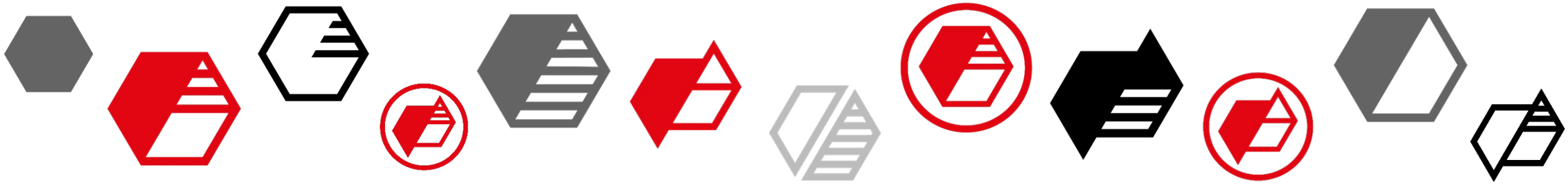


# Neuburg Siliceous Earth in water-based corrosion protection

# DTM acrylate single-layer white, Covestro base

**Author:** Bodo Essen

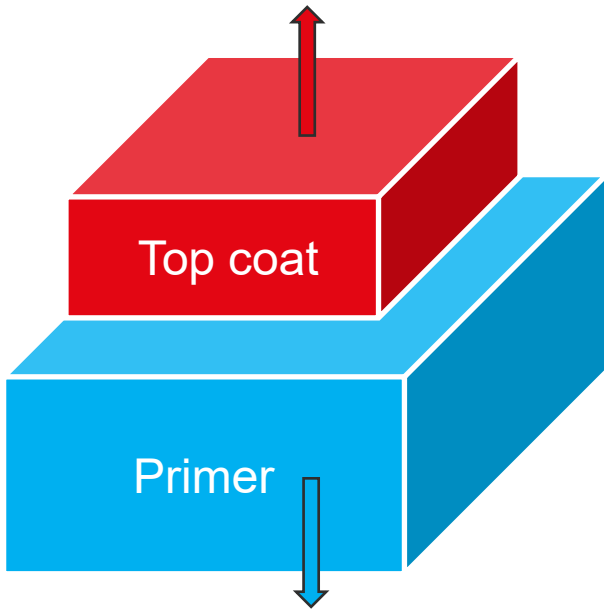
HOFFMANN MINERAL®
We supply material for good ideas

# Contents

# Status Quo

## Classical coating multi-layered

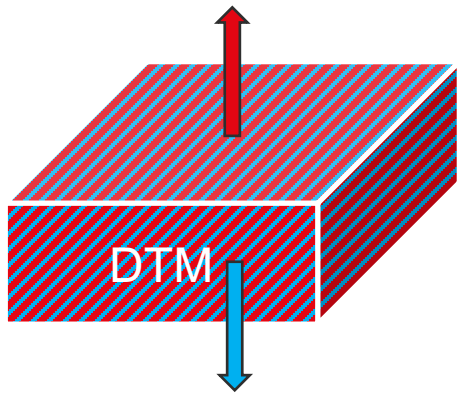
Optical appearance




Corrosion protection for substrate

## Combined performance in a single Direct to metal layer

Gloss / Color
Hiding power




Adhesion
Barrier effect

- ✓ reduced material consumption
- ✓ cost-effective
- ✓ faster application + „return to service“

**Optimizable by**
**Neuburg Siliceous Earth**

# Objective

Improvement of the DTM property profile of a white, filler-free corrosion protection coating through the use of suitable functional fillers.

Challenges:

- Maintaining optical properties, especially gloss level.
- Satisfactory protective effect in humidity test and salt spray test.
  already in the single-layer and at low layer thickness.
- Preferably without corrosion protection pigments.
- With improved $CO_2$ footprint.

# Base Formulation

| | | | | parts by weight |
|---|---|---|---|---|
| Pigment preparation | NeoCryl XK-85 | | Binder, acrylic emulsion | 18.55 |
| | Water deionized | Premix | | 2.52 |
| | AMP-95 | | Multifunctional additive | 0.20 |
| | Acrysol RM 8 WE (1:6 in $H_2O$) | | Rheology modifier | 0.54 |
| | Disperbyk 190 BF | | Dispersing additive | 1.05 |
| | Byk 024 | | Defoamer | 0.13 |
| | Surfynol 104E | | Surfactant additive | 0.33 |
| | Kronos 2310 | | Pigment white $TiO_2$ | 19.60 |
| | Nubirox 302 | | Anti-corrosion pigment | 2.79 |
| Let Down | NeoCryl XK-85 | | Binder, acrylic emulsion | 49.53 |
| | Dowanol DPnB | | Solvent, coalescent agent | 3.32 |
| | Nalzin FA-179 | | Flashrust inhibitor | 0.33 |
| | Acrysol RM 8 WE (1:6 in $H_2O$) | | Rheology modifier | 1.11 |
| | **Total** | | | **100.00** |
| | Solids content w/w [%] | | | 50.7 |
| | v/v [%] | | | 38.9 |
| | PVC [%] | | | 19.1 |

Water-based DTM 1K Acrylic Anti-corrosion Coating

of Covestro company

No filler

For variants with filler:

replacement of
50 % white pigment portion v/v

and additionally with NSE replacement of
100 % anti corrosion pigment v/v

# Formulation variants

| | Control | - 50 % $TiO_2$ replaced1:1 v/v by filler | | and anti-corrosion pigment replaced 1:1 v/v by filler |
|---|---|---|---|---|
| | | Classical standards | | |
| | No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |
| Pigment- / filler dosage [Parts by weight on formulation] | | | | |
| Kronos 2310 | 19.60 | 9.80 | 9.80 | 9.80 |
| Nubirox 302 | 2.79 | 2.79 | 2.79 | |
| Talc | | 7.23 | | |
| Barium sulfate ppt | | | 10.78 | |
| Neuburg Siliceous Earth | | | | 8.85 |

