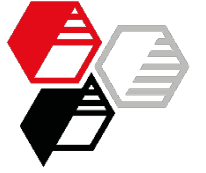


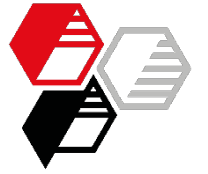
Neuburg Siliceous Earth in water-based corrosion protection DTM acrylate single-layer white, Covestro base

Author: Bodo Essen

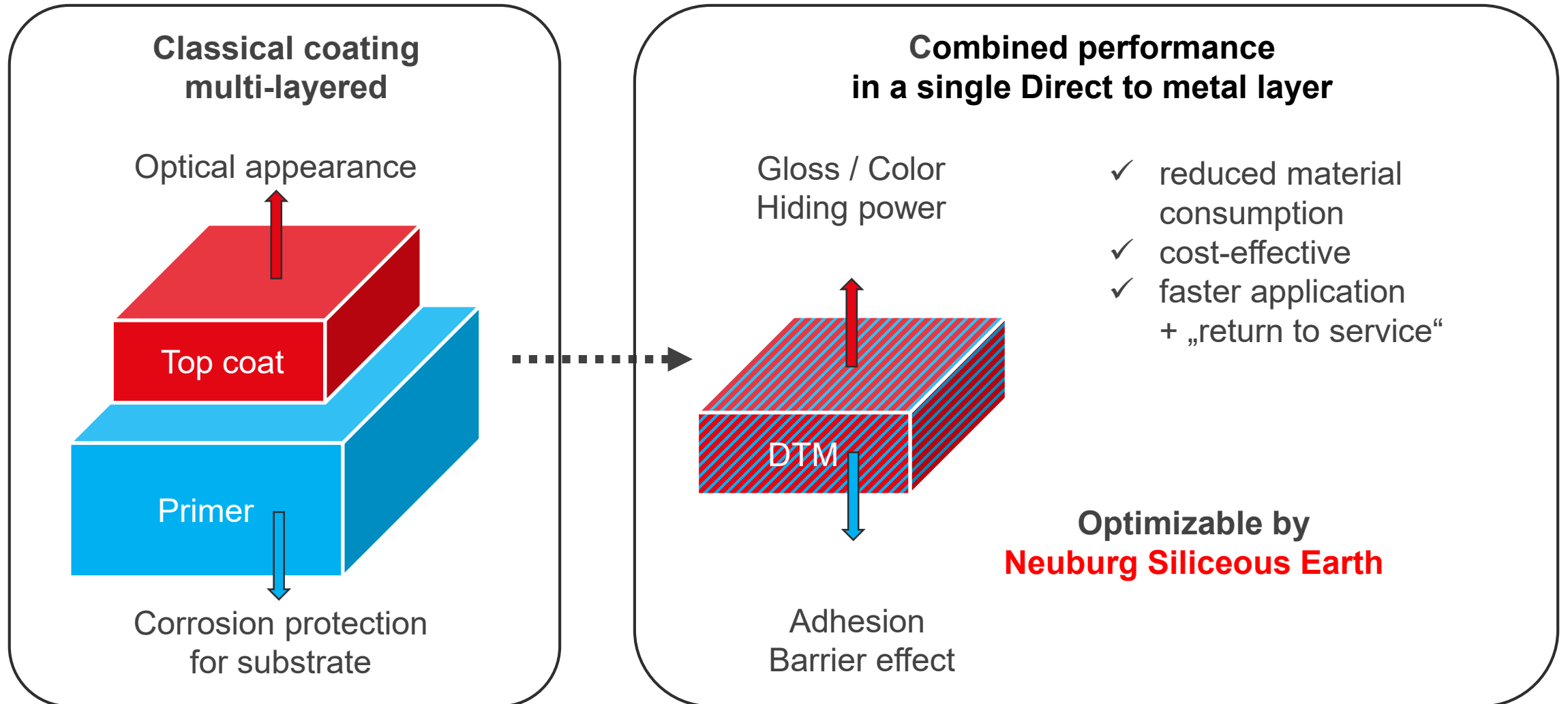


Contents

- Introduction
- Experimental
- Results
 - Optical performance
 - Mechanical performance
 - Corrosion protection
 - Humidity test
 - Salt spray test
- Summary
- Appendix



Status Quo



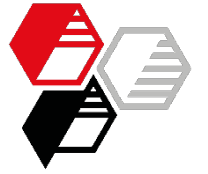


Objective

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 CO₂ footprint.



