Solution?



Outstanding matting efficiency



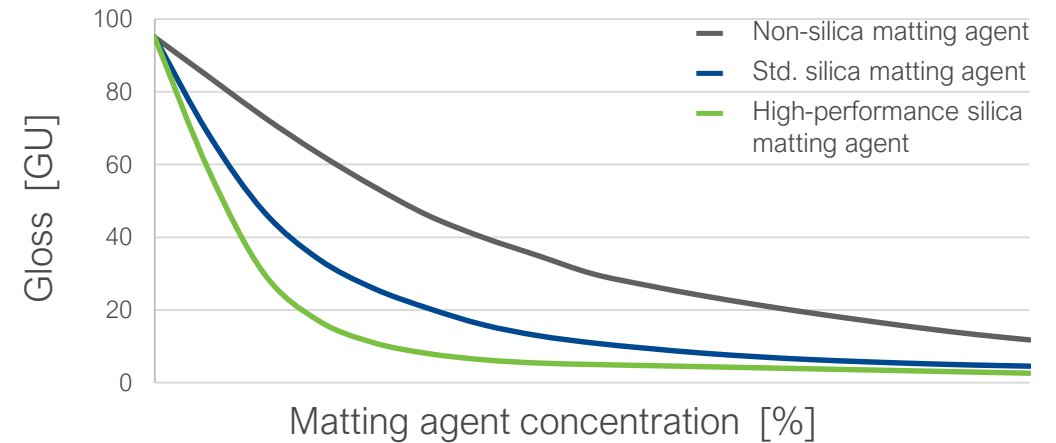
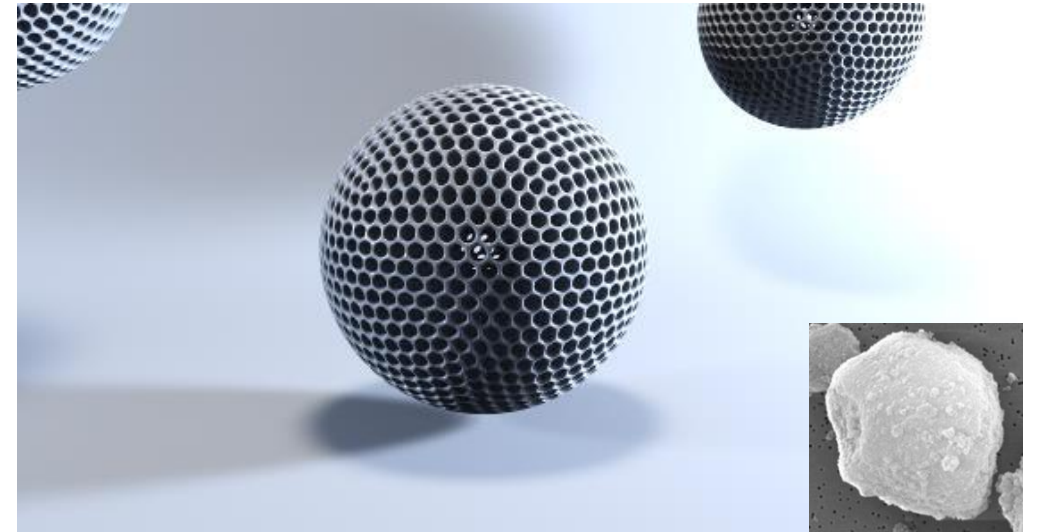
Excellent cost-performance ratio



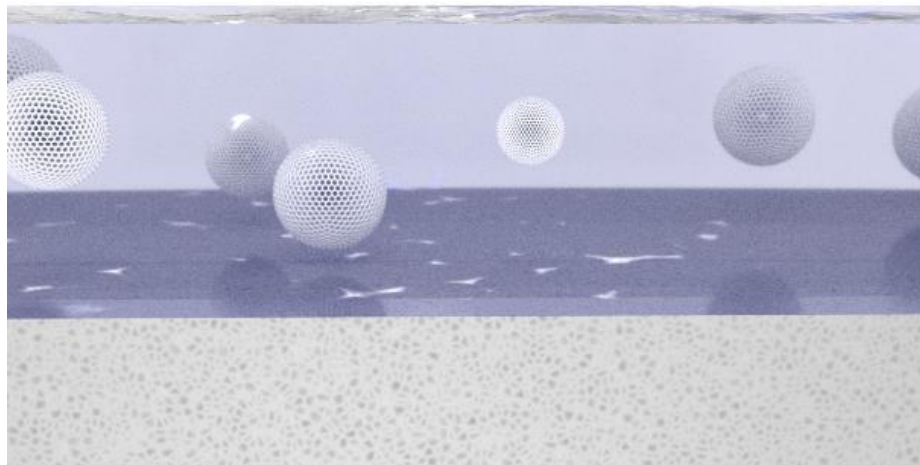
Highly transparent (IOR ~1.45)