# Filler characteristics

| | Particle size | | Oil absorption | Density | Spezific surface area BET | Color | | | Special characteristics |
|---|---|---|---|---|---|---|---|---|---|
| | $d_{50}$ [µm] | $d_{97}$ [µm] | [g/100g] | [g/cm³] | [m²/g] | L* | a* | b* | Surface treatment |
| Talc | 4.4 | 12.5 | 54 | 2.8 | 8.3 | 98.3 | 0.0 | 0.8 | - |
| Barium sulfate ppt | 0.9 | 3.5 | 15 | 4.4 | 2.7 | 99.9 | - 0.1 | 1.0 | - |
| Aktisil PF 115/89 | 1.6 | 7.3 | 46 | 2.6 | 9.1 | 96.4 | 0.1 | 3.8 | amino-functionalized hydrophobic |

i Structure Neuburg Siliceous Earth

# Preparation and application

| | |
|---|---|
| Mixing  Source: VMA Getzmann | Pigment preparation<br>• Dissolver with toothed disc (Cowles Blade)<br>• Submission of part of binder<br>• Successively dosage of Premix, additives and pigments (+ filler) at 5 m/s speed<br>• Dispersing 15 min at 8 m/s under ice water cooling until fineness of grind < 5 µm<br><br>Let Down<br>• Addition of remaining binder and ingredients at 5.0 m/s<br>• After dosing thickener finally 5 min mixing avoiding air entry |
| Application | After 10 d maturing time on cold-rolled steel, Q-Panel Type R 48<br>Doctor blade: **Single-layered → Dry film thickness ~ 50 µm** |
| Conditioning | 14 d drying at 23 °C / 50 % relative humidity |

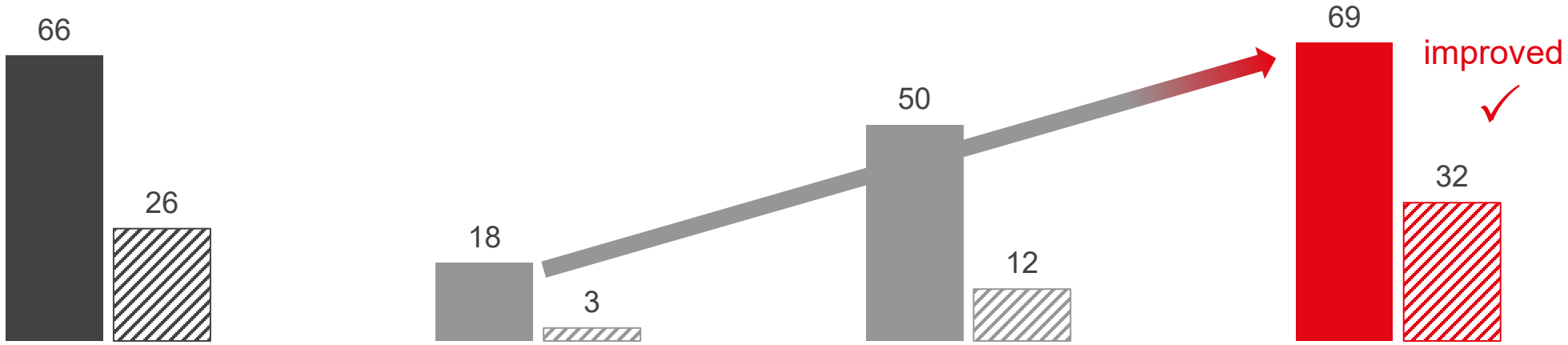
# Optical performance

| | | Control | - 50 % $TiO_2$ replaced 1:1 v/v by filler | | and anti-corrosion pigment replaced 1:1 v/v by filler |
|---|---|---|---|---|---|
| Color | L* | 97.7 | 96.7 | 96.9 | 96.3 |
| | a* | - 0.7 | - 0.7 | - 0.6 | - 0.6 |
| | b* | 0.8 | 1.0 | 1.0 | 2.4 |
| Hiding | [%] | 99.2 | 98.3 | 98.1 | 98.2 |

Gloss [GU]

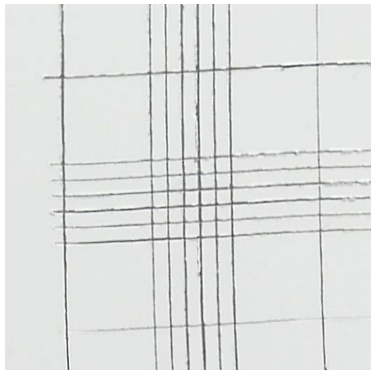
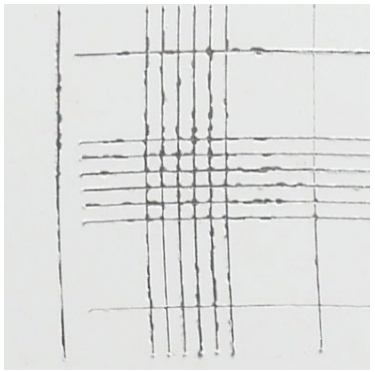
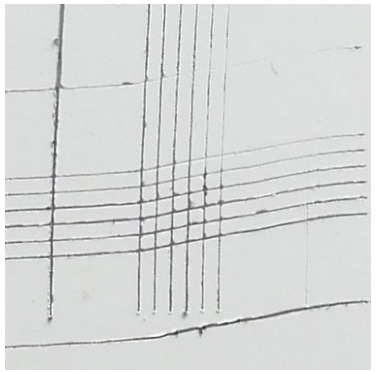
60°