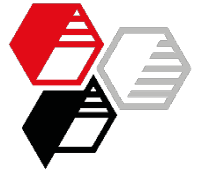
Base Formulation

		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 ₂ O)		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 ₂ O)	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

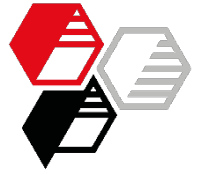


Formulation variants



Pigment- / filler dosage
[Parts by weight on formulation]

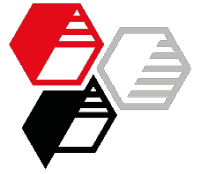
Kronos 2310	19.60	9.80	9.80	9.80
Nubirox 302	2.79	2.79	2.79	
Talc		7.23		
Barium sulfate ppt			10.78	
Neuburg Siliceous Earth				8.85




Filler characteristics

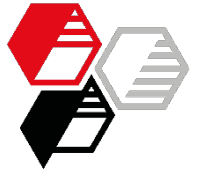
	Particle size		Oil absorption [g/100g]	Density [g/cm ³]	Spezific surface area BET [m ² /g]	Color			Special characteristics Surface treatment
	d ₅₀ [μm]	d ₉₇ [μm]				L*	a*	b*	
Talc	4.4	12.5	54	2.8	8.3	98.3	0.0	0.8	-
Barium sulfate ppt	0.9	3.5	15	4.4	2.7	99.9	- 0.1	1.0	-
TP 2022060 = coated Sillitin Z 89	1.6	7.3	46	2.6	9.1	96.4	0.1	3.8	amino- functionalized hydrophobic