No inhalation hazard as with crystalline silica

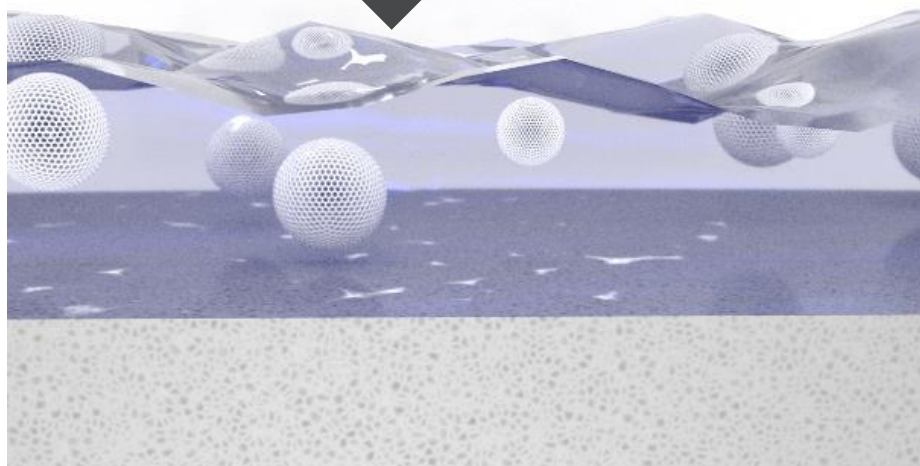


Matting – Conventional Systems



Wet Film
Smooth,
glossy surface

Drying
Solvent/Water evaporation shrinkage



Dry Film
Micro-rough,
matte surface

Key Requirement

Micro-roughness in the dry-film surface sufficient for diffuse reflection ($R_a > 0.1 \mu\text{m}$)

Silica Parameters

- Particle size and number
- Pore volume
- Orientation of particles
- State / quality of dispersion

Formulation Parameters

- Solid content (determines shrinkage and dry film thickness)
- Polymeric binder
- Interactions with other components

General Comments on Silicas for Coatings

Silica Gel

- Higher purity
- Resistant to over-grind
 - Flexibility of addition
 - Consistent rheology
- Internal pore volume
 - Increased tunability

Precipitated Silica

- Lower purity
- Potential for over-grinding
 - Inconsistent matting
 - Variable rheology
- Good dispersion

Fumed Silica

- Highest purity
- Grind sensitivity
 - Inconsistent matting
 - Variable rheology
- Low bulk density
 - Dust generation
 - Inaccurate dosing

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Silica Particle Structure

Pore Network

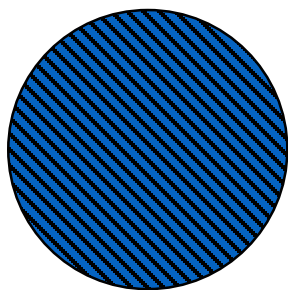
Surface Area

Pore Size

Pore Volume

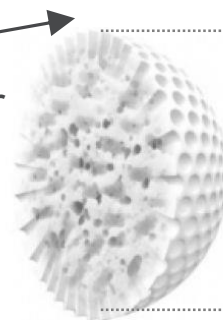
$$\text{APD } (\text{\AA}) = 4 \times 10^4 \times \frac{\text{PV (ml/g)}}{\text{SA (m}^2\text{/g)}}$$

SiO₂ Particle



Density = 2.15 g/ml (17.9 lbs/gal)
Pore Volume = 0 ml/g

Pore Diameter



Particle Diameter

Density = 0.4 g/ml (3.4 lbs/gal)
Pore Volume = 2.0 ml/g



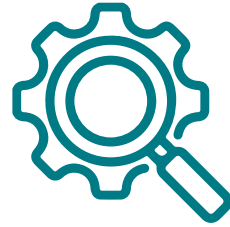
Pore Volume, Surface Area, and Pore Diameter are inter-related

Challenges of Waterborne Coatings

- **Film properties**
 - Clarity/Transparency
 - Chemical resistance
 - Mechanical resistance (scratch, burnishing,...)
- **Cost pressure**