20°




| No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |
|---|---|---|---|

# Mechanical performance

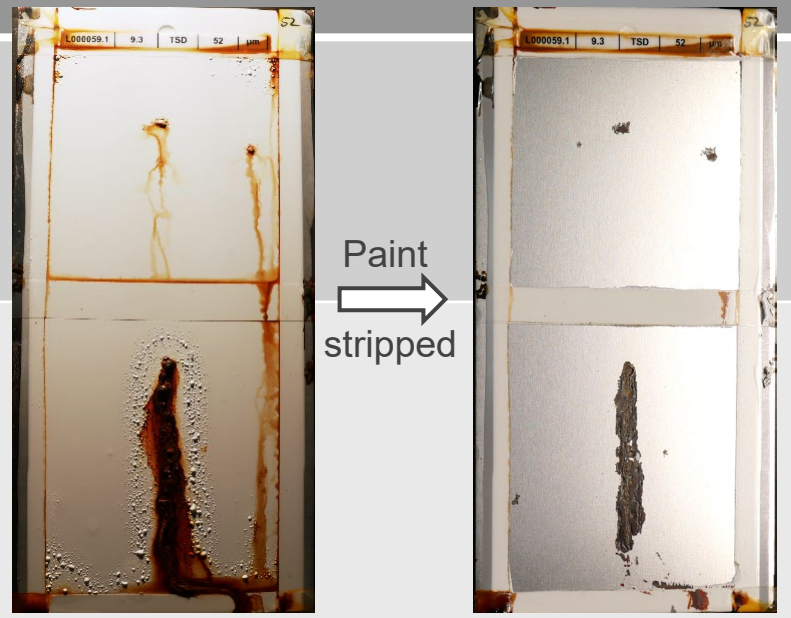
| | | Control | - 50 % $TiO_2$ replaced 1:1 v/v by filler | | and anti-corrosion pigment replaced 1:1 v/v by filler |
|---|---|---|---|---|---|
| Pendulum hardness Koenig | 7 d | 27 | 28 | 28 | 24 |
| | 14 d | 35 | 36 | 35 | 31 |
| Adhesion Cross-cut 1 mm | | GT 1 - 2 | GT 0 - 1 | GT 1 - 2 | GT 1 |
| | |  |  |  |  |
| | | No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |

# Corrosion protection

## Evaluation criteria on non-scribed paint film area and at scribe

| Humidity test | DIN EN ISO 6270-2 CH |
|---|---|
| Non-scribed | • Adhesion (Cross-cut test)<br>• Blistering<br>• Corrosion (stripped) |


| Salt spray test | DIN EN ISO 9227 NSS |
|---|---|
| Non-scribed | • Adhesion<br>• Blistering<br>• Corrosion (stripped) |
| Scribed<br><br>Sikkens 1 mm wide / 6 cm long | • Blistering<br>• Delamination<br>• Corrosion (stripped) |

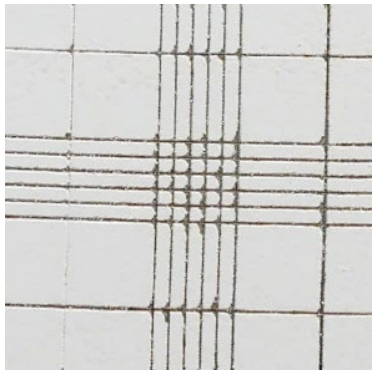
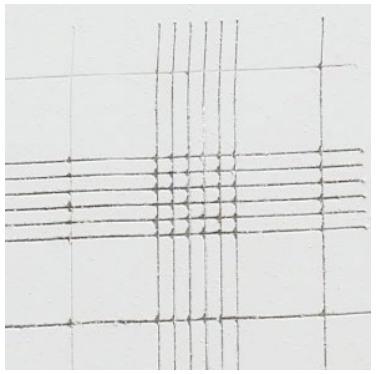
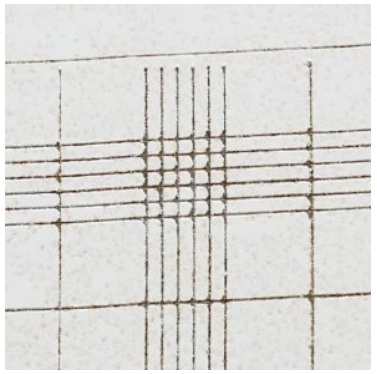
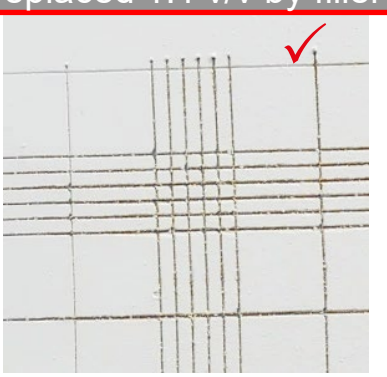
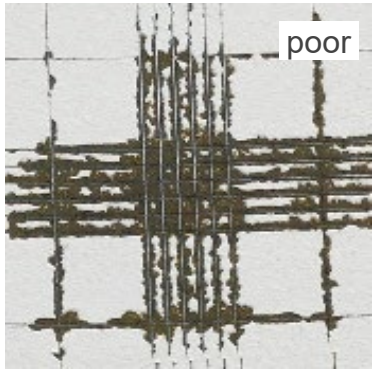
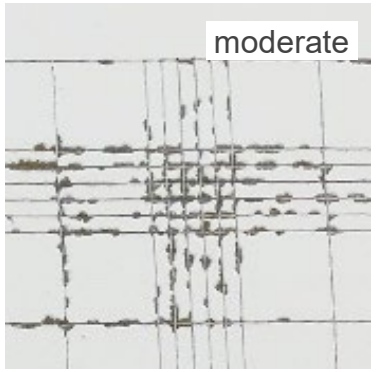
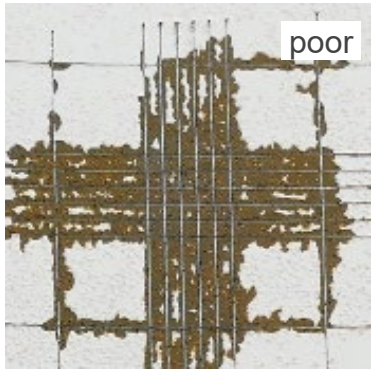
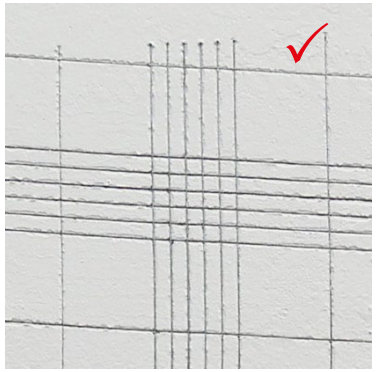