i Structure Neuburg Siliceous Earth

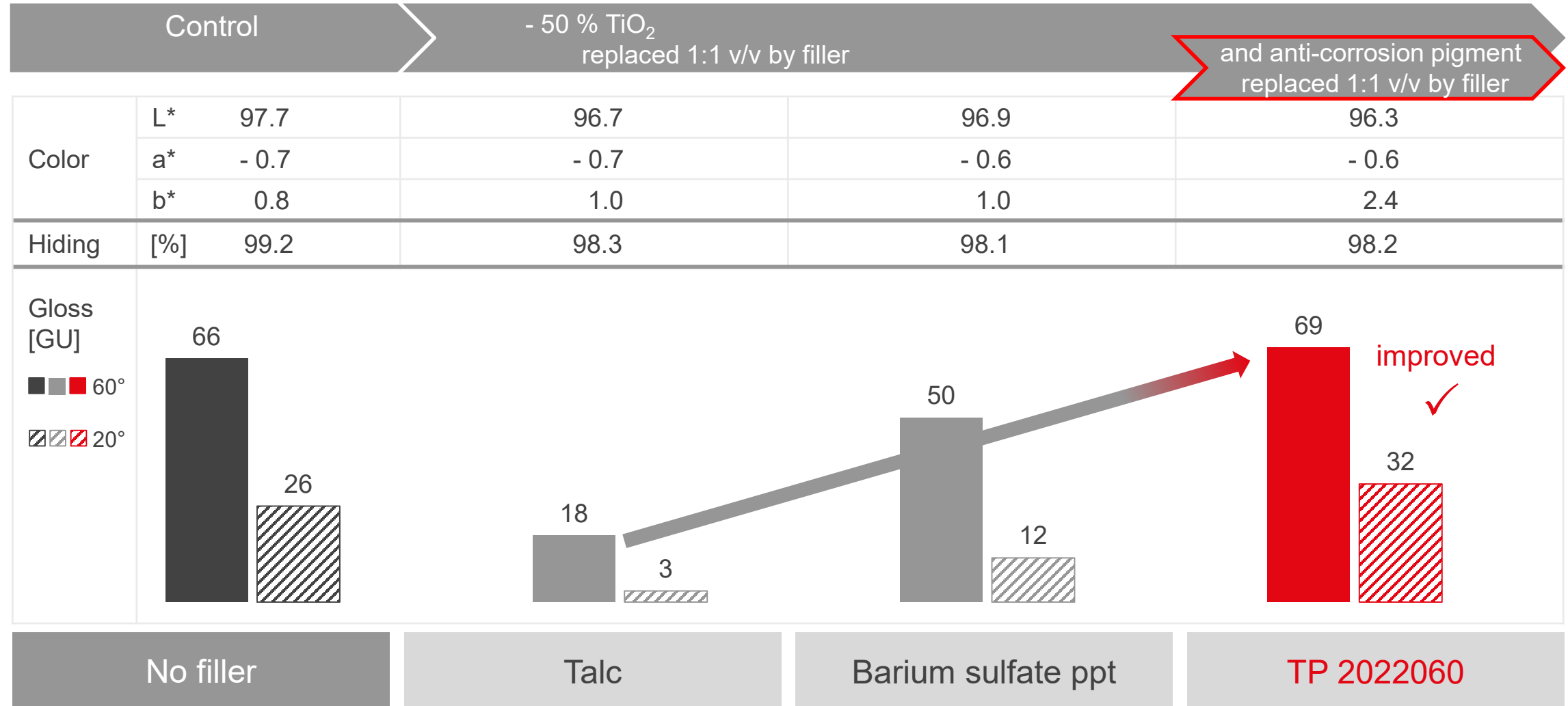


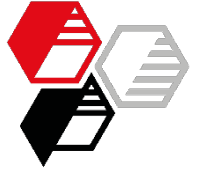
Preparation and application

<p>Mixing</p>  <p>Source: VMA Getzmann</p>	<p>Pigment preparation</p> <ul style="list-style-type: none"> • Dissolver with toothed disc (Cowles Blade) • Submission of part of binder • Successively dosage of Premix, additives and pigments (+ filler) at 5 m/s speed • Dispersing 15 min at 8 m/s under ice water cooling until fineness of grind $< 5 \mu\text{m}$ <p>Let Down</p> <ul style="list-style-type: none"> • Addition of remaining binder and ingredients at 5.0 m/s • After dosing thickener finally 5 min mixing avoiding air entry
<p>Application</p>	<p>After 10 d maturing time on cold-rolled steel, Q-Panel Type R 48 Doctor blade: Single-layered → Dry film thickness ~ 50 μm</p>
<p>Conditioning</p>	<p>14 d drying at 23 °C / 50 % relative humidity</p>

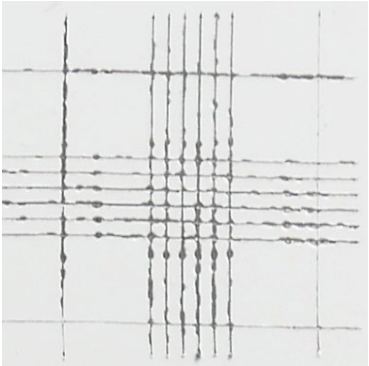
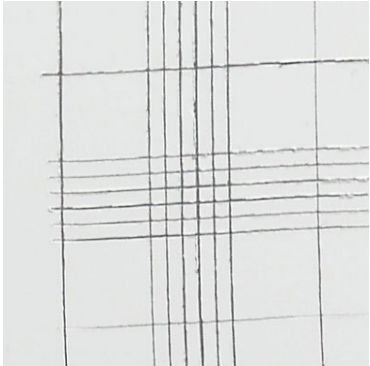
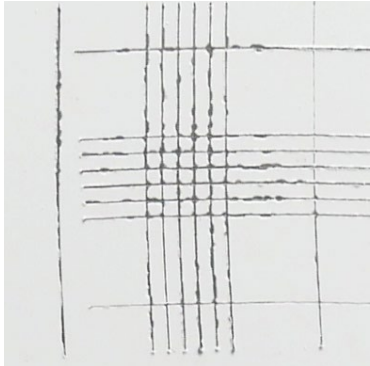
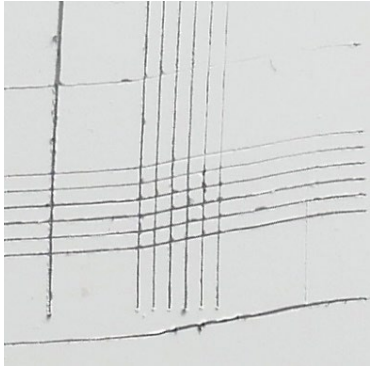