**1K WB Acrylic
& Acrylic/PUD**

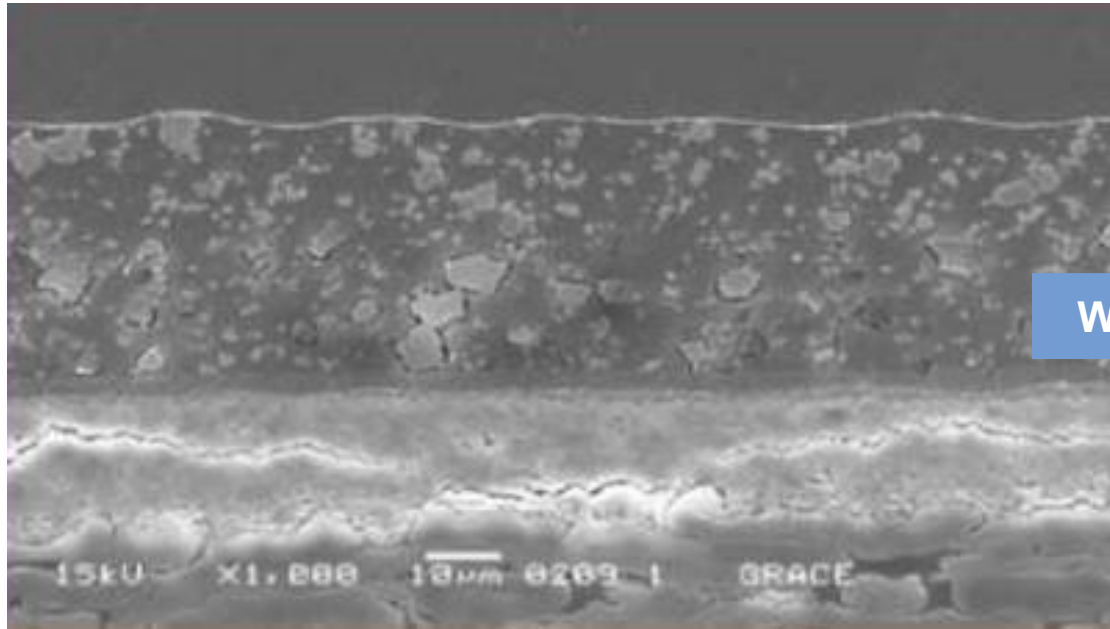
- **Environmental & Regulatory drivers**
- **Market trends**
- **Ease of processing**



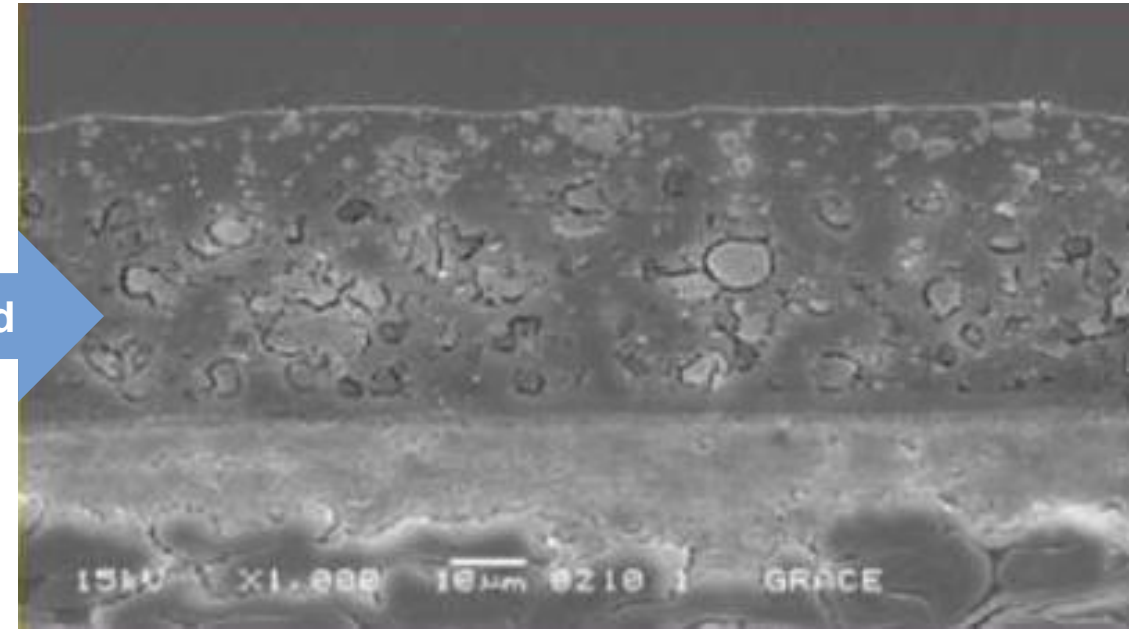
Develop matting agents for waterborne industrial wood coatings with