# Humidity test 650 h Adhesion by cross-cut 1 mm

Control

- 50 % $TiO_2$ replaced 1:1 v/v by filler

and anti-corrosion pigment replaced 1:1 v/v by filler

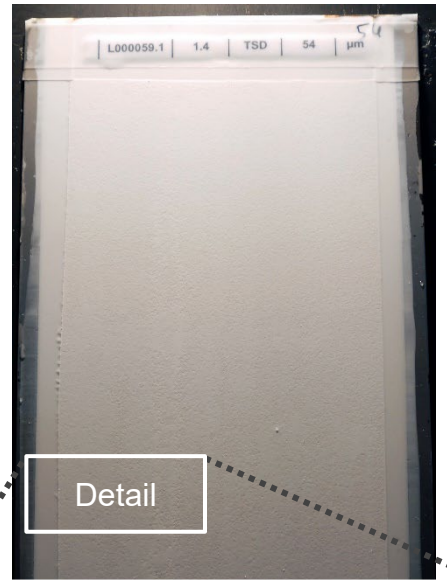
| | No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |
|---|---|---|---|---|
| Wet without adhesive tape |  |  |  |  ✓ |
| Dry with adhesive tape |  poor |  moderate |  poor |  ✓ |

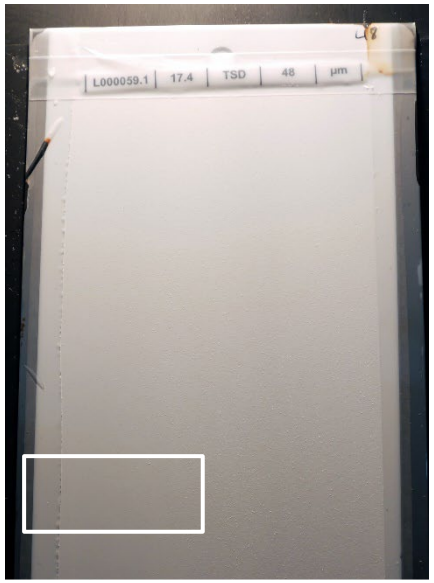
# Humidity test 650 h Corrosion resistance

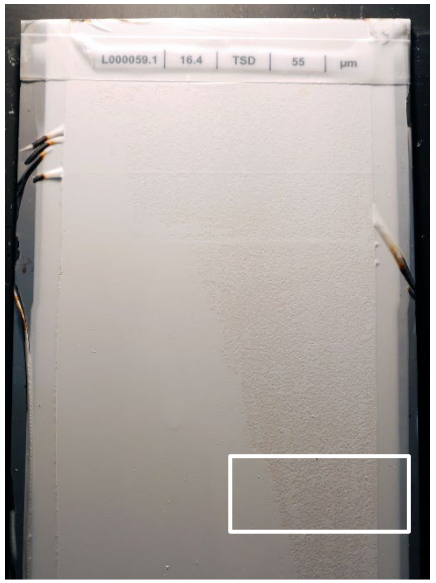
Control

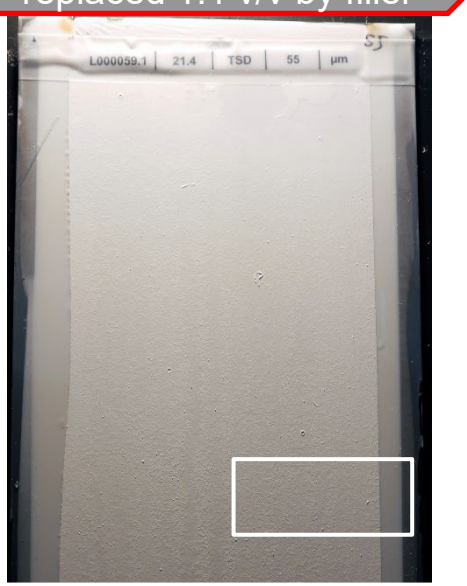
- 50 % $TiO_2$ replaced 1:1 v/v by filler

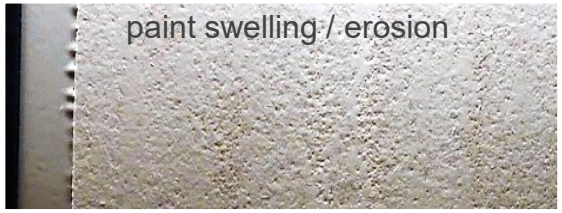
and anti-corrosion pigment replaced 1:1 v/v by filler