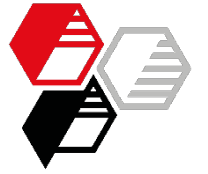
Optical performance





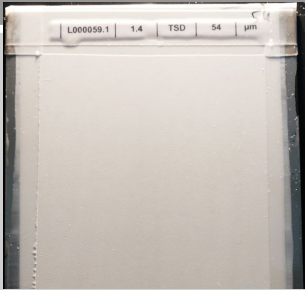

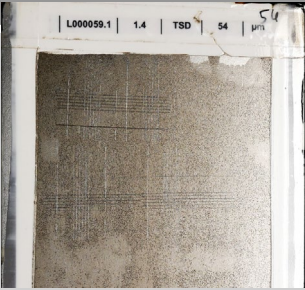






Mechanical performance

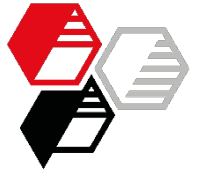
Control		- 50 % TiO ₂ replaced 1:1 v/v by filler		and anti-corrosion pigment replaced 1:1 v/v by filler	
Pendulum hardness Koenig	7 d	27	28	28	24
	14 d	35	36	35	31
Adhesion Cross-cut 1 mm		GT 1 - 2	GT 0 - 1	GT 1 - 2	GT 1
					
No filler		Talc	Barium sulfate ppt	TP 2022060	



Corrosion protection

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

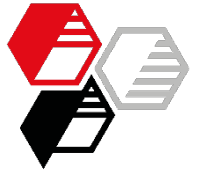
Humidity test		DIN EN ISO 6270-2 CH		
Non-scribed	<ul style="list-style-type: none"> • Adhesion (Cross-cut test) • Blistering • Corrosion (stripped) 			
Salt spray test		DIN EN ISO 9227 NSS		
Non-scribed	<ul style="list-style-type: none"> • Adhesion • Blistering • Corrosion (stripped) 			
Scribed	<ul style="list-style-type: none"> • Blistering • Delamination • Corrosion (stripped) 			
Sikkens 1 mm wide / 6 cm long				



Humidity test 650 h

Adhesion by cross-cut 1 mm

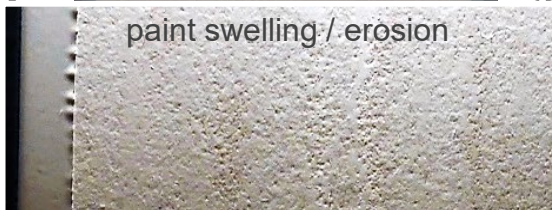
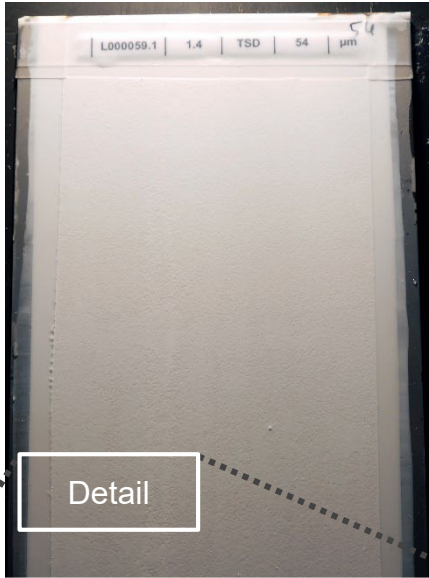
	Control	- 50 % TiO ₂ replaced 1:1 v/v by filler		and anti-corrosion pigment replaced 1:1 v/v by filler
Wet without adhesive tape				
Dry with adhesive tape				
	No filler	Talc	Barium sulfate ppt	TP 2022060