- ④ Least impact to warmth of wood (Grain enhancement/"Anfeuerung")
- ④ Good chemical resistance comparable to organic matting agents
- ④ Better matting efficiency than organic matting agents
- ④ Good burnish resistance

Understanding the Problem



Water load



Non-film forming materials typically deteriorate film integrity



Applied stress results in degradation of visual properties



Bad film integrity leads to lower chemical resistance



The organic/inorganic interface is the defect site

Providing a Silica-based Solution

New Silica Gel Products

Based on a proprietary combination of silica gel particle engineering and optimized organic treatment

Product A Highlights

✓
Excellent matting efficiency

✓
Very good chemical resistance

✓
Very good transparency

✓
Very good burnishing resistance

Product B Highlights

✓
Good Matting efficiency

✓
Excellent chemical resistance

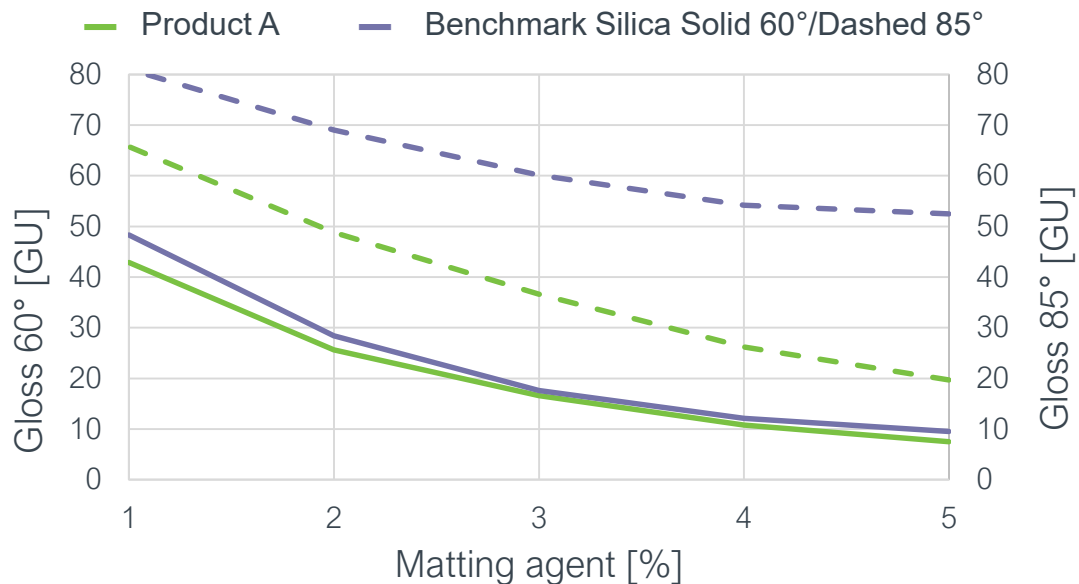
✓
Excellent transparency

✓
Excellent burnishing resistance

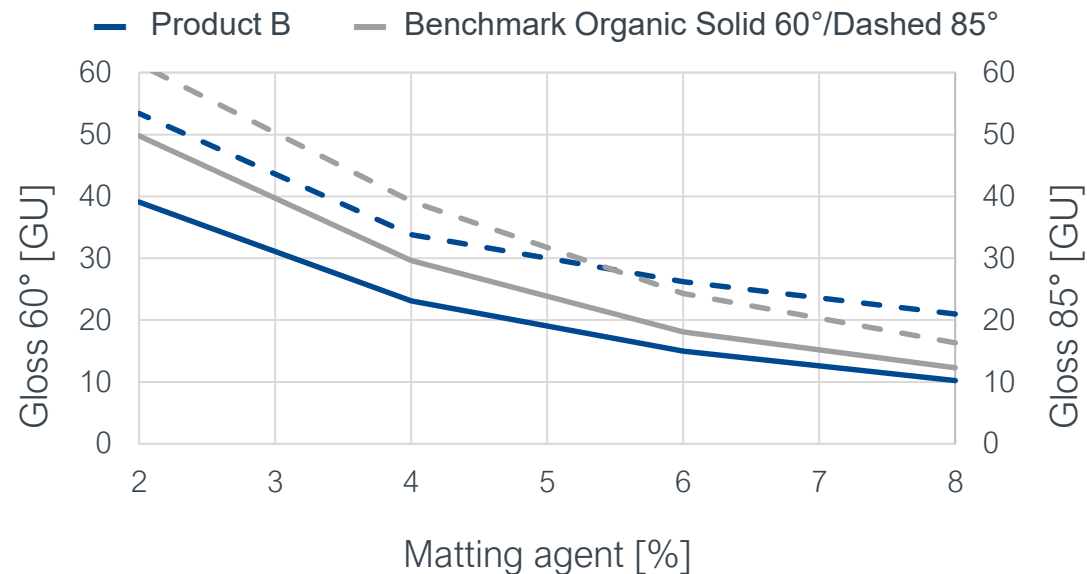
Matting Agent	Chemistry	Modification	d ₅₀ (µm)
Product A	Silica gel	Organic	7.0
Product B	Silica gel	Organic	7.0
Benchmark Silica	Thermal Silica (based on fumed silica)	-	9.5
Benchmark Organic	Micronized wax	-	8.0

