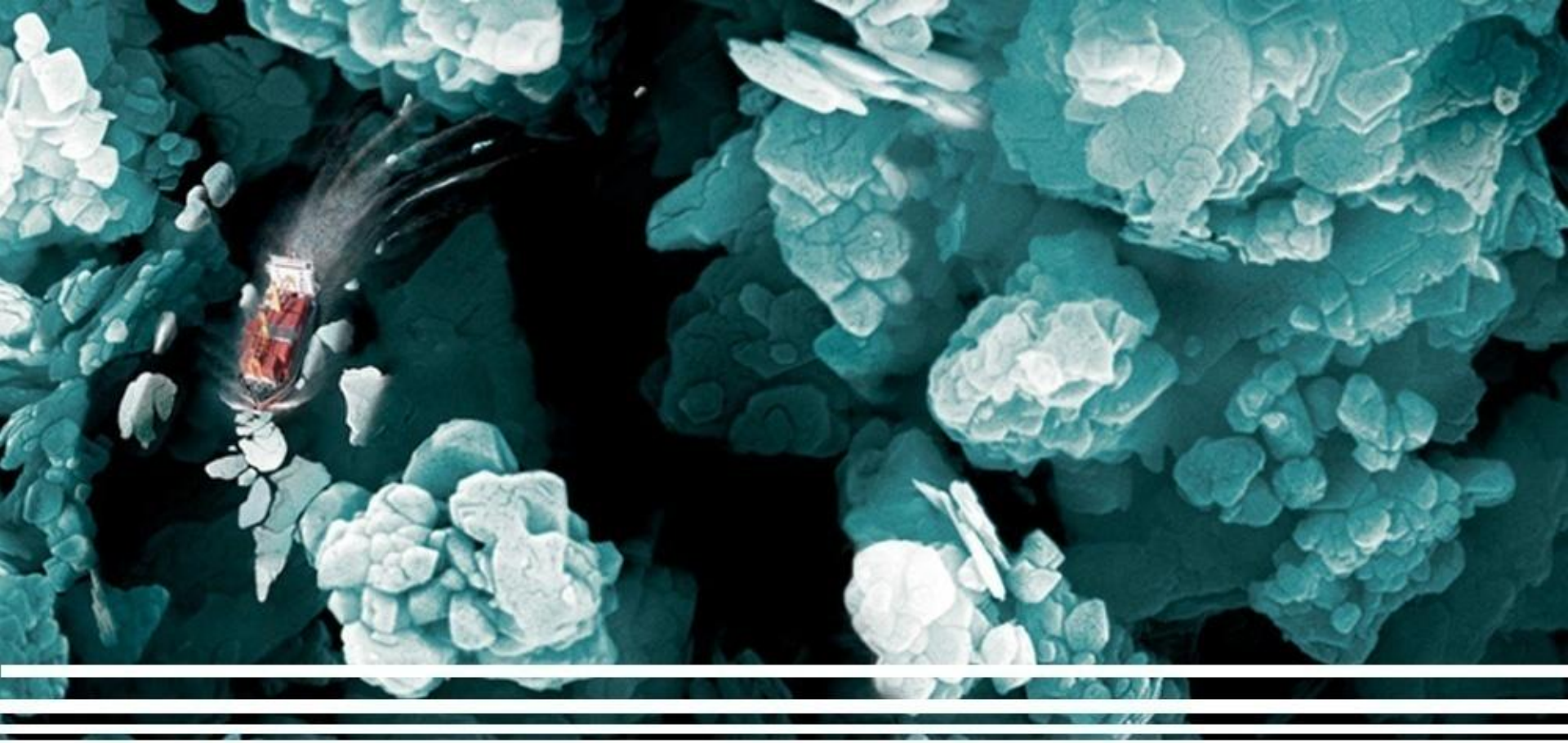


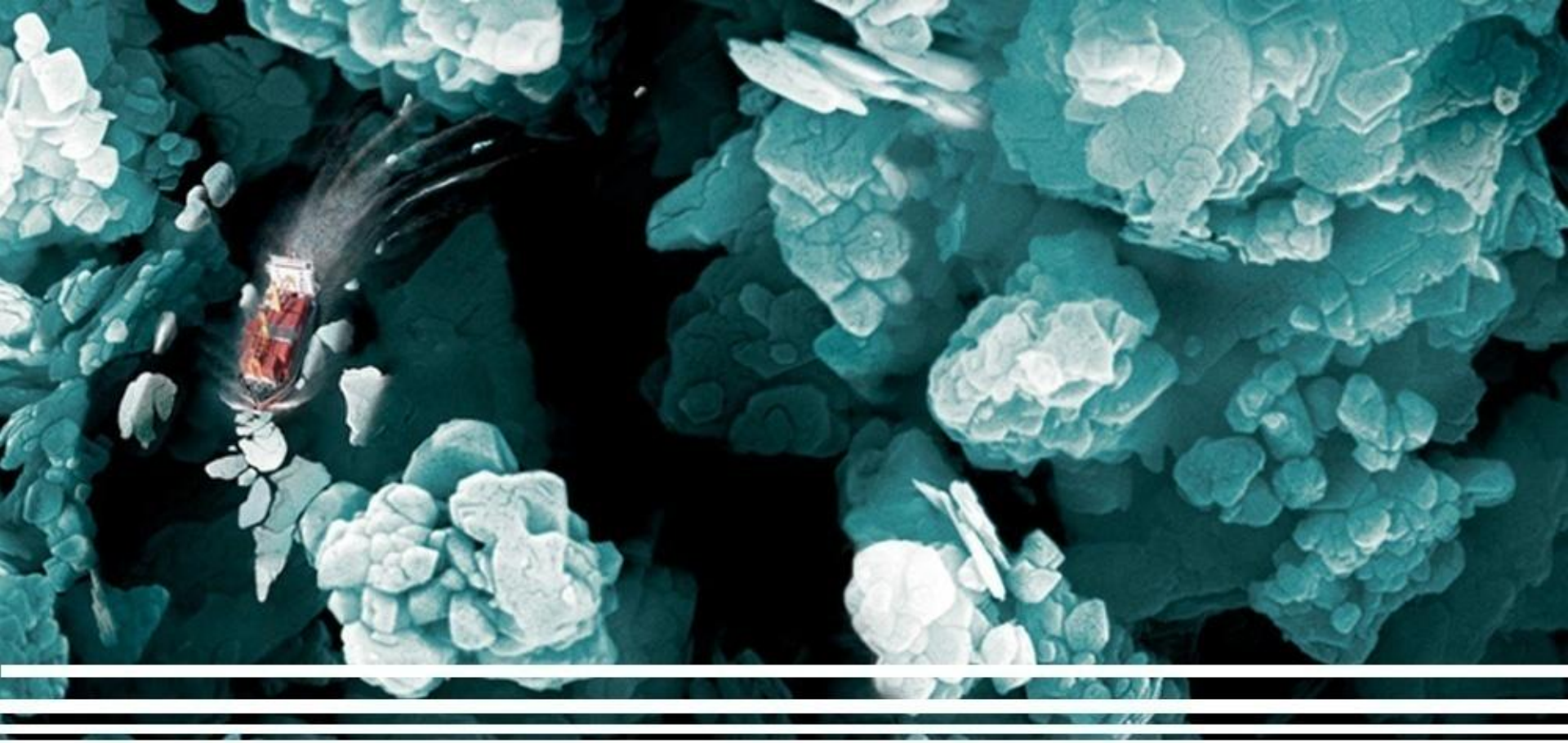
# Water-based Wood Coatings

## Aktisil WW & Gloxil WW

**Speaker: Siegfried Heckl**

**Author: Bodo Essen, Hubert Oggermueller**

HOFFMANN MINERAL
We supply material for good ideas

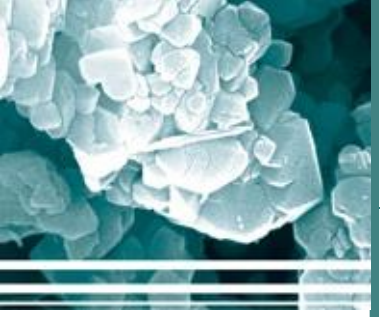


# Aktisil WW

## Functional Filler for Matting Water-based Acrylic Clear Coats for Wood

Author: Bodo Essen, Hubert Oggermueller

HOFFMANN MINERAL
We supply material for good ideas





# Objective

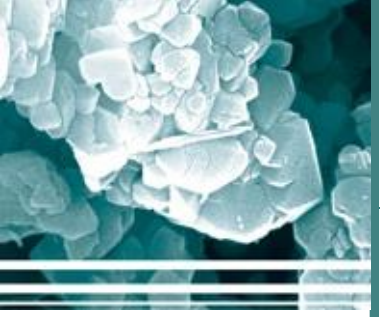
Assessment of the performance of Aktisil WW versus commercially available and established silica matting agents in a water-based clear coat for wood coating.

Competitive products:

Fumed Silica (Acematt TS 100)
Precipitated Silica (Syloid ED 5)

Special attention should be paid to resulting effects on optical appearance as well as the coatings resistance to

- Water
- ethanol and
- ink





# Base Formulation

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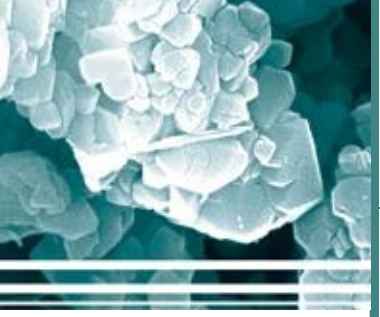
| | | pbw * |
|---|---|---|
| Alberdingk AC 2514 | Binder, acrylic emulsion, self-crosslinking, MFFT 43 °C | 79.4 |
| Byk 024 | Defoamer | 0.8 |
| Butyl diglycol | Cosolvent | 6.0 |
| Butyl glycol | Cosolvent | 2.0 |
| Water demineralized | | 7.5 |
| Matting agent | Silica or Aktisil WW | varied X |
| Aquamat 272 | Wax dispersion | 3.3 |
| Byk 346 | Wetting agent | 0.4 |
| Total | | 99.4 + X |

* Parts by weight





# Formulation Variations

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| | Without | With matting agent | | | | | |
|---|---|---|---|---|---|---|---|
| | | pbw | | | | | |
| | | Semi-mat (gloss 60° ~30) | | | Mat (gloss 60° ~15) | | |
| Acematt TS 100 | --- | 0.8 | --- | --- | 2.5 | --- | --- |
| Syloid ED 5 | --- | --- | 0.8 | --- | --- | 2.5 | --- |
| Aktisil WW | --- | --- | --- | 6.25 | --- | --- | 11.5 |
| Total | 99.4 | 100.2 | 100.2 | 105.7 | 101.9 | 101.9 | 110.9 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Solids content w/w | [%] | 37.2 | 37.7 | 37.7 | 40.9 | 38.7 | 38.9 | 43.7 |
| PVC | [%] | 0.0 | 1.2 | 1.3 | 8.7 | 3.5 | 3.9 | 15.0 |

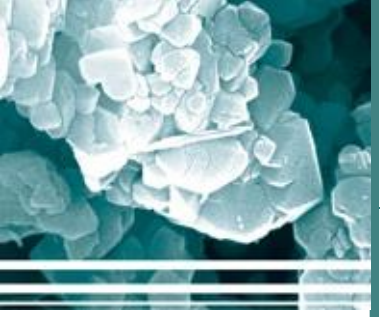
Subsequently individual thickening with DSX 1514 to In-can viscosity (150 s DIN 4 mm) and dilution to application viscosity (100 s DIN 4 mm)