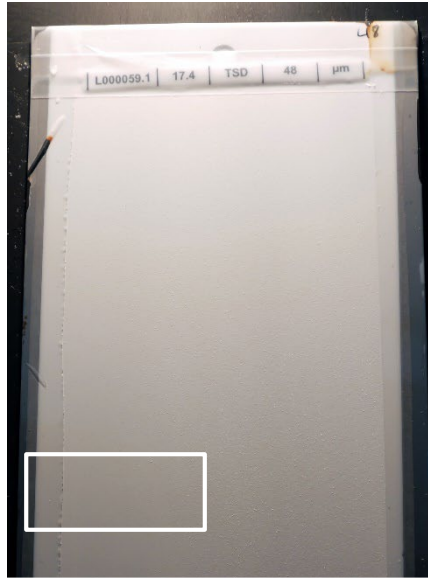
Humidity test 650 h

Corrosion resistance

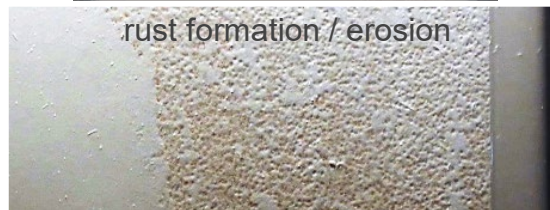
Control - 50 % TiO₂ replaced 1:1 v/v by filler and anti-corrosion pigment replaced 1:1 v/v by filler



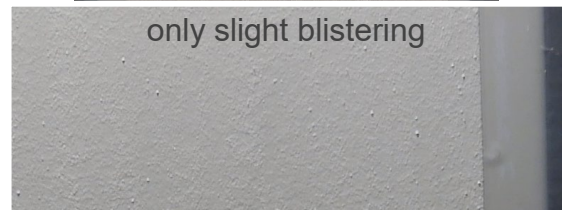
No filler



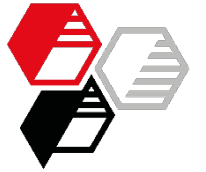
Talc



Barium sulfate ppt



TP 2022060



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

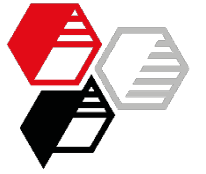


Barium sulfate ppt



TP 2022060




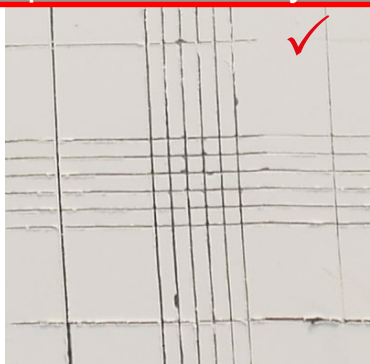
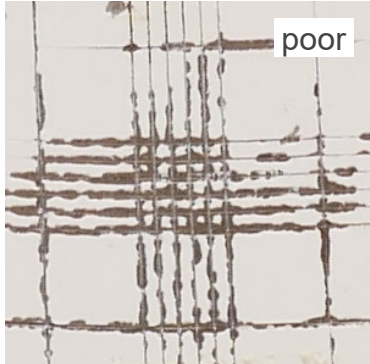

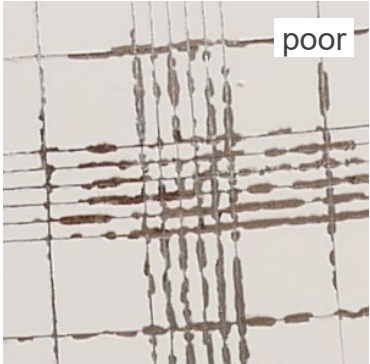
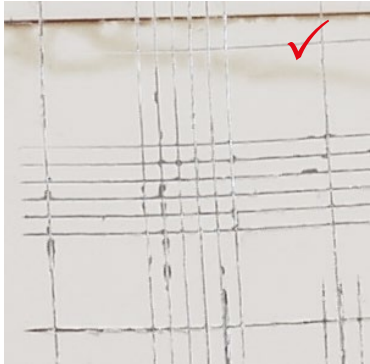
i and classical fillers ?