Case Study - 1K WB Clear Acrylic Wood Coating

Matting Efficiency Comparison



Product A shows comparable results at 60° and a significantly higher matting efficiency at 85°



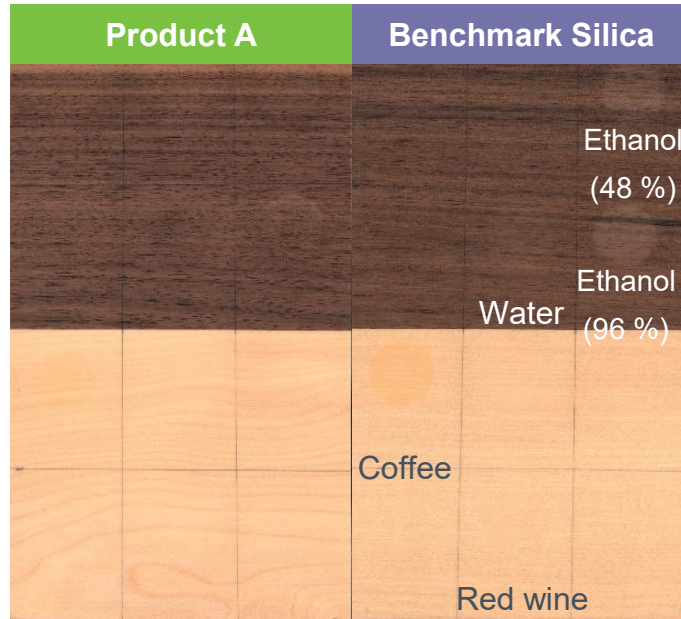
Product B shows slightly improved matting efficiency at 60° and comparable results at 85°

SPF with waterbased all acrylic resin is used for all testings and evaluations.

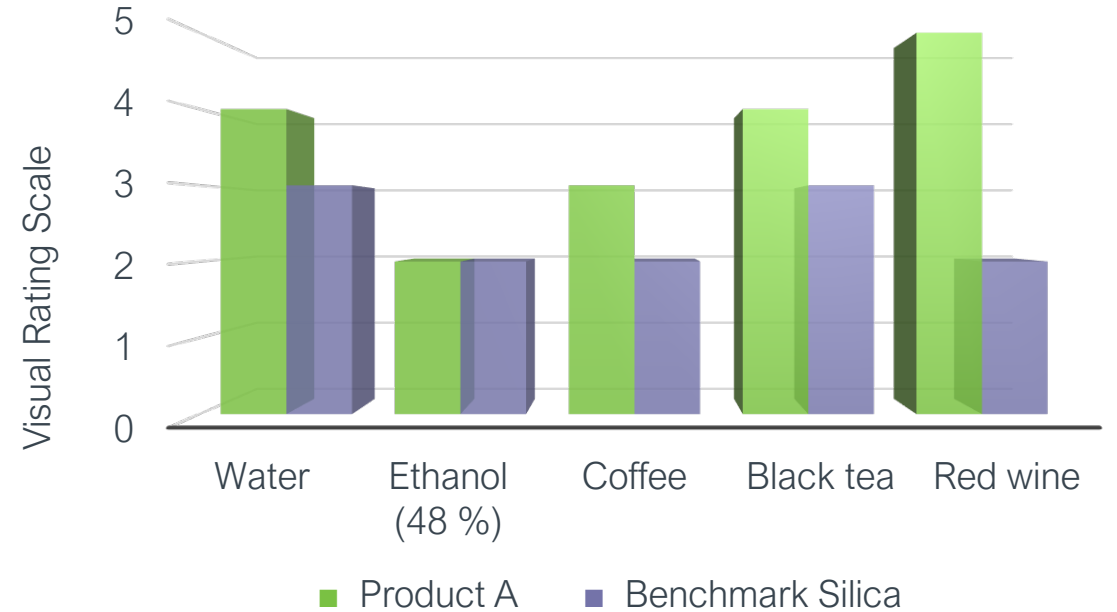
Case Study - 1K WB Clear Acrylic Wood Coating



