









Metal & Corrosion Protection Coatings

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ALBERDINGKK BOLEY in a nutshell

| | | |
|--|--|---|
|  <p>Leading global manufacturer of environmentally friendly water-based binders and oils with unique properties to refine, refurbish, bind and protect multiple types of substrates</p> |  <p>Medium sized, privately owned company</p> <p>> a partner to our customers for more than 250 years</p> |  <p>> 500 employees</p> |
|  <p>Dynamic, Innovative and flexible</p> <p>Pioneers in biobased polymer dispersions</p> |  <p>Dispersions: Acrylic, Vinyl acetate, Polyurethane and hybrid dispersions</p> <p>Oils: Linseed oil, Castor oil, Derivatives</p> |  <p>Locations:</p> <ul style="list-style-type: none"> • Krefeld, Germany • Kerpen, Germany • Leuna, Germany • Treviso, Italy • Congleton, UK • Greensboro, USA • Shenzhen, China • Zhuhai, China |

For more information about ALBERDINGKK BOLEY and our product offerings, visit www.alberdingk-boley.de.

Overview

| | Primer | 1K DTM coatings | 1K DTM coatings for galvanized steel | Topcoats | Rust converter | Peelable coatings | Topcoats for electroplated surfaces | Chrome free metal pre-treatment (neutral pH) | Chrome free metal pre-treatment (acidic) | Heavy Corrosion Protection (Tubes / Pipelines) |
|--------------|--------|-----------------|--------------------------------------|----------|----------------|-------------------|-------------------------------------|--|--|--|
| AC 2003 | x | x | | | | x | | | | |
| AC 2360 | | | | | | | | x | | |
| AC 2403 | | x | | | x | | | x | | |
| AC 2420 | | x | x | | | | | x | | |
| AC 2433 | x | x | | | x | | | | | |
| AC 25352 | | | | | | | x | | | |
| AC 27401 | | | | x | | | | | | |
| ALBODUR 1054 | | | | | | | | | | x |
| ALBODUR 921 | | | | | | | | | | x |
| ALBODUR 942 | | | | | | | | | | x |
| CUD 4835 | | | | | | | | | x | |
| PUR-MATT 910 | | | | x | | | x | x | | |
| Ren AC 8003 | x | x | | | | x | | | | |
| Ren AC 8403 | | x | | | x | | | x | | |
| SC 48 | x | | | | | | | | | |
| U 502 | | | | | | x | | | | |
| U 6300 | | | | | | | x | x | | |
| U 9000 | | | | x | | | x | x | | |
| U 9380 | | | | | | | | x | | |
| UC 84 | | | | x | | | | | | |

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Metal Coatings

Metal coatings protect values - experts from the NACE (National Association of Corrosion Engineers) estimated the global cost of corrosion to be approx. \$2.5 trillion!

At ALBERDINGK BOLEY we try to help protecting metal with novel waterbased products which can reach the highest protection levels.

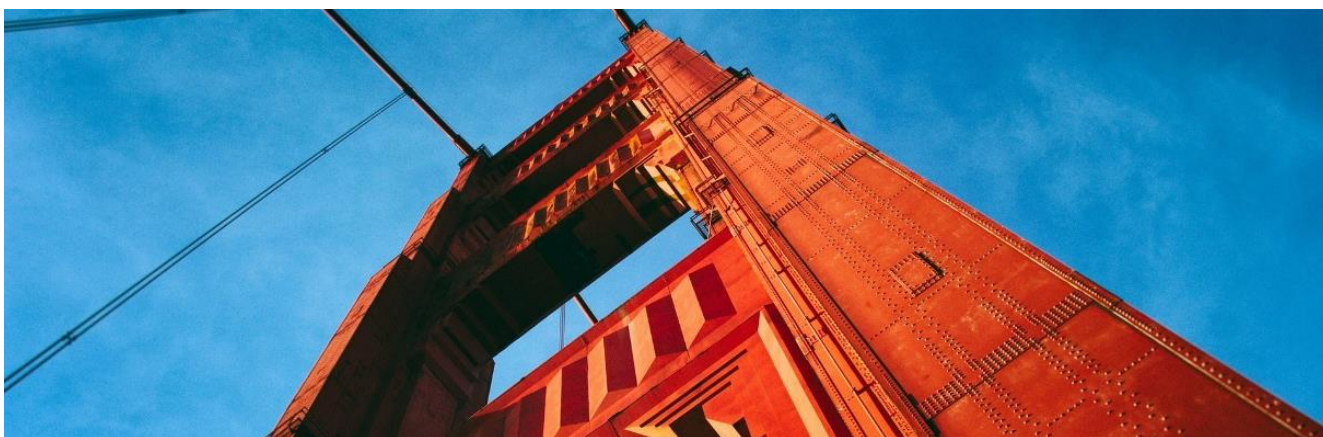
Our portfolio covers a lot of different applications, reaching from 100% solids, 2-pack heavy duty to ultra-thin film protections of < 1µm DFT.

General Metal Coatings

Primer

For primer we offer economic styrene acrylic dispersions such as **ALBERDINGK® SC 48** or pure acrylics like **ALBERDINGK® AC 2003**.

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|---|
| AC 2003 | 49.0-51.0 | 20-2,000 | 7.0-9.0 | 3 | Economic acrylic with excellent corrosion resistance, high PVC possible |
| Ren AC 8003 | 49.0-51.0 | 20-2,000 | 7.0-9.0 | 3 | Biobased version of AC 2003 |
| SC 48 | 49.0-51.0 | 3,000-5,000 | 7.0-7.5 | 14 | Economic styrene-acrylic, Zn-pigment compatible |
| AC 2433 | 43.0-45.0 | 100-1,000 | 8.5-9.5 | 20 | Hard acrylic with excellent corrosion resistance |



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1K DTM coatings

For DTM our offer reaches from **ALBERDINGK® AC 2403** for very high demanding corrosion protection in low DFT to economic products like **ALBERDINGK® AC 2003** and **ALBERDINGK® AC 2433**.

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|--|
| AC 2003 | 49.0-51.0 | 20-2,000 | 7.0-9.0 | 3 | Economic acrylic for low VOC DTM coatings |
| Ren AC 8003 | 49.0-51.0 | 20-2,000 | 7.0-9.0 | 3 | Biobased version of AC 2003 |
| AC 2433 | 43.0-45.0 | 100-1,000 | 8.5-9.5 | 20 | Economic, hard acrylic for coatings with C3/C4-resistance |
| AC 2403 | 46.0-48.0 | 200-2,000 | 8.0-9.0 | 16 | Best in class corrosion resistance, meets C5I-L, super hydrophobic |
| Ren AC 8403 | 46.0-48.0 | 200-2,000 | 8.0-9.0 | 20 | Biobased version of AC 2403 |
| AC 2420 | 45.0-47.0 | 1,000-3,000 | 8.0-9.0 | 22 | Harder version of ALBERDINGK® AC 2403 , optimized for galvanized surfaces |

1K DTM coatings for galvanized steel

1K DTM coatings for galvanized require specific polymers which ensure the best possible adhesion and corrosion protection.

Our latest development **ALBERDINGK® AC 2420** offers best possible corrosion protection on steel and galvanized surfaces.