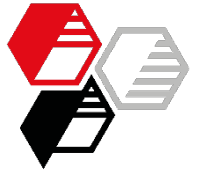


Salt spray test 650 h

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
Wet with adhesive tape	 poor	 moderate	 poor	 ✓
Dry with adhesive tape	 poor	 ✓	 poor	 ✓
	No filler	Talc	Barium sulfate ppt	TP 2022060



Salt spray test 650 h

Non-scribed area

Corrosion resistance

Control

- 50 % TiO₂ replaced 1:1 v/v by filler

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

Paint stripped

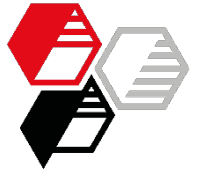
Condition	No filler	Talc	Barium sulfate ppt	TP 2022060
Original	Scale: 57 µm	Scale: 50 µm	Scale: 59 µm	Scale: 56 µm
After 650h Salt Spray	Scale: 57 µm	Scale: 50 µm	Scale: 59 µm	Scale: 56 µm

No filler

Talc

Barium sulfate ppt

TP 2022060



Salt spray test 650 h

Scribed area

Corrosion resistance

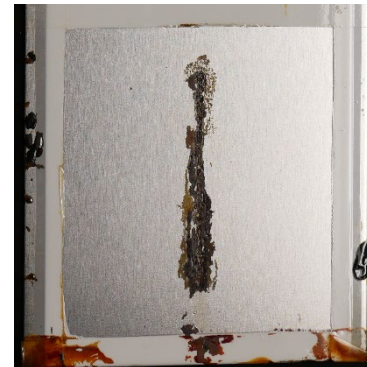
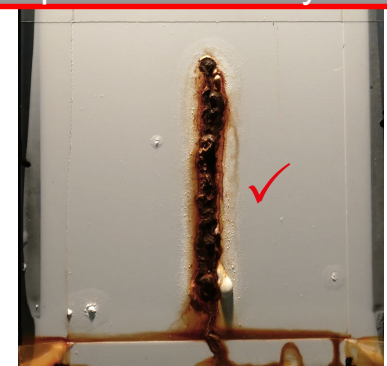
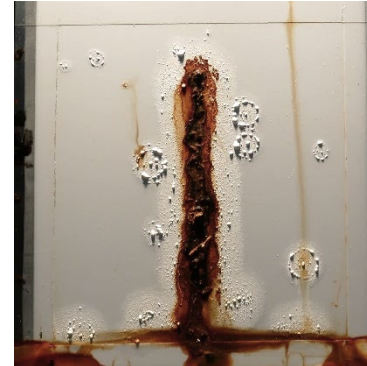
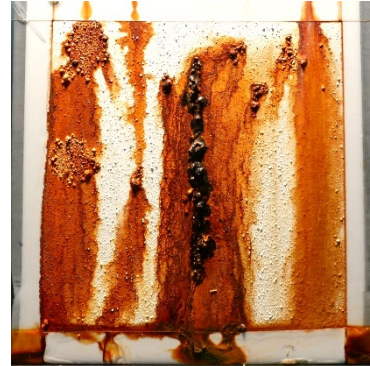
Control

- 50 % TiO₂
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

TP 2022060

i and classical fillers ?



Conclusion

Addition of **TP 2022060** instead of 50 % TiO₂ 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

+

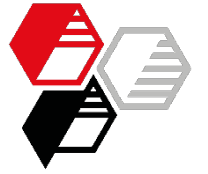


raw material savings
cost savings

=

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
	Acrysol RM 8 WE (1:6 in H ₂ O)	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
	TP 2022060	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 ₂ O)	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 CO₂ footprint
- aktiv pigment free
- reduced titanium dioxide content
- high gloss
- high wet- / dry adhesion
- very good humidity- and corrosion resistance

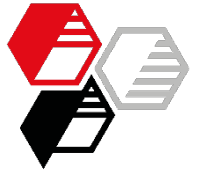


We supply material for good ideas!