Chemical resistance on wooden substrates (walnut/maple)



Testing stains include Vinegar, Na₂CO₃, Ethanol (96%), Water, Ethanol (48%), Coffee, Black Tea, Ketchup, Mustard, and Red Wine



Improvement observed in resistance against:



Water



Coffee



Black Tea



Red wine

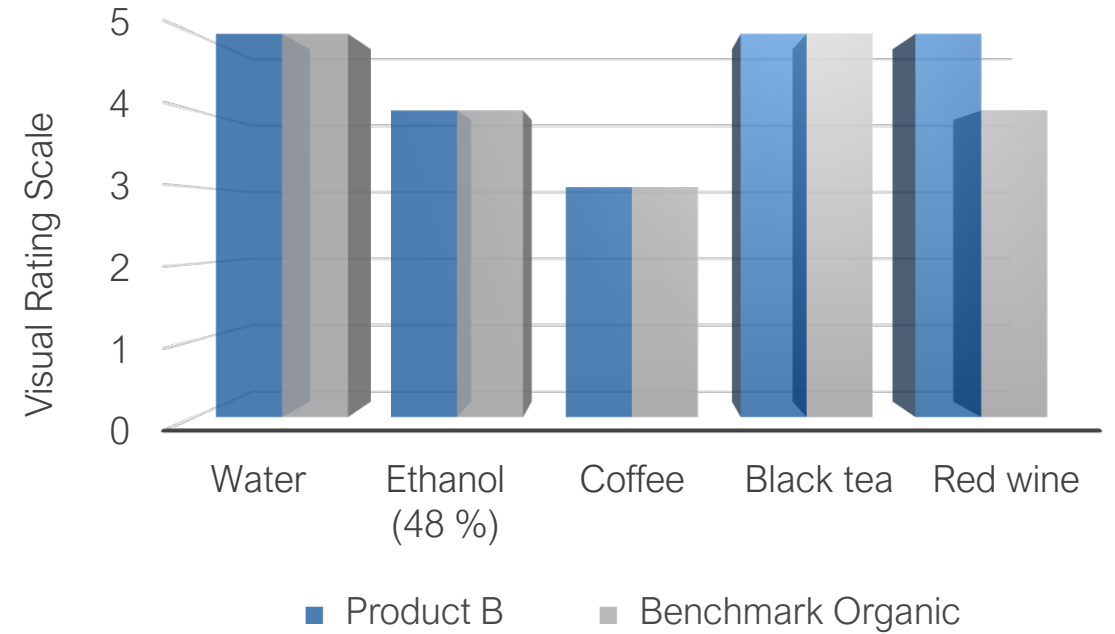
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Chemical resistance on wooden substrates (walnut/maple)

Product B	Benchmark Organic
	Ethanol (48%)
	Ethanol (96%)
	Water
	Coffee
	Red wine

Testing stains include Vinegar, Na₂CO₃, Ethanol (96%), Water, Ethanol (48%), Coffee, Black Tea, Ketchup, Mustard, and Red Wine