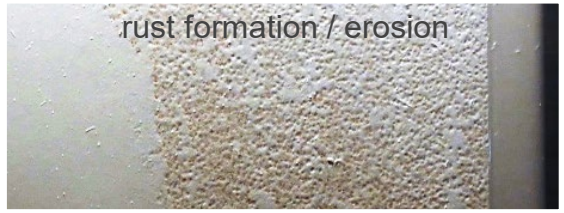



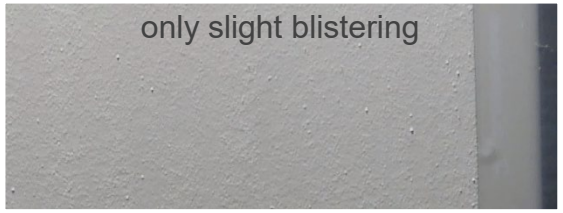











| No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |
|---|---|---|---|

# Humidity test 650 h Corrosion resistance Paint stripped

Control

- 50 % $TiO_2$ replaced 1:1 v/v by filler

and anti-corrosion pigment replaced 1:1 v/v by filler


No filler


Talc


Barium sulfate ppt


Aktisil PF 115/89

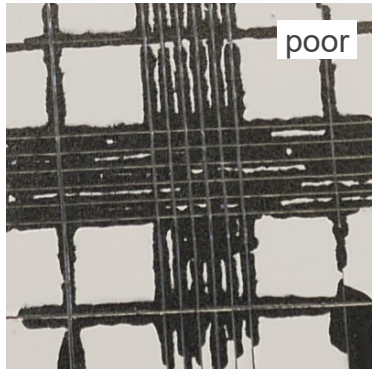
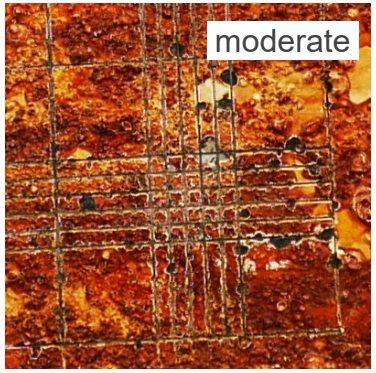
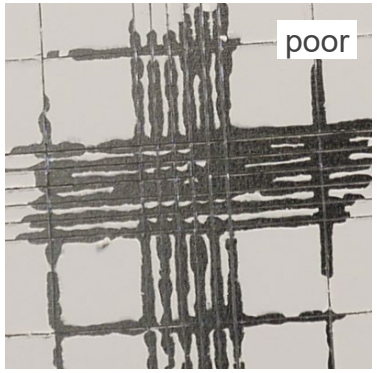
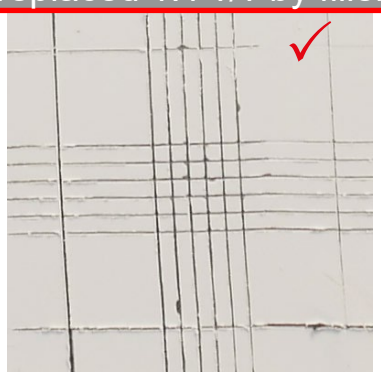
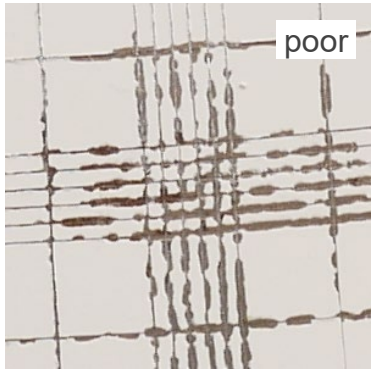
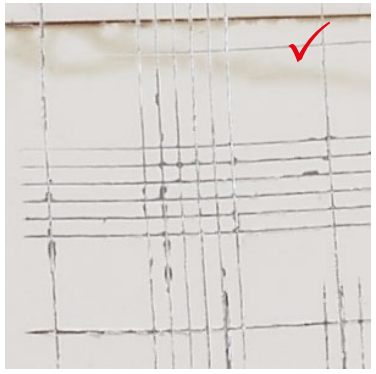
i and classical fillers ?

# Salt spray test 650 h Non-scribed area Adhesion by cross-cut 1 mm

Control

- 50 % $TiO_2$ replaced 1:1 v/v by filler

and anti-corrosion pigment replaced 1:1 v/v by filler

| | No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |
|---|---|---|---|---|
| Wet with adhesive tape |  poor |  moderate |  poor |  ✓ |
| Dry with adhesive tape |  poor |  ✓ |  poor |  ✓ |

# Salt spray test 650 h Non-scribed area Corrosion resistance

Control

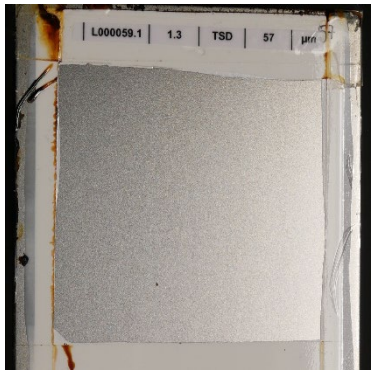
- 50 % $TiO_2$ replaced 1:1 v/v by filler

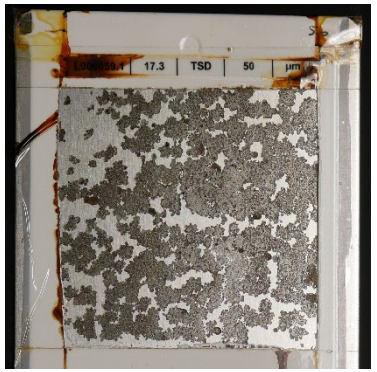
and anti-corrosion pigment replaced 1:1 v/v by filler