# Matting Agent Characteristics



| | | Fumed Silica | Precipitated Silica | Neuburg Siliceous Earth |
|---|---|---|---|---|
| | | Acematt TS 100 | Syloid ED 5 | Aktisil WW |
| Density | [g/cm³] | 2.2 | 2.0 | 2.1 |
| Particle size $d_{50}$ | [µm] | 4 * | 9 | 4 |
| Oil absorption | [g/100g] | 360 | 320 | 22 |
| Specific surface area, BET | [m²/g] | 250 | 400 | Unquantifyable, <= 8 |
| Surface treatment | | none | none | yes |
| Bulk volume of 1 g | |  | | |

* average agglomerate particle size (TEM)

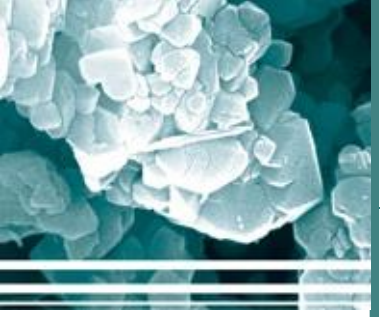




# Results

- Processing properties and storage stability *forward to results*
- Abrasion resistance
- Optical properties
- Water, alcohol and ink resistance
- Spreading rate and cost calculations

*forward to summary*

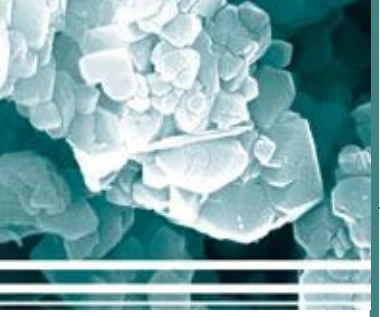




# Processing Properties and Storage Stability

HOFFMANN MINERAL

- Mixing and dispersing
- Storage stability
- Drying time





# Mixing and Dispersing

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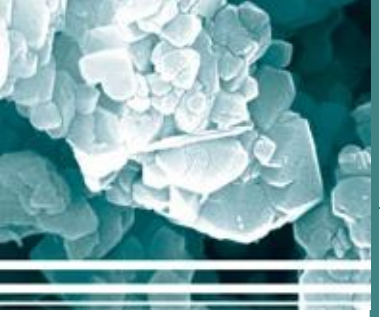
| | Matting agent | | |
|---|---|---|---|
| **Criteria** | **Acematt TS 100** | **Syloid ED 5** | **Aktisil WW** |
| **Dust formation** | ☹ | 😐 | 🙂 |
| **Incorporation** | ☹ | 😐 | 🙂 |
| **Dispersibility** | 😐 | 🙂 | 🙂 |
| **Foam formation** | 😐 | 😐 | 🙂 |





# Storage Stability 12 weeks at 23°C

HOFFMANN MINERAL

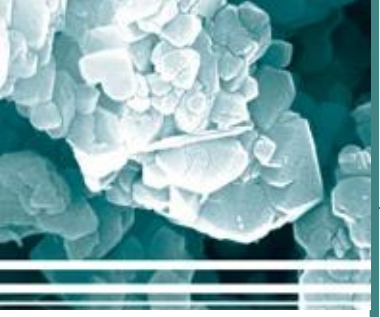
## In-can viscosity

| | Matting agent | | |
|---|---|---|---|
| **Criteria** | **Acematt TS 100** | **Syloid ED 5** | **Aktisil WW** |
| **Gelling** |  |  |  |
| **Phase Separation** |  |  * |  |
| **Settling** |  |  ** |  ** |
| **Re-stir** | No sediment |  |  |

* Partly floating of wax dispersion

** Slight settling of matting agent without forming of hard sediment

Tests carried out in 50 ml bottles





# Dry Through Time Improvement

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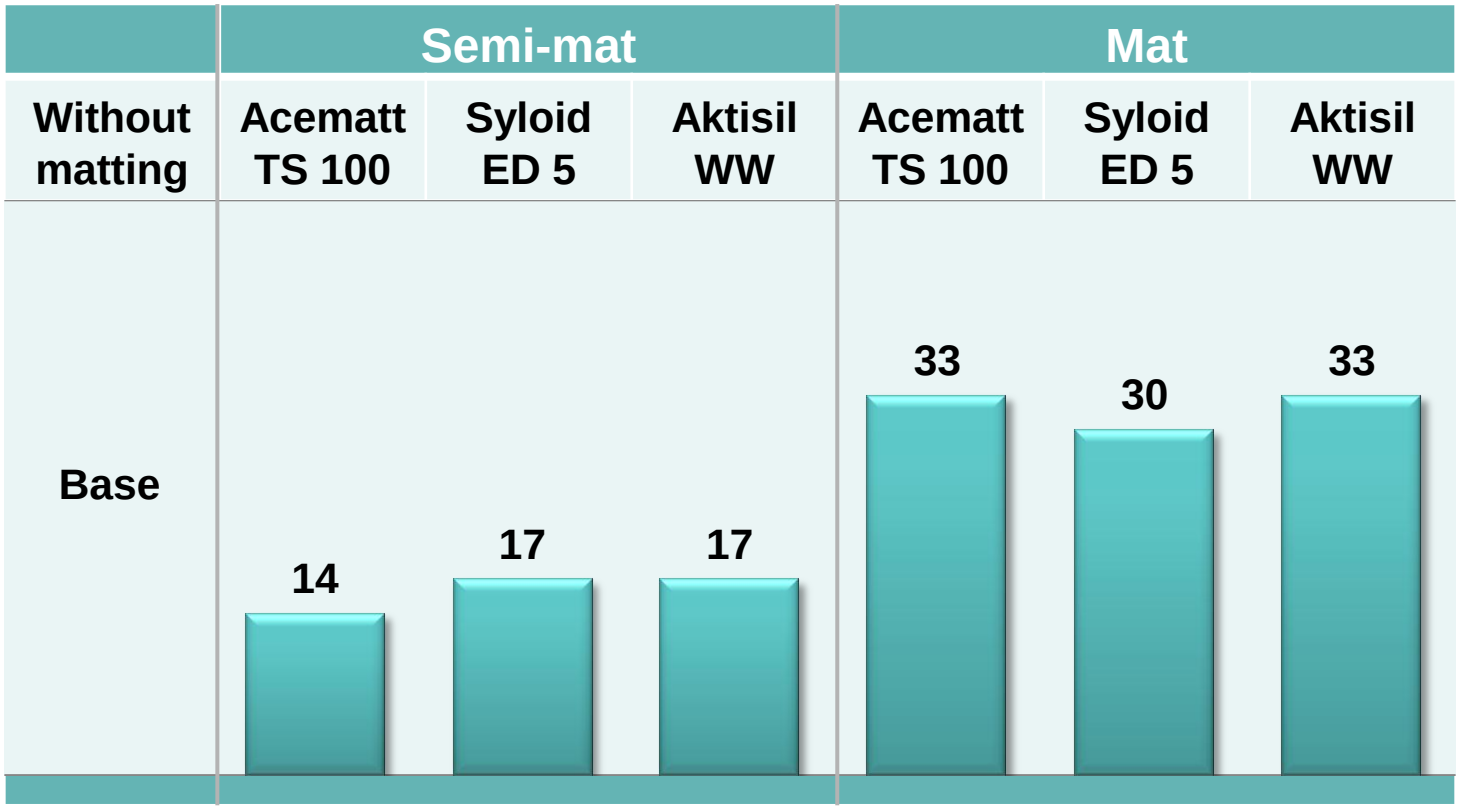
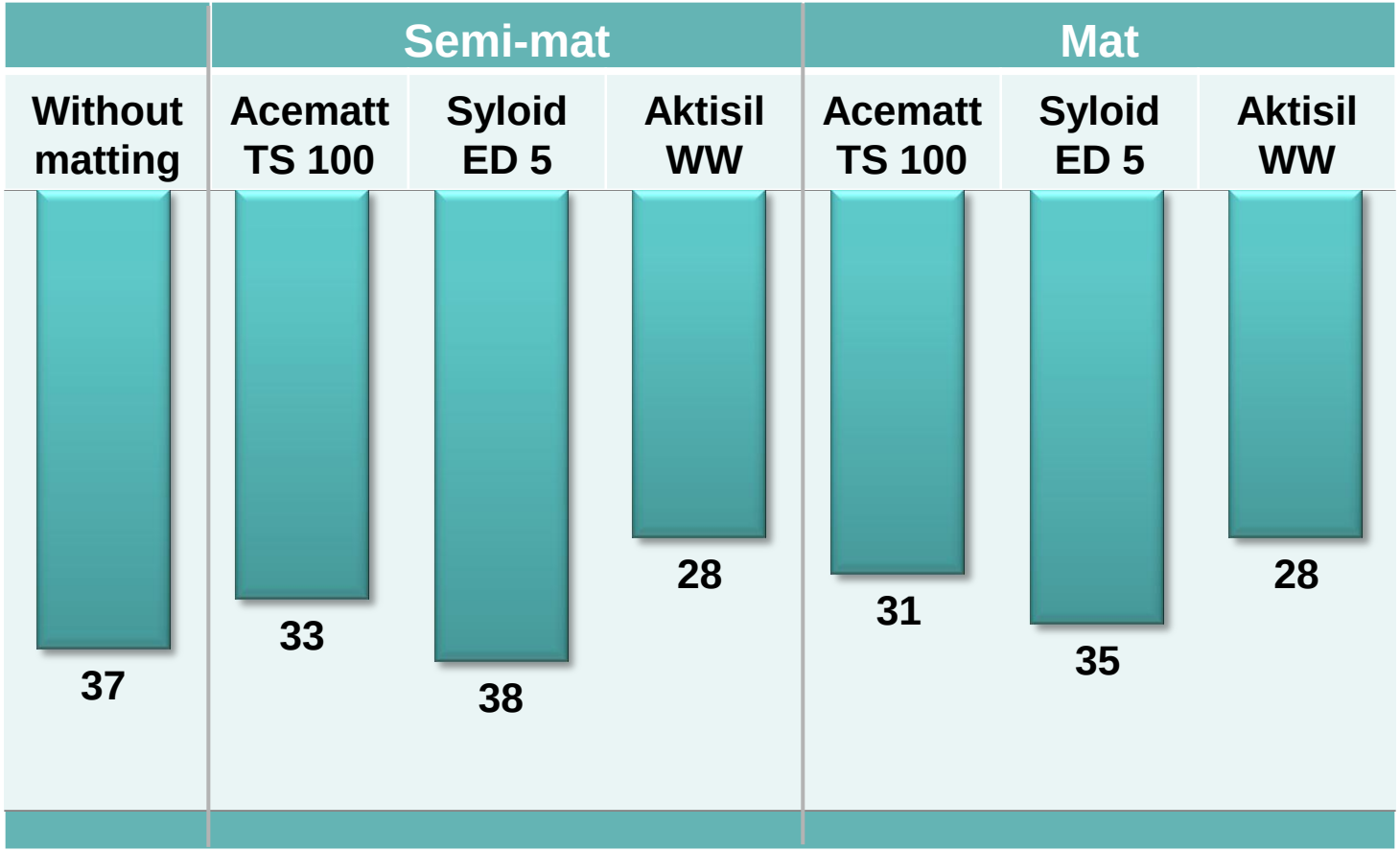
Reduction of drying time [%] compared to Base at DFT 30 µm