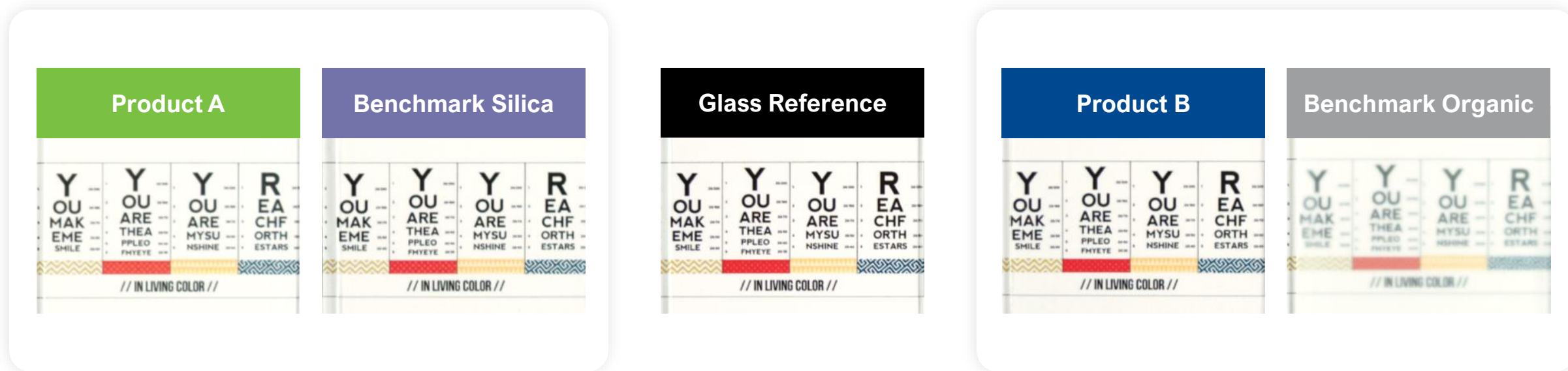


Improvement observed in resistance against:



Case Study I - 1K WB Clear Acrylic Wood Coating

Visual clarity evaluation

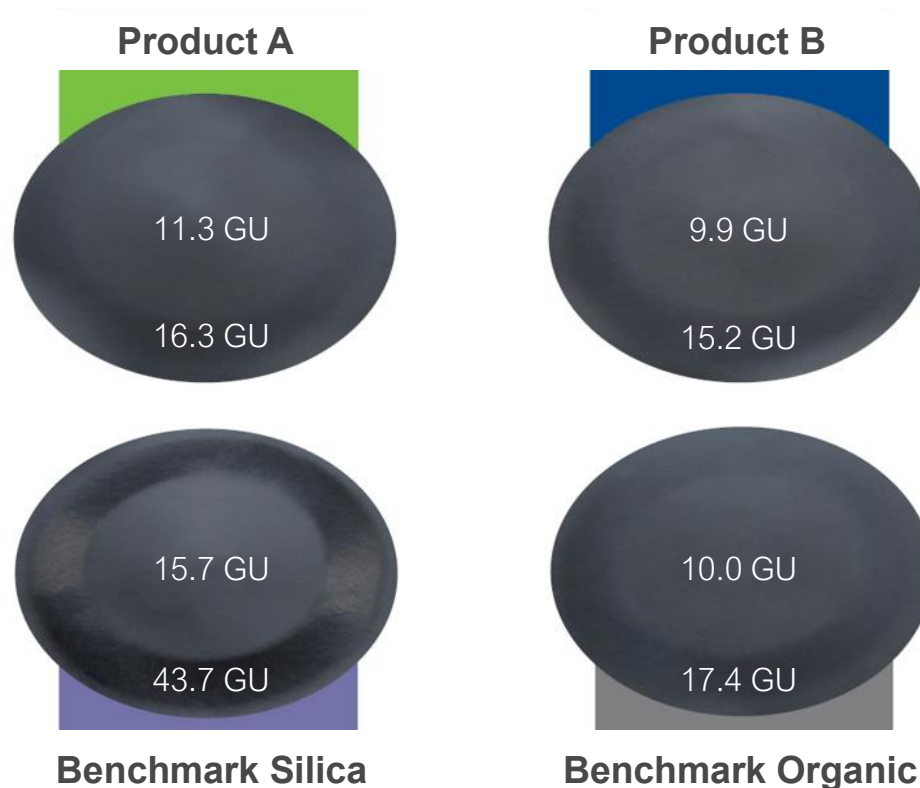


Product A is comparable in visual clarity to Benchmark Silica, while Product B excels relative to All Matting Agents