Paint stripped

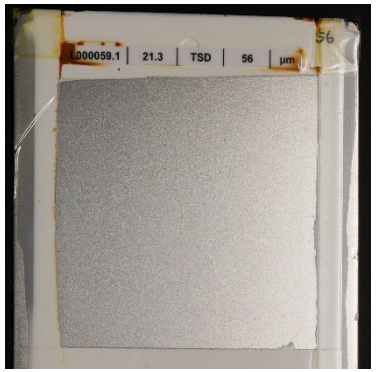











| No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |
|---|---|---|---|

# Salt spray test 650 h Scribed area Corrosion resistance

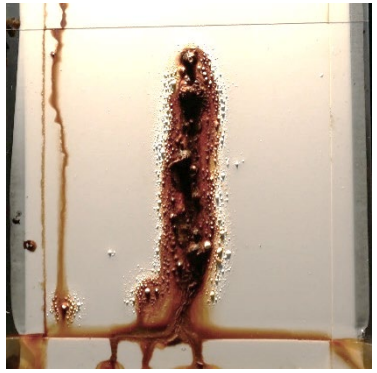
Control

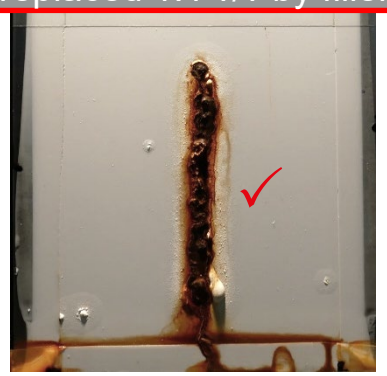
- 50 % $TiO_2$ replaced 1:1 v/v by filler

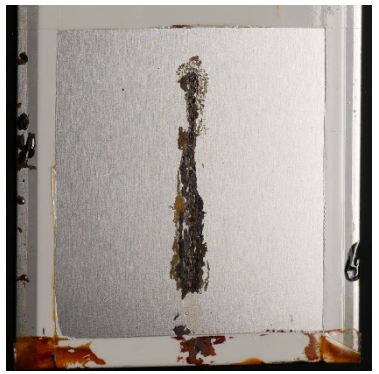
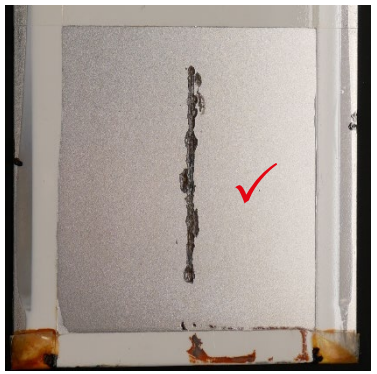
and anti-corrosion pigment replaced 1:1 v/v by filler

All variants: No delamination area or adhesion loss detectable at scribe

stripped



| No filler | Talc | Barium sulfate ppt | Aktisil PF 115/89 |
|---|---|---|---|

i and classical fillers ?



HOFFMANN MINERAL

# Conclusion

Addition of Aktisil PF 115/89 instead of 50 % $TiO_2$ and 100 % anti-corrosion pigment beneficially gains

- ✓ higher gloss for better optical appearance
- ✓ optimized, excellent adhesion
- ✓ extended corrosion protection due to effective paint barrier effect and improved wet and dry adhesion during / after exposure tests
  - high humidity resistance against paint degradation, swelling, blistering or under-film rusting
  - rust protection at scribe + non-scribed area in salt spray test
- ✓ no need for anti-corrosive pigment
- ✓ significant white pigment replacement
- ✓ synergy with single-layered DTM application

» improved technical performance

+

» raw material savings cost savings

=

Potential for higher sustainability and carbon-footprint reduction. ✓

# Starting formulation

| | | | | parts by weight | [%] |
|---|---|---|---|---|---|
| Pigment preparation | NeoCryl XK-85 | | Binder, acrylic emulsion | 18.55 | 19.27 |
| | Water deionized | Premix | | 2.52 | 2.62 |
| | AMP-95 | | Multifunctional additive | 0.20 | 0.21 |
| | Acrysol RM 8 WE (1:6 in $H_2O$) | | Rheology modifier | 0.54 | 0.56 |
| | Disperbyk 190 BF | | Dispersing additive | 1.05 | 1.09 |
| | Byk 024 | | Defoamer | 0.13 | 0.14 |
| | Surfynol 104E | | Surfactant additive | 0.33 | 0.34 |
| | Kronos 2310 | | Pigment white $TiO_2$ | 9.80 | 10.18 |
| | Aktisil PF 115/89 | | Filler, Neuburg Siliceous Earth | 8.85 | 9.19 |
| Let Down | NeoCryl XK-85 | | Binder, acrylic emulsion | 49.53 | 51.46 |
| | Dowanol DPnB | | Solvent, coalescent agent | 3.32 | 3.45 |
| | Nalzin FA-179 | | Flashrust inhibitor | 0.33 | 0.34 |
| | Acrysol RM 8 WE (1:6 in $H_2O$) | | Rheology modifier | 1.11 | 1.15 |
| | **Total** | | | **96.26** | **100.00** |
| | Solids content w/w | | | | 48.8 |
| | v/v | | | | 38.9 |
| | PVC | | | | 19.1 |

## Water-based DTM 1K Acrylate Anti-corrosion coating

- cost-effective direct-to-metal single-layer system for sustainable metal protection and reduced $CO_2$ footprint
- aktiv pigment free
- reduced titanium dioxide content
- high gloss
- high wet- / dry adhesion
- very good humidity- and corrosion resistance