Erichsen method, no surface damage with sliding wire bow

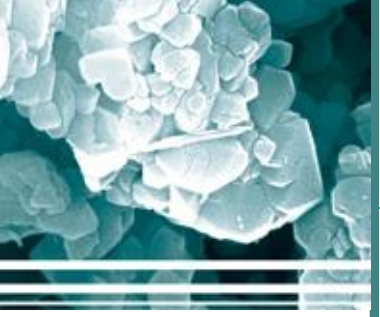


# Abrasion Resistance

Volume loss [mm³] per 500 revolutions Taber CS17, 1 kg, DFT 30µm




back to selection
forward to summary





# Optical Properties

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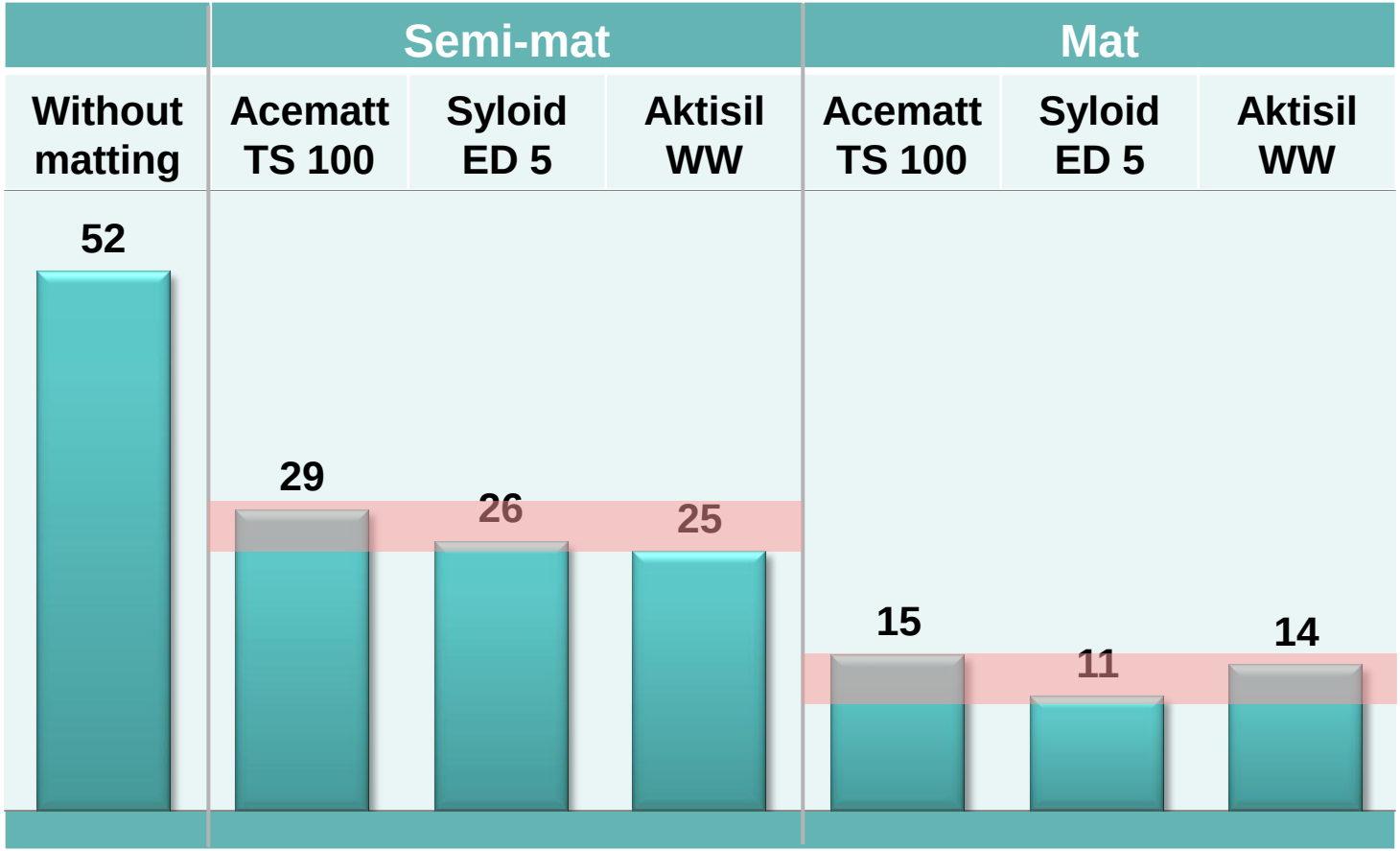
- Matting

- Appearance on wood

# Matting

Gloss 60°, DFT 30 µm

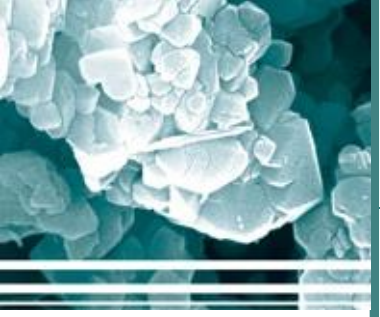


# Appearance on Wood

| DFT 90 µm (3 x 30)<br>Drying 7 d | Mat<br>Without matting | Mat<br>Acematt TS 100<br>2.5 pbw | Mat<br>Syloid ED 5<br>2.5 pbw | Mat<br>Aktisil WW<br>11.5 pbw |
|---|---|---|---|---|
| Black walnut |  |  |  slight decrease of transparency over time |  |

*back to selection*

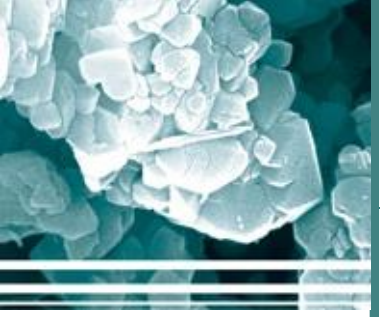
*forward to summary*



# Water, Alcohol and Ink Resistance



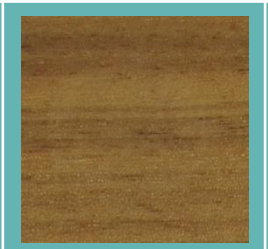
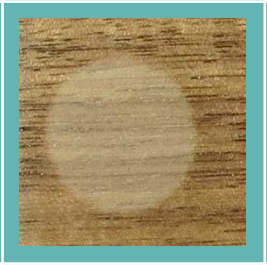
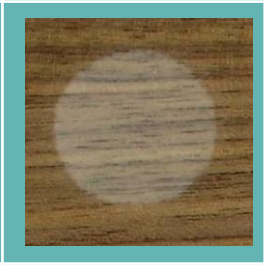
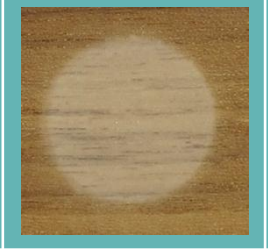
- At early stage, 15 h after film application
- 28 d after film application according to DIN 68861-1,1A
- Ink resistance optimization

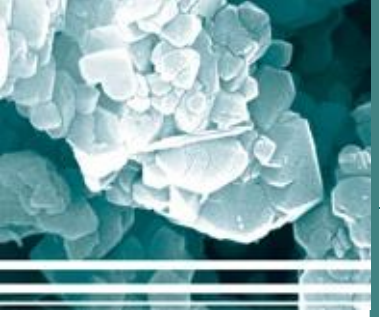




# Water Resistance

HOFFMANN MINERAL

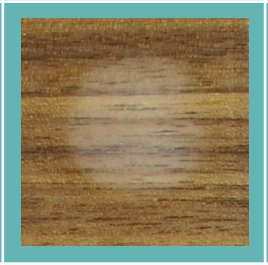
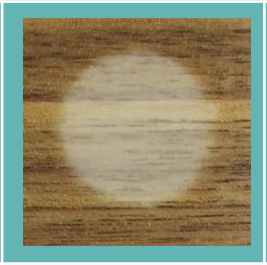
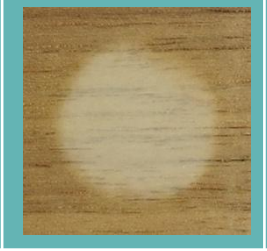
| DFT 90 µm (3 x 30) | | Without matting | Mat | | |
|---|---|---|---|---|---|
| | | | Acematt TS 100 | Syloid ED 5 | Aktisil WW |
| Drying | Exposure | | 2.5 pbw | 2.5 pbw | 11.5 pbw |
| 15 h | 1 h |  |  |  |  |
| 15 h | 16 h |  |  |  |  |
| 28 d | 16 h |  |  |  |  |

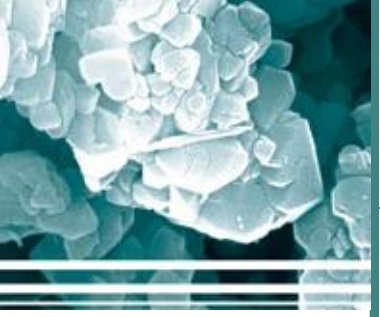




# Alcohol Resistance Ethanol 48%

HOFFMANN MINERAL

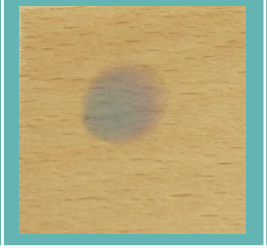
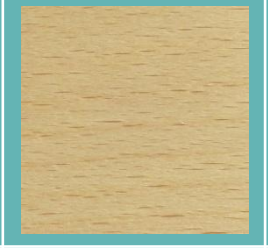
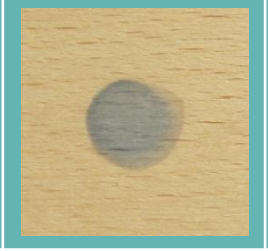
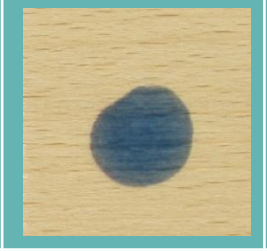
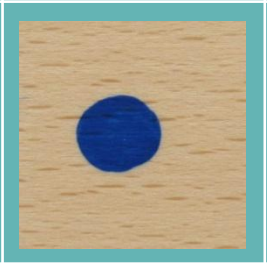
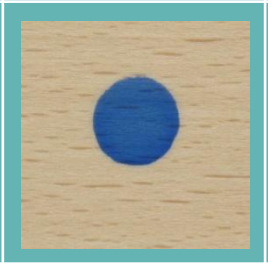
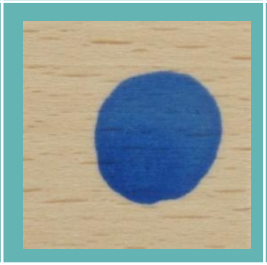
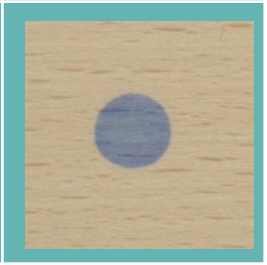
| DFT 90 µm (3 x 30) | | Without matting | Mat | | |
|---|---|---|---|---|---|
| Drying | Exposure | | Acematt TS 100<br>2.5 pbw | Syloid ED 5<br>2.5 pbw | Aktisil WW<br>11.5 pbw |
| 15 h | 1 h |  |  |  |  |
| 15 h | 16 h |  |  |  |  |
| 28 d | 16 h |  |  |  |  |