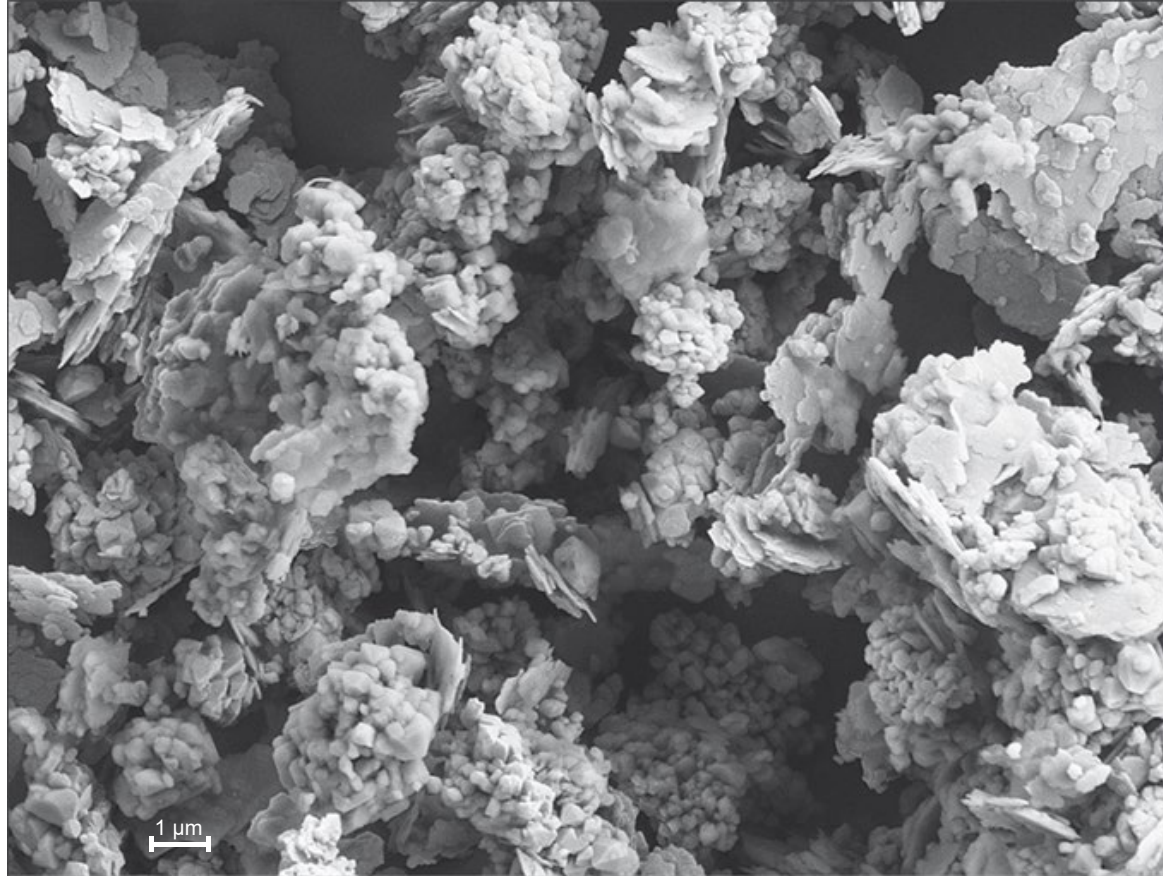
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Phone: +49 8431 53-0
Internet: www.hoffmann-mineral.com
E-mail: info@hoffmann-mineral.com

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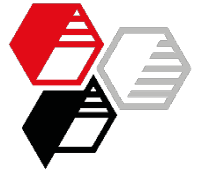


Neuburg Siliceous Earth



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.