# We supply material for good ideas!

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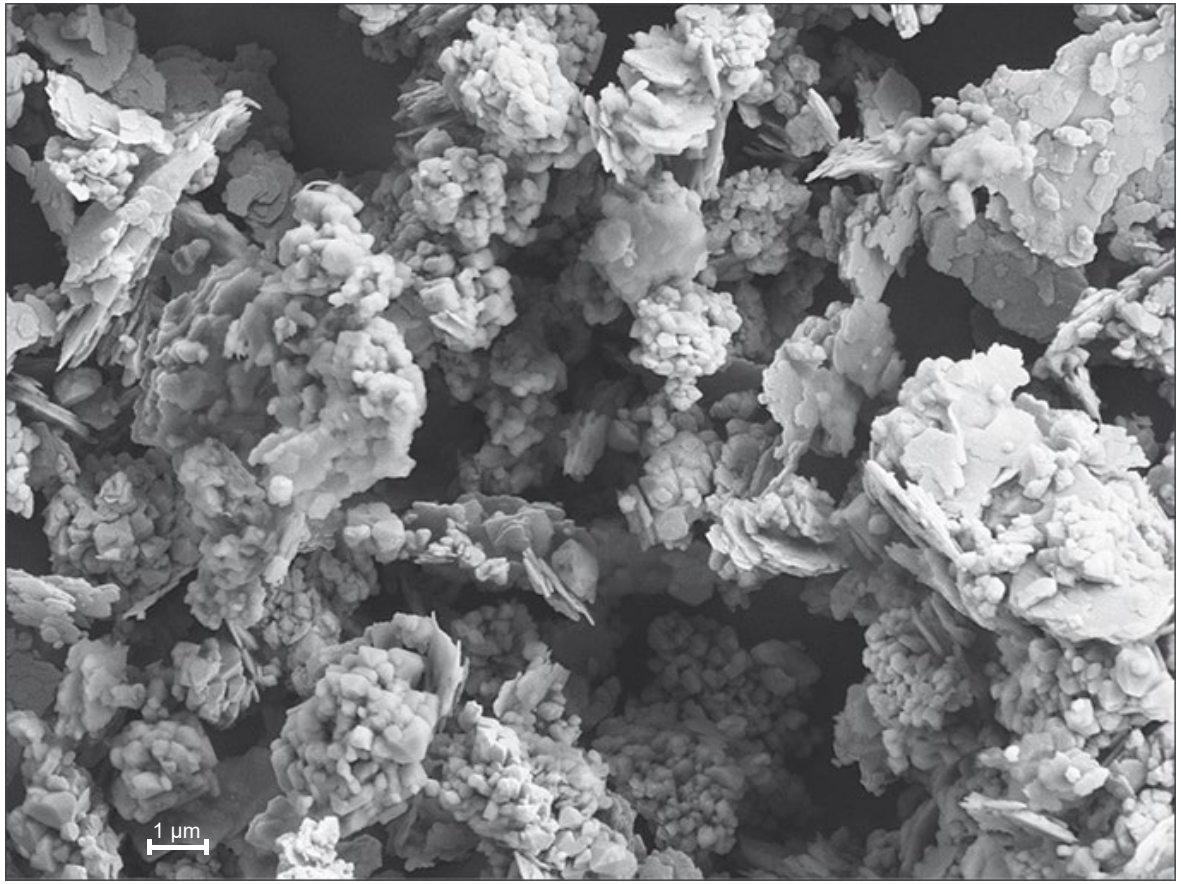
# Neuburg Siliceous Earth

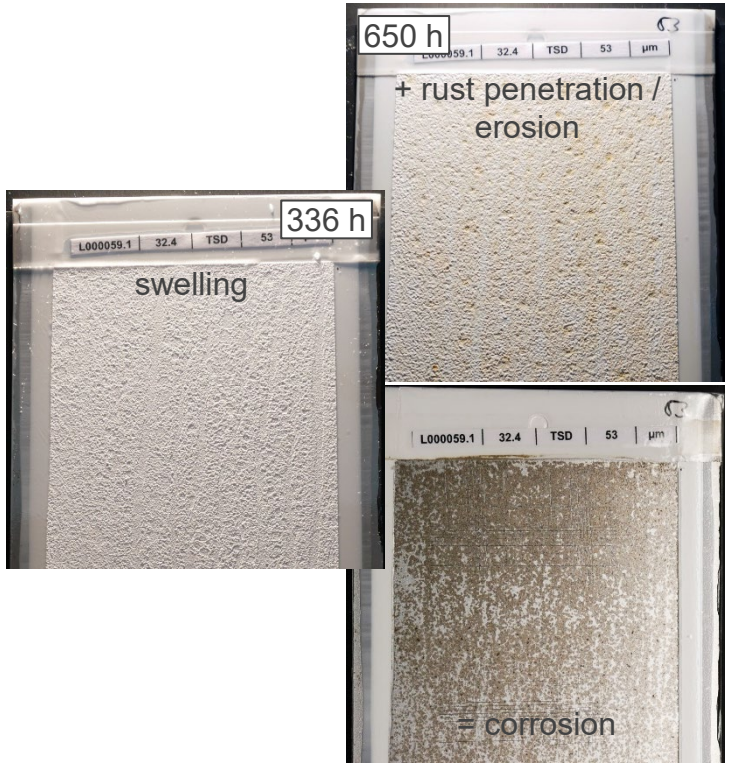



A natural combination of corpuscular Neuburg silica and lamellar kaolinite: a loose mixture impossible to separate by physical methods. The silica portion exhibits a round grain shape and consists of aggregated primary particles of about 200 nm diameter.

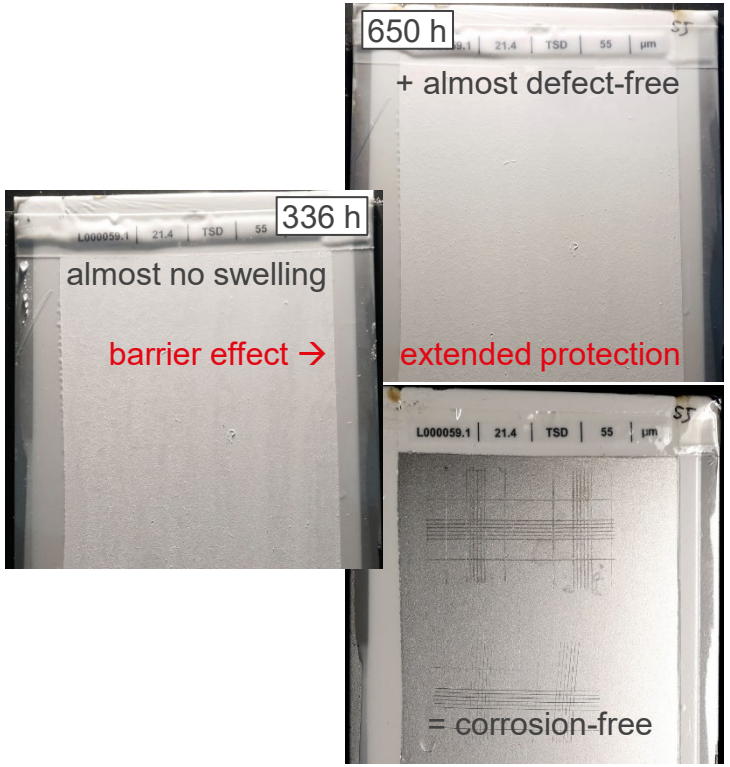
# Humidity test — Protection without anti-corrosion pigment?