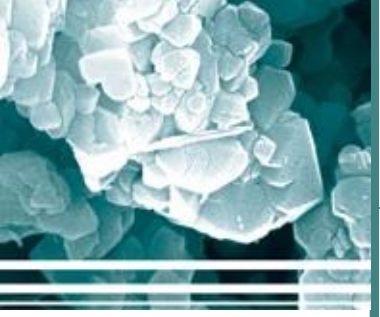




# Ink Resistance

HOFFMANN MINERAL

| DFT 90 µm (3 x 30) | | Without matting | Mat | | |
|---|---|---|---|---|---|
| Drying | Exposure | | Acematt TS 100<br>2.5 pbw | Syloid ED 5<br>2.5 pbw | Aktisil WW<br>11.5 pbw |
| 15 h | 1 h |  |  |  |  |
| 15 h | 5 h |  |  |  |  |
| 28 d | 16 h |  |  |  |  |





# Ink Resistance Optimization

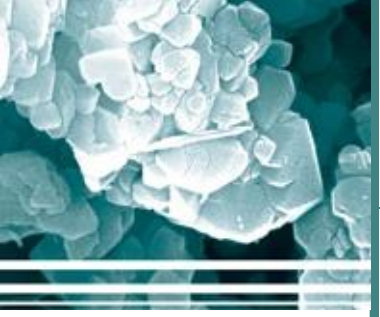
HOFFMANN MINERAL

Measures investigated for mat coatings:

1. Efflux time adjusted to 100 s by less water / thickener content

2. Entirely without thickening agent lowering efflux time to 15 - 20 s

3. Equivalent conditions of 2. but change of cosolvent. Butyldiglycol (BDG) / Butylglycol (BG) replaced by pure Dipropylene glycol monomethyl ether (DPM) by weight





# Ink Resistance Optimization Drying 15 h / Exposure 5 h

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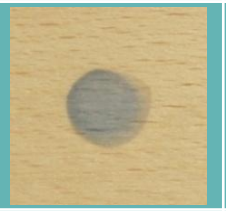
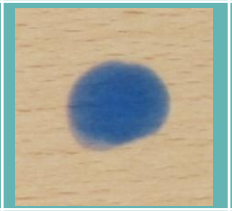
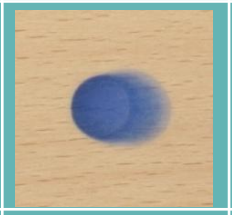
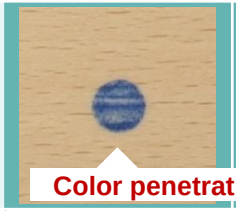
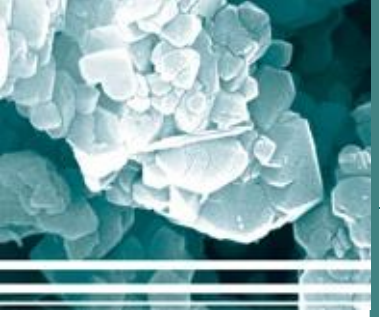
| DFT 90 µm (3 x 30) | pbw | | | | | Efflux time DIN 4 [s] | Mat | | |
|---|---|---|---|---|---|---|---|---|---|
| | BDG / BG | DPM | Water demin. | Water demin. dilution | DSX 1514 | | **Acematt TS 100** **2.5 pbw** | **Syloid ED 5** **2.5 pbw** | **Aktisil WW** **11.5 pbw** |
| | 6 / 2 | --- | 7.5 | 4.0-7.8 | regular | 150 |  |  |  |
| **1.** | 6 / 2 | --- | --- | --- | reduced | 100 |  |  |  |
| **2.** | 6 / 2 | --- | --- | --- | --- | 15-20 |  |  |  |
| **3.** | --- | 8 | --- | --- | --- | 15-20 |  |  |  |

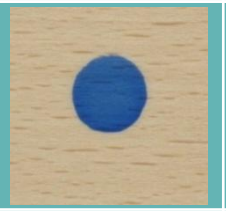
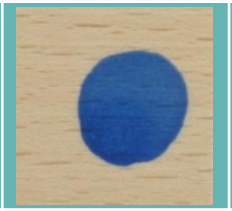
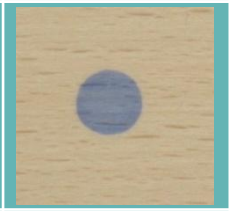
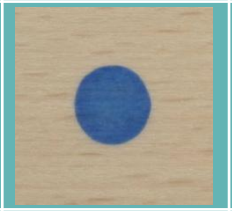
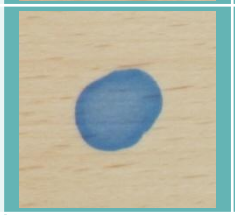
Color penetrating into wood

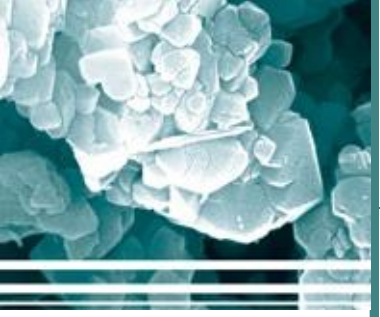




# Ink Resistance Optimization Drying 28 d / Exposure 16 h

HOFFMANN MINERAL

| DFT 90 µm (3 x 30) | pbw | | | | | Efflux time DIN 4 [s] | Mat | | |
|---|---|---|---|---|---|---|---|---|---|
| | BDG / BG | DPM | Water demin. | Water demin. dilution | DSX 1514 | | **Acematt TS 100** **2.5 pbw** | **Syloid ED 5** **2.5 pbw** | **Aktisil WW** **11.5 pbw** |
| | 6 / 2 | --- | 7.5 | 4.0-7.8 | regular | 150 |  |  |  |
| **1.** | 6 / 2 | --- | --- | --- | reduced | 100 |  |  |  |
| **2.** | 6 / 2 | --- | --- | --- | --- | 15-20 |  |  |  |
| **3.** | --- | 8 | --- | --- | --- | 15-20 |  |  |  |



# Spreading Rate and Cost Calculations



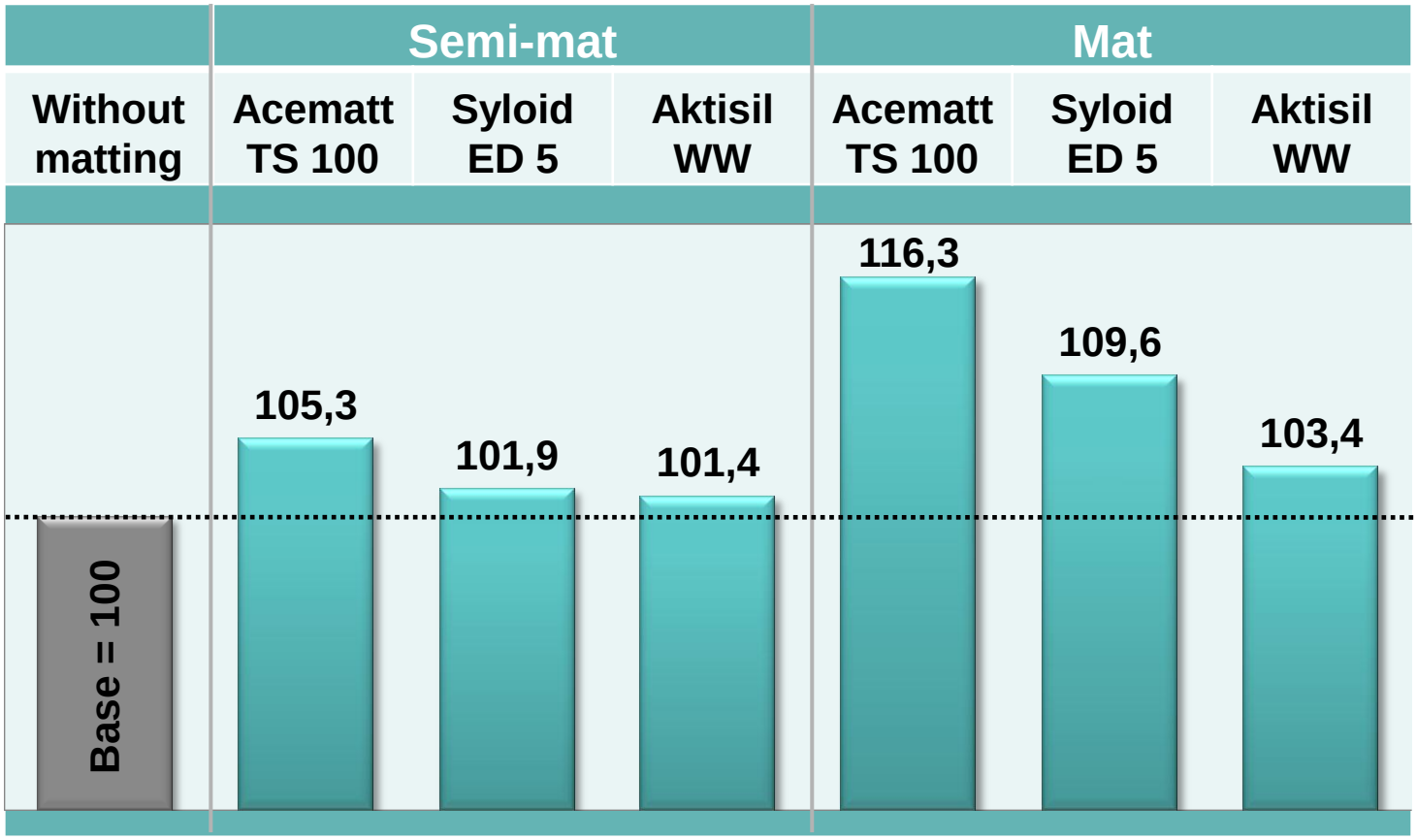
- At application viscosity
  - Formulation Costs
  - Spreading Rate
  - Overall System Costs

# Formulation Costs (€/L) at Application Viscosity

HOFFMANN MINERAL



Base “Without matting”, Index [%] (Germany 2012)



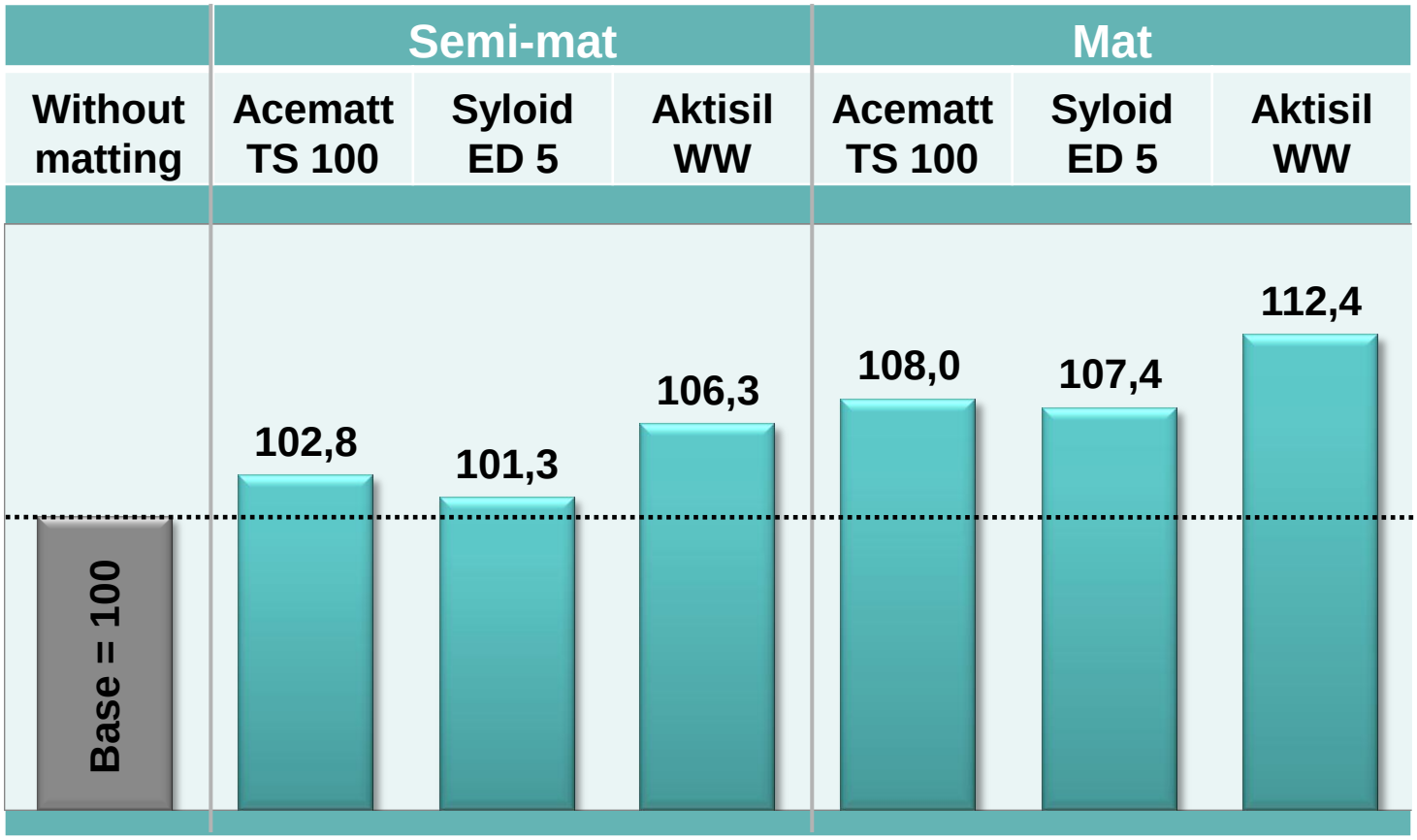
# Spreading Rate (m²/L) at Application Viscosity

HOFFMANN MINERAL



Base “Without matting”, Index [%] (Germany 2012)

Equivalent DFT



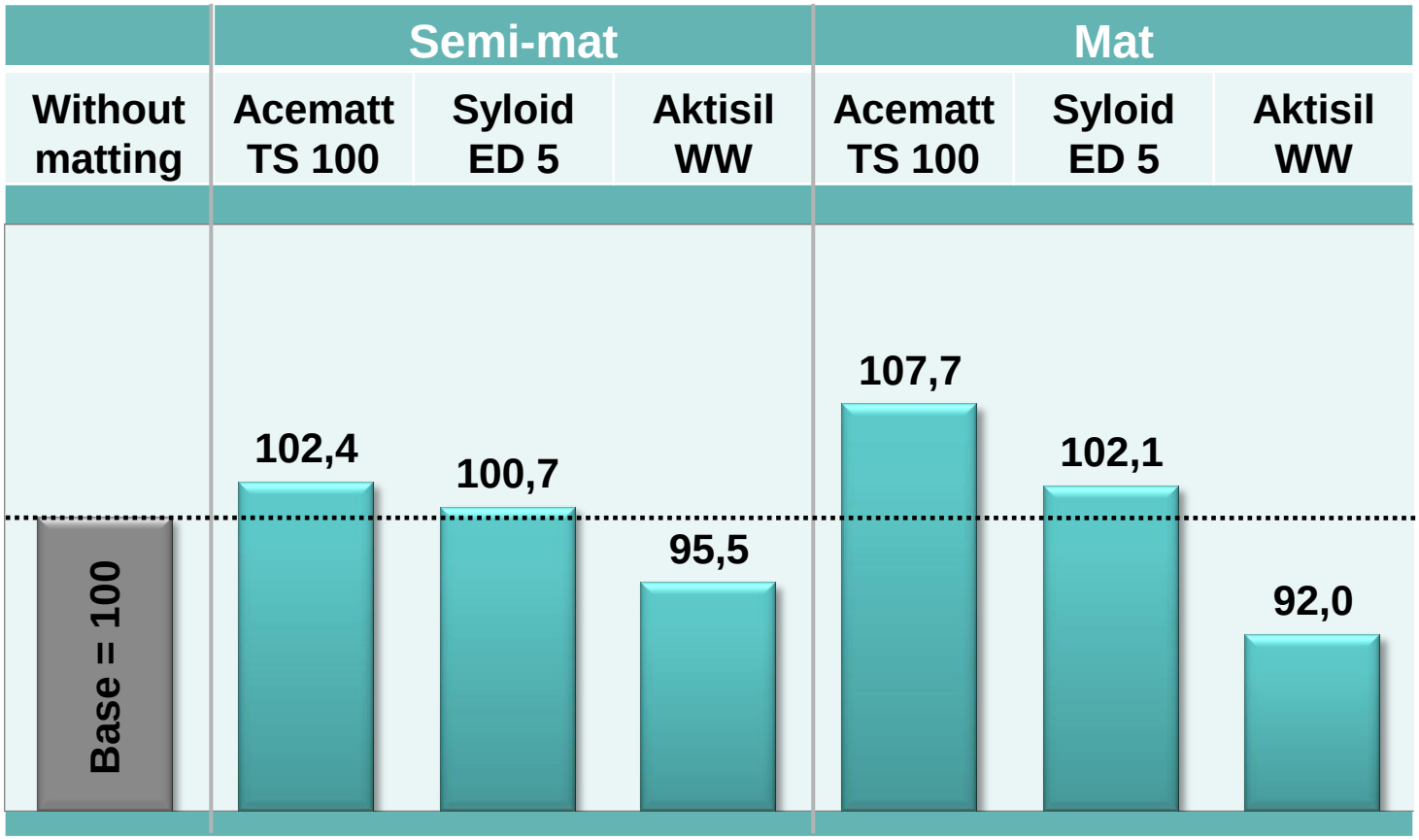
# Overall System Costs (€/m²) at Application Viscosity

HOFFMANN MINERAL



Base “Without matting”, Index [%] (Germany 2012)

Considering formulation costs and spreading rate, equivalent DFT

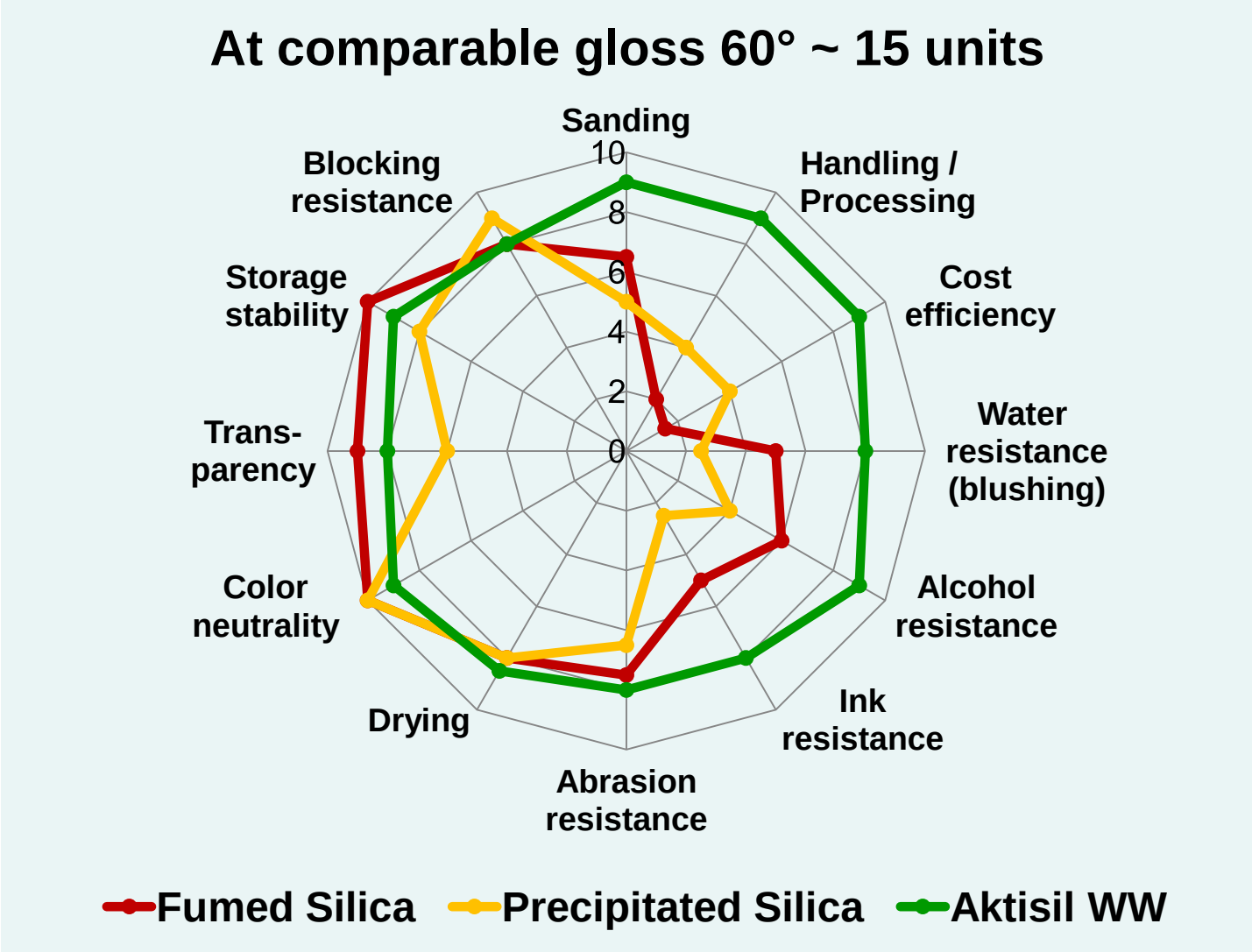


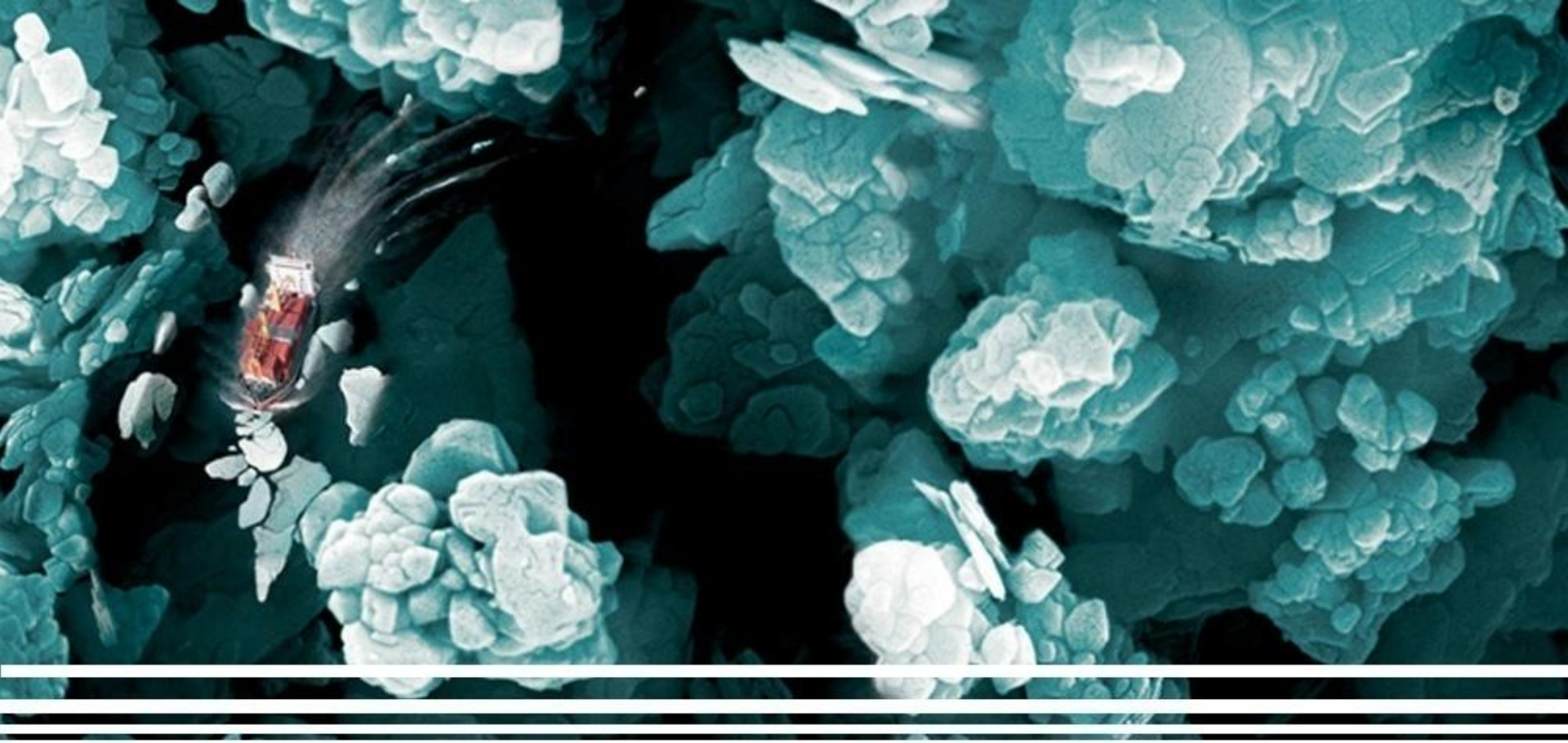


*back to selection*

*forward to summary*

# Overall Performance



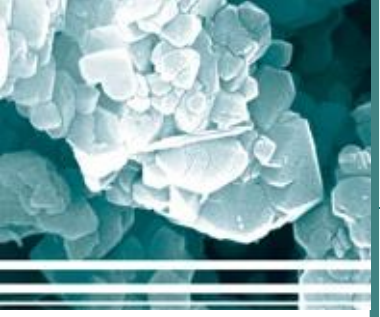


# Gloxil WW

## Functional Matting Agent for Water-based Clear Coats for Wood

Author: Bodo Essen

HOFFMANN MINERAL
We supply material for good ideas





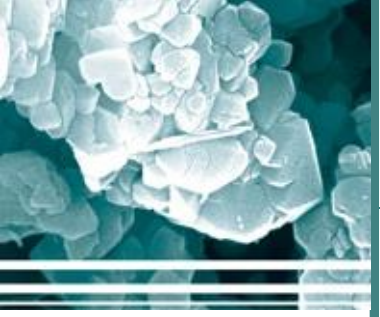
# Objective

Performance of Gloxil WW versus established Silica gel matting agent in a water-based clear coat for wood

**GLOXIL WW**

is matting agent on silica gel basis (Precipitated Silica)
that has been modified by treatment with a special additive

First product of Hoffmann Mineral which is not based
on our Neuburg Siliceous Earth since more than 20 Years



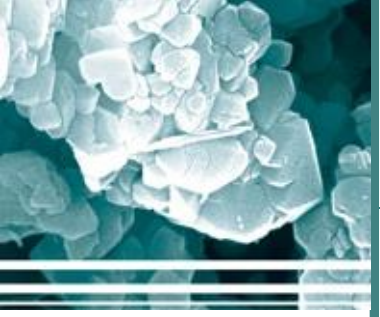


# Base Formulation

HOFFMANN MINERAL

| | | pbw * |
|---|---|---|
| Alberdingk AC 2514 | Binder, acrylic emulsion, self-crosslinking, MFFT 43 °C | 79.4 |
| Byk 024 | Defoamer | 0.8 |
| Butyl diglycol | Cosolvent | 6.0 |
| Butyl glycol | Cosolvent | 2.0 |
| Water demineralized | | 7.5 |
| Matting agent | Silica gel or Gloxil WW | varied X |
| Aquamat 272 | Wax dispersion | 3.3 |
| Byk 346 | Wetting agent | 0.4 |
| DSX 1514 | Thickener | 0.5 |
| Total | | 99.9 + X |

* Parts by weight



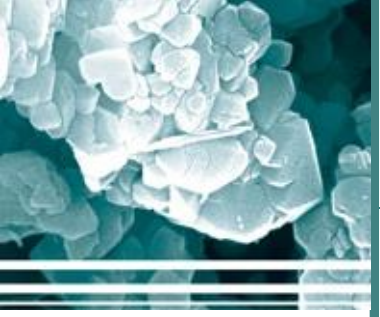


# Formulation Variations

HOFFMANN MINERAL

| | Without | With matting agent [pbw] | | | |
|---|---|---|---|---|---|
| **Silica gel** | **---** | **2.5** | **---** | **---** | **---** |
| **Gloxil WW** | **---** | **---** | **2.0** | **4.0** | **6.0** |
| Total | 99.9 | 102.4 | 101.9 | 103.9 | 105.9 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Solids content w/w | [%] | 37.2 | 38.7 | 38.4 | 39.6 | 40.7 |
| PVC | [%] | 0.0 | 3.9 | 4.7 | 9.0 | 12.9 |



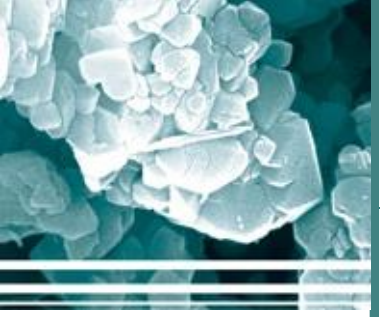


# Matting Agent

HOFFMANN MINERAL

## Characteristics

| | | Silica gel | Gloxil WW |
|---|---|---|---|
| Density | [g/cm³] | 2.0 | 1.3 |
| Particle size $d_{50}$ | [µm] | 9 | 8 |
| Oil absorption | [g/100g] | 320 | 120 |
| Specific surface area, BET | [m²/g] | 400 | unquantifyable |
| Surface treatment | | no | yes |





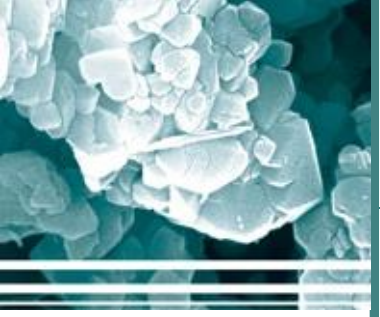
# Results

- Properties without significant difference

*forward to results*

- Processing properties and storage stability
- Matting / Transparency / Appearance on wood
- Water, alcohol and ink resistance

*forward to summary*





# Properties Without Significant Difference

HOFFMANN MINERAL

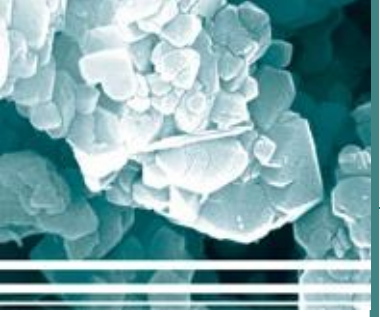
Evaluation after 28 d:

- Color
- Adhesion to wood
- Hardness of coating
- Abrasion resistance Taber S42 / CS17
- Burnish resistance
- Metal marking resistance
- Scratch resistance
- Blocking resistance

*back to selection*

*details in appendix*

*forward to summary*

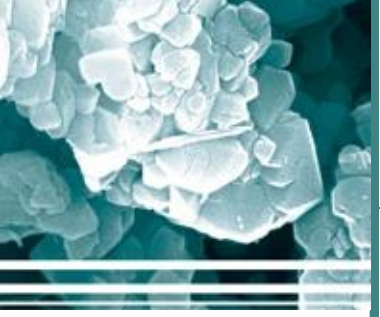


# Handling of powder material

HOFFMANN MINERAL



| | Silica gel | Gloxil WW |
|---|---|---|
| **Bulk volume**<br>**equal weight** |  | |
| **Reduced dust formation** |  |  |
| **Reduced adhesion on surfaces** |  | |

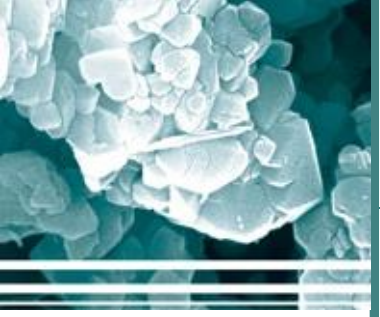




# Preparation / Storage

HOFFMANN MINERAL

| | Silica gel | Gloxil WW |
|---|---|---|
| **Incorporation** | 😐 | 🙂 |
| **Dispersibility** | 🙂 | |
| **Reduced foam formation** | 😐 | 🙂 |
| **Deaeration 12 h** | 🙂 | |
| **Viscosity** | Efflux time 15 - 16 s in DIN 4 mm | |
| **Storage stability 10 weeks 23 °C** | Slight settling of matting agent, easy to re-stir and to homogenize 🙂 | |





# Application Process

HOFFMANN MINERAL

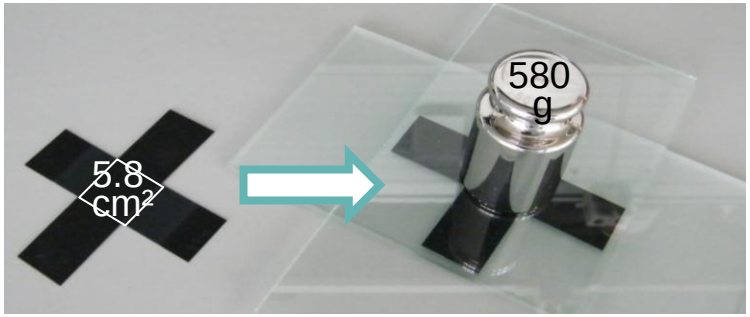
| | Silica gel | Gloxil WW |
|---|---|---|
| **Drying** |  | |
| **Sanding 24 h** |  | |

*details in appendix* 

| | | |
|---|---|---|
| **Early blocking resistance 24 h** |  |  |

Coated leneta strips
“face to face” crossed

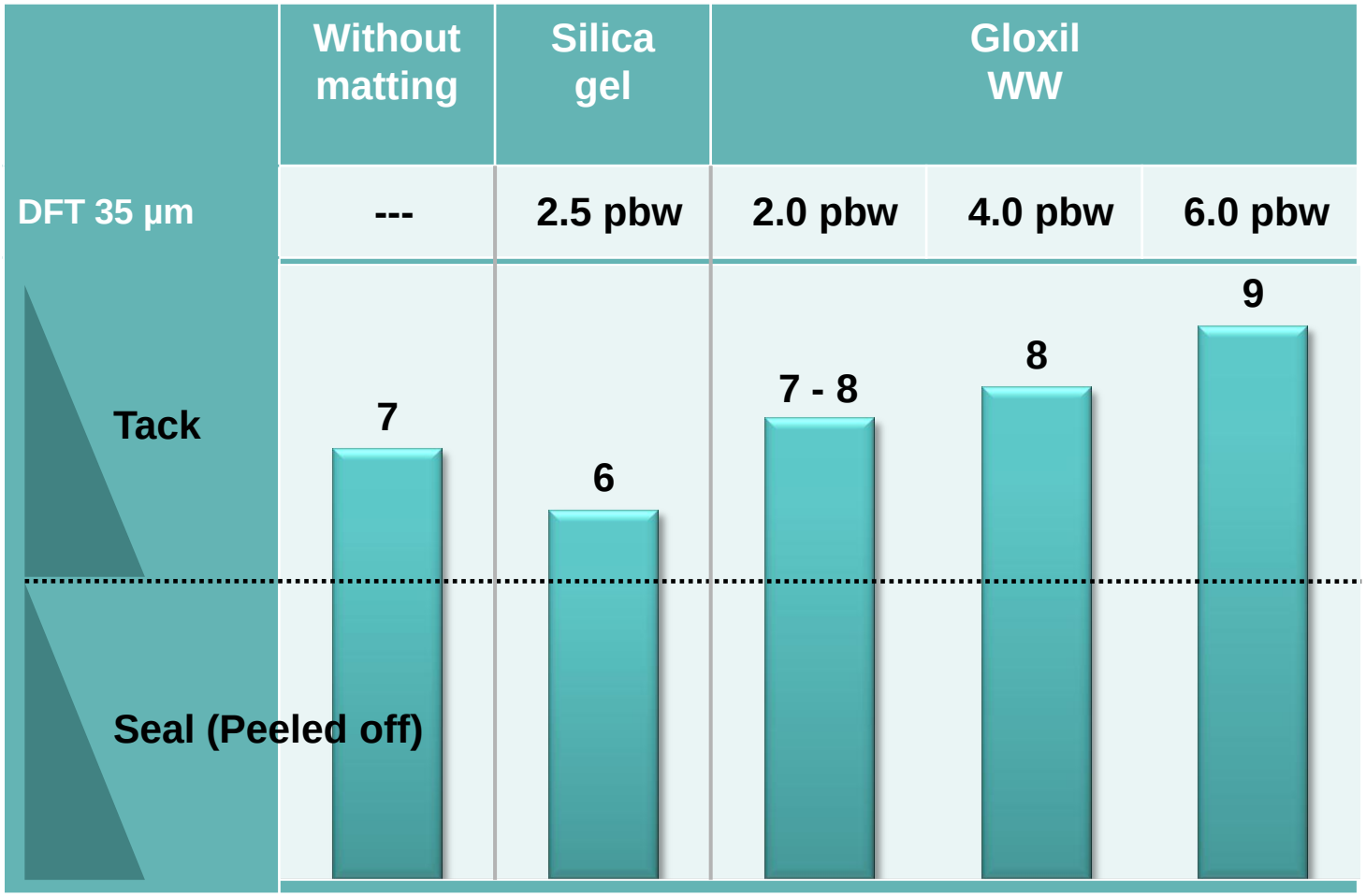
- DFT 35 µm
- Drying 24 h / 23°C / 50% rh
- Pressing 24 h / 100 g/cm² / 23°C



# Early Blocking Resistance 24 h

HOFFMANN MINERAL

Evaluation according to ASTM D 4946, 0 = worst, 10 = best

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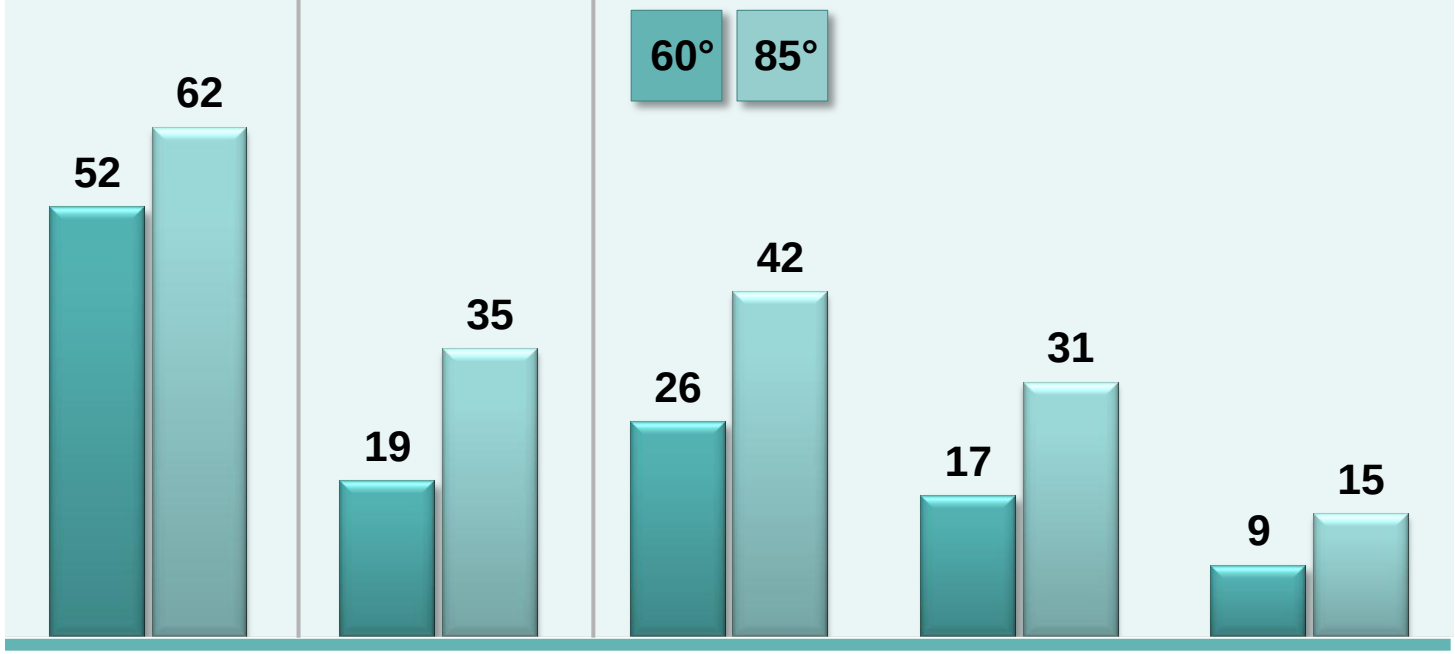
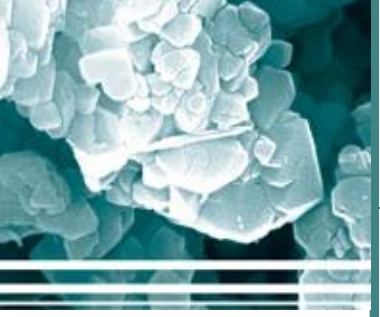
# Matting

Gloss level, DFT 35 µm

| Without matting | Silica gel | Gloxil WW | | |
|---|---|---|---|---|
| --- | 2.5 pbw | 2.0 pbw | 4.0 pbw | 6.0 pbw |



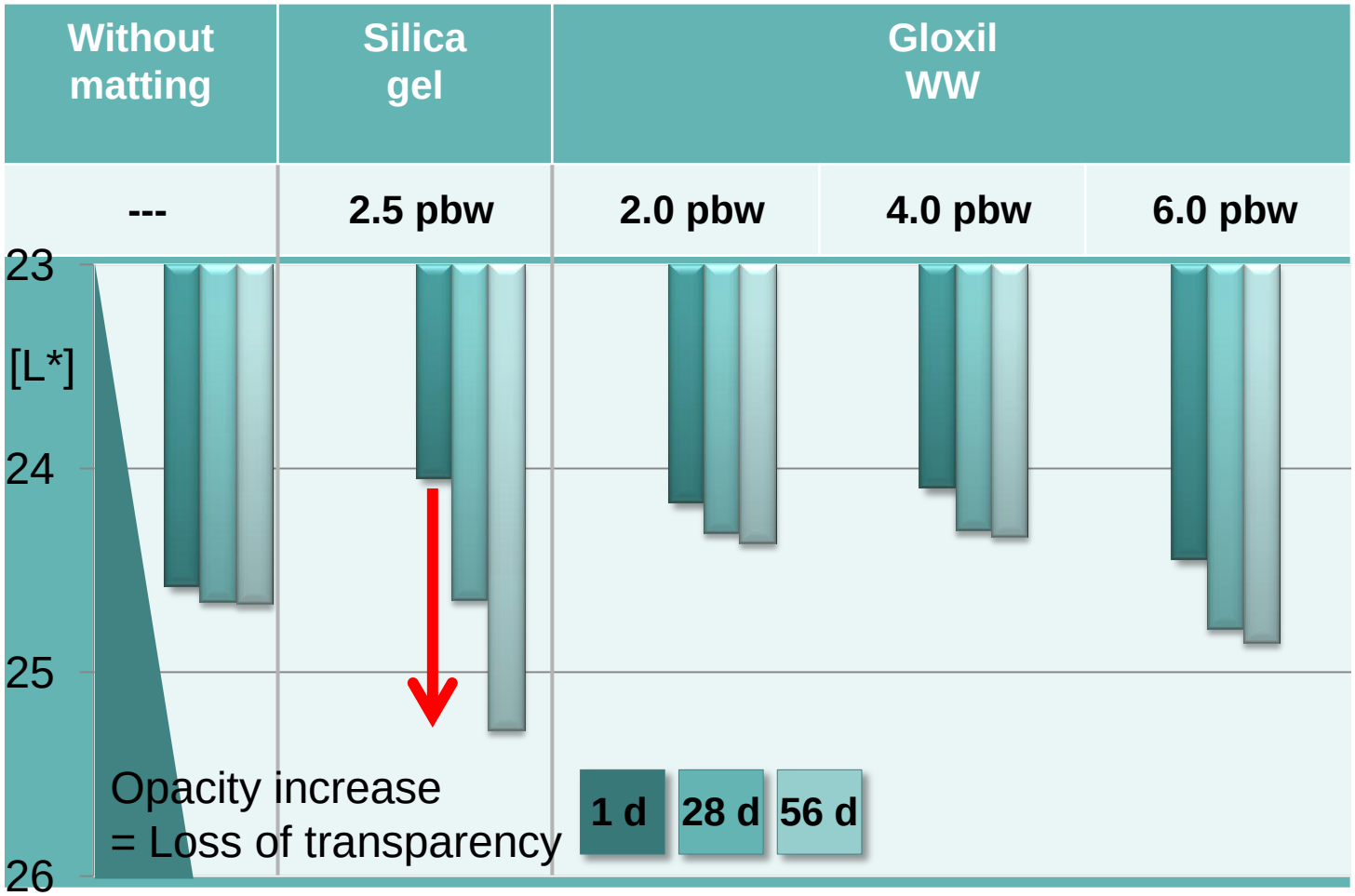




# Transparency

HOFFMANN MINERAL

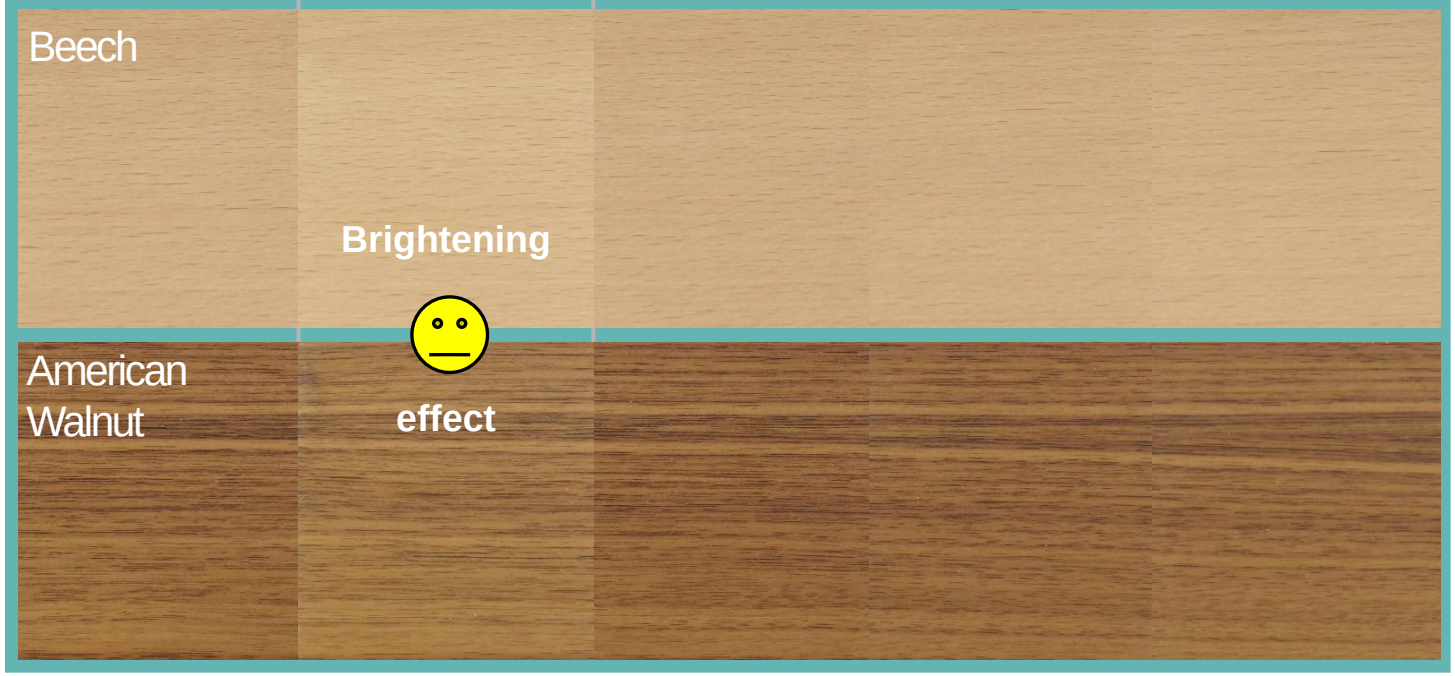
Brightness L* on black contrast cardboard, DFT 35 µm



# Appearance on Wood

Beech / American Walnut  Drying 28 d, DFT 105 µm (3 x 35)

| Without matting | Silica gel | Gloxil WW | | |
|---|---|---|---|---|
| --- | 2.5 pbw | 2.0 pbw | 4.0 pbw | 6.0 pbw |

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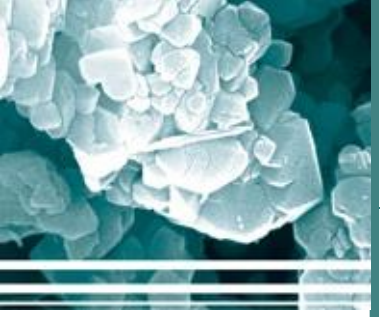



# Water Resistance

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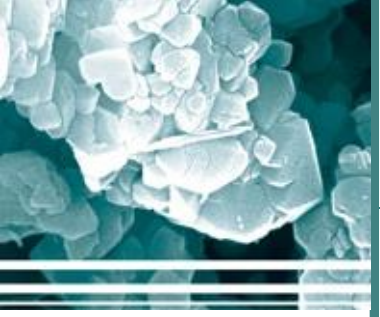
Early stage and 28 d after application acc. to DIN 68861-1, 1A

| DFT 105 µm (3 x 35) | | Without matting | Silica gel | Gloxil WW | | |
|---|---|---|---|---|---|---|
| Drying | Exposure | --- | 2.5 pbw | 2.0 pbw | 4.0 pbw | 6.0 pbw |
| 15 h | 1 h |  |  |  |  |  |
| 15 h | 16 h |  |  |  |  |  |
| 28 d | 16 h |  |  |  |  |  |



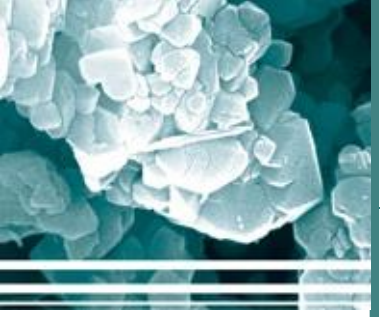


# Alcohol Resistance

HOFFMANN MINERAL

80 d after application, exposure time 16 h

| DFT 105 µm (3 x 35) | Without matting | Silica gel | Gloxil WW | | |
|---|---|---|---|---|---|
| | --- | 2.5 pbw | 2.0 pbw | 4.0 pbw | 6.0 pbw |
| Ethanol 48 % |  |  |  |  |  |
| Water (for comparison) |  |  |  |  |  |

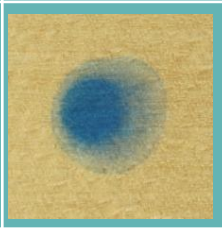
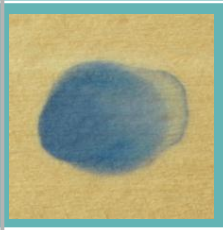
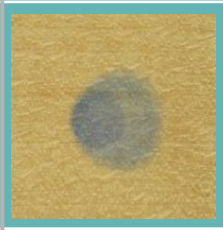




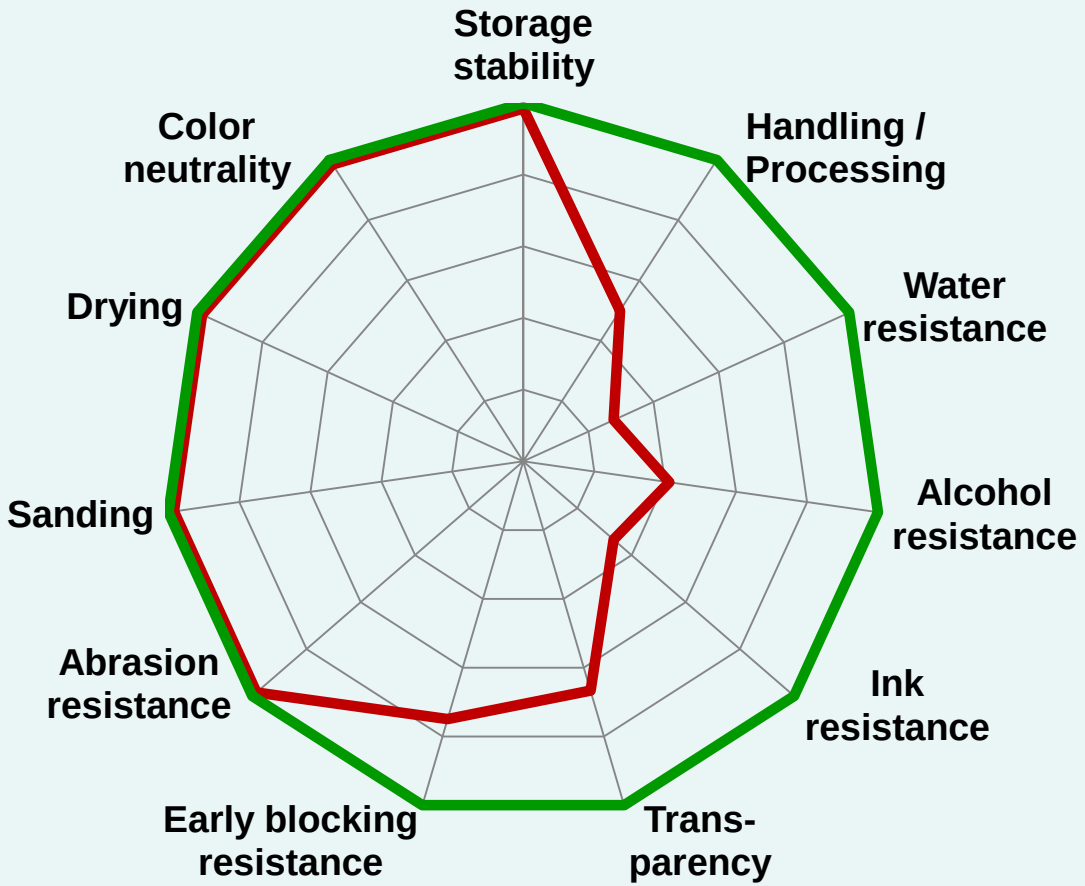
# Ink Resistance

HOFFMANN MINERAL

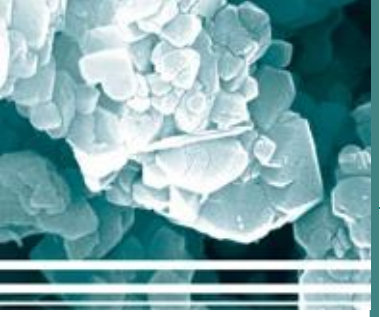
Early stage and 28 d after application acc. to DIN 68861-1, 1A

| DFT 105 µm (3 x 35) | | Without matting | Silica gel | Gloxil WW | | |
|---|---|---|---|---|---|---|
| Drying | Exposure | --- | 2.5 pbw | 2.0 pbw | 4.0 pbw | 6.0 pbw |
| 15 h | 1 h |  |  Blushing effect |  |  |  |
| 15 h | 5 h |  |  |  |  |  |
| 28 d | 16 h |  |  |  |  |  |

# Overall Performance




back to selection



# Thank you very much!

HOFFMANN MINERAL GmbH • P.O.Box 14 60 • D-86619 Neuburg (Donau)
Phone +49 (0) 8431-53-0 • Fax +49 (0) 8431-53-3 30
Internet: www.hoffmann-mineral.com • e-Mail: info@hoffmann-mineral.com