Case Study - 1K WB Clear Acrylic Wood Coating

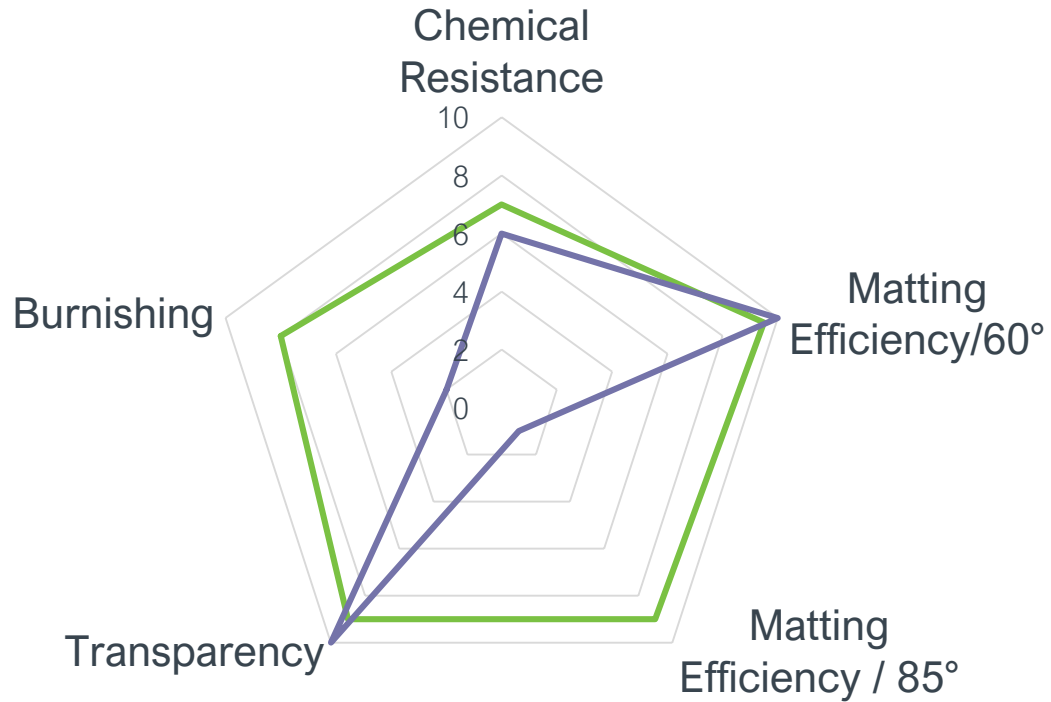


Improvement in burnish resistance

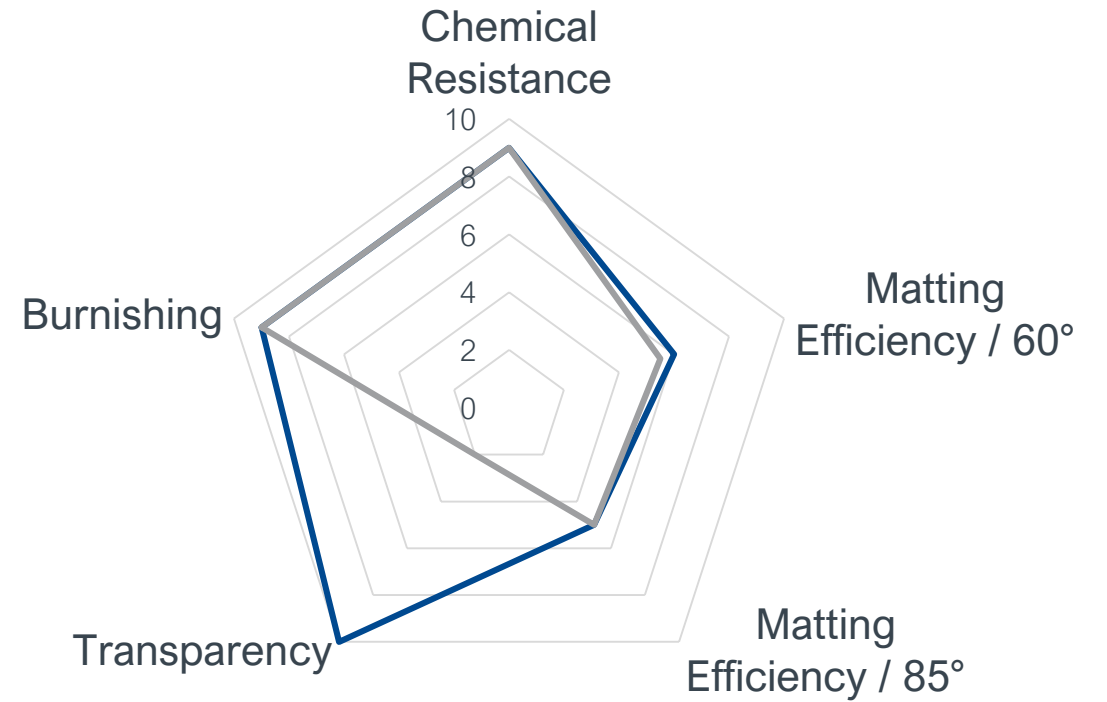


New silica gel products demonstrate improved burnish resistance as well as enhanced scratch resistance comparable to organic-type matting additives

Value Comparison



Product A offers a stronger balance of performance relative to Benchmark Silica



Product B provides enhanced transparency and burnish resistance relative to Benchmark Organic

Thank You for Your Time

Questions?

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