50 % $TiO_2$ and 100 % anti-corrosion pigment replaced 1:1 v/v by filler


Talc → no !




Barium sulfate ppt → no !

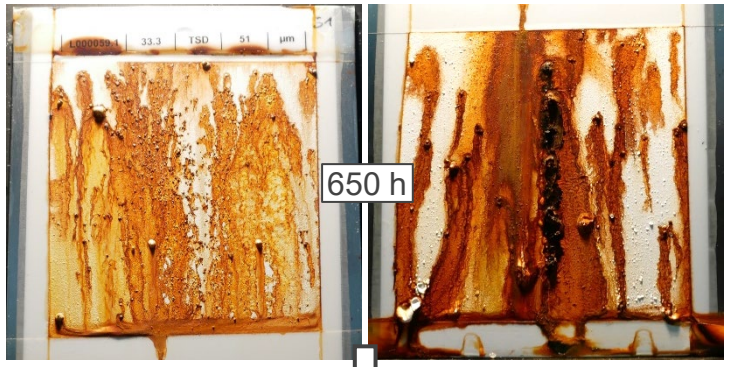



Aktisil PF 115/89 → ✓

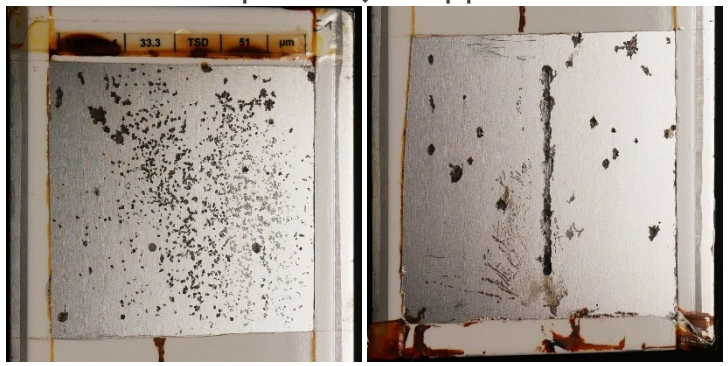
# Salt spray test — Protection without anti-corrosion pigment?

50 % $TiO_2$ and 100 % anti-corrosion pigment replaced 1:1 v/v by filler

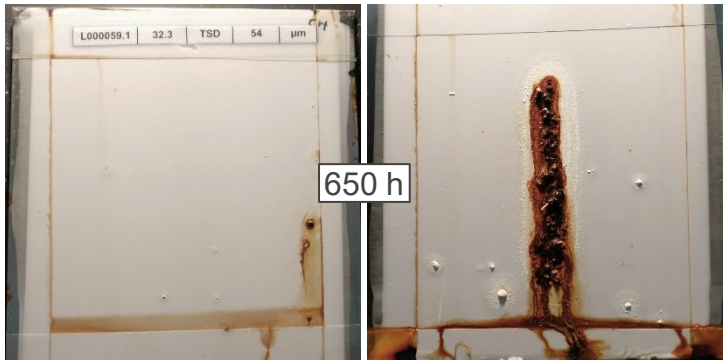
non-scribed area | scribed area

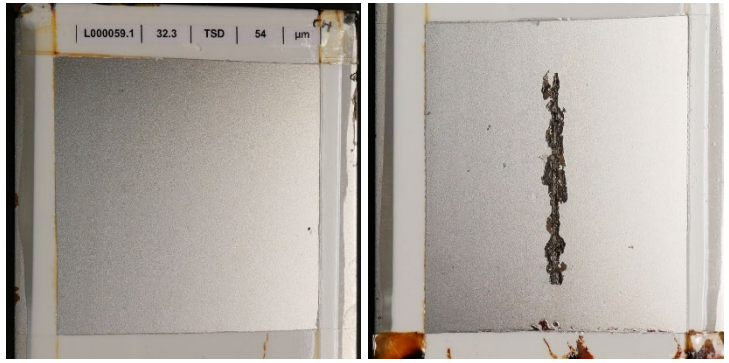



paint stripped

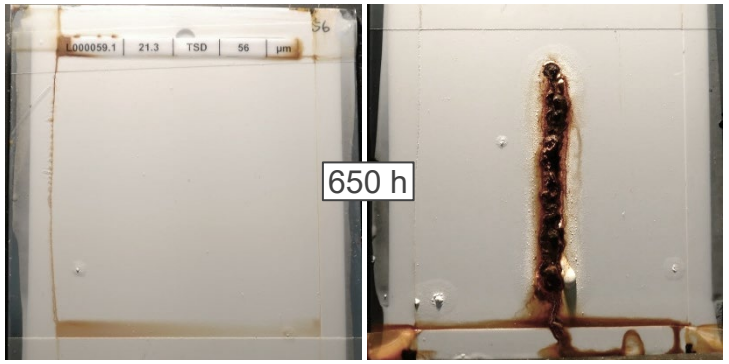


Talc → no !



Barium sulfate ppt → ~ ok





Aktisil PF 115/89 → ✓