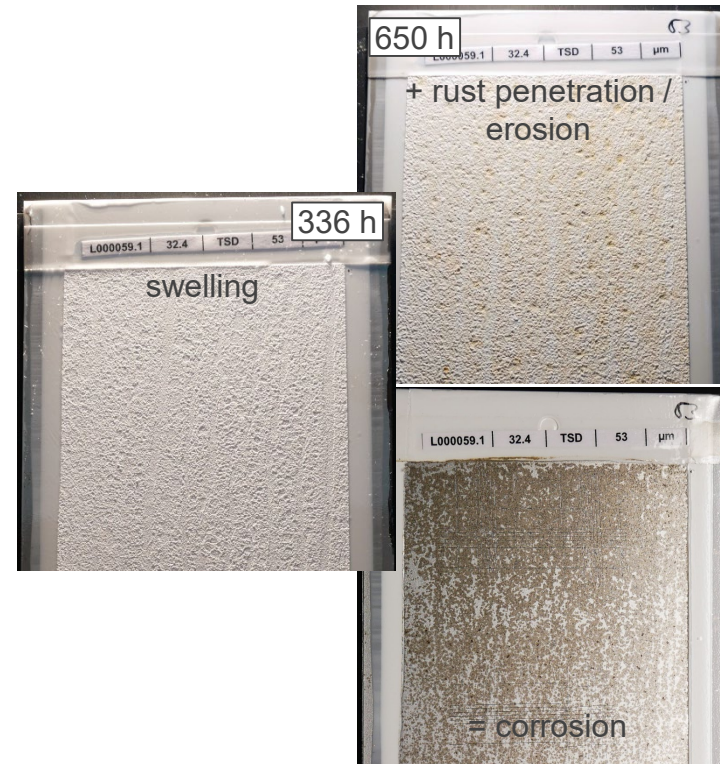
Humidity test

Protection without anti-corrosion pigment?

50 % TiO₂ and 100 % anti-corrosion pigment replaced 1:1 v/v by filler



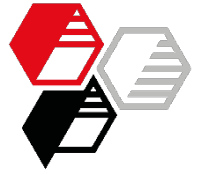
Talc → no !



Barium sulfate ppt → no !





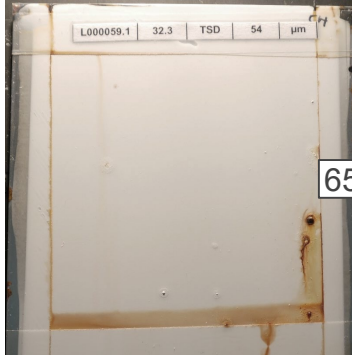
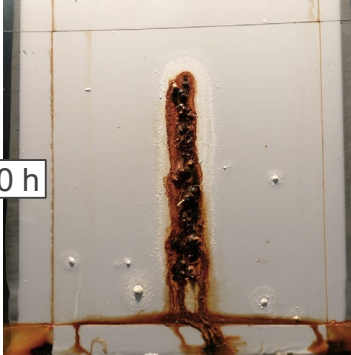
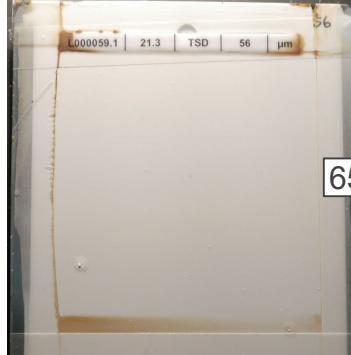

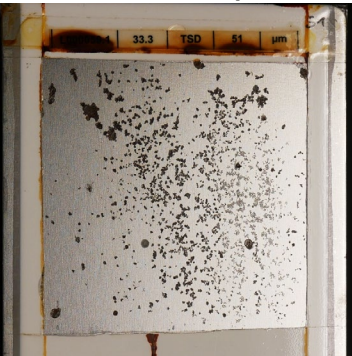



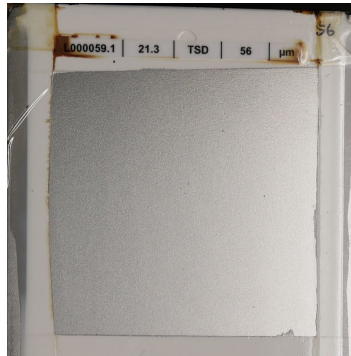
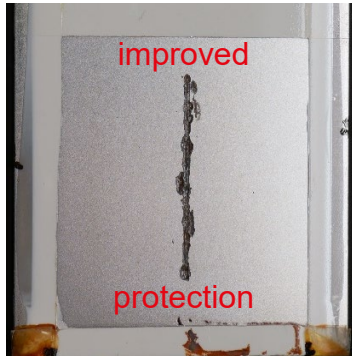

TP 2022060 → ✓



Salt spray test

Protection without anti-corrosion pigment?

50 % TiO₂ and 100 % anti-corrosion pigment replaced 1:1 v/v by filler

non-scribed area	scribed area		
			
			
			
			
<p>paint ↓ stripped</p> <p>Talc → no !</p>		<p>Barium sulfate ppt → ~ ok</p>	
		<p>TP 2022060 → ✓ </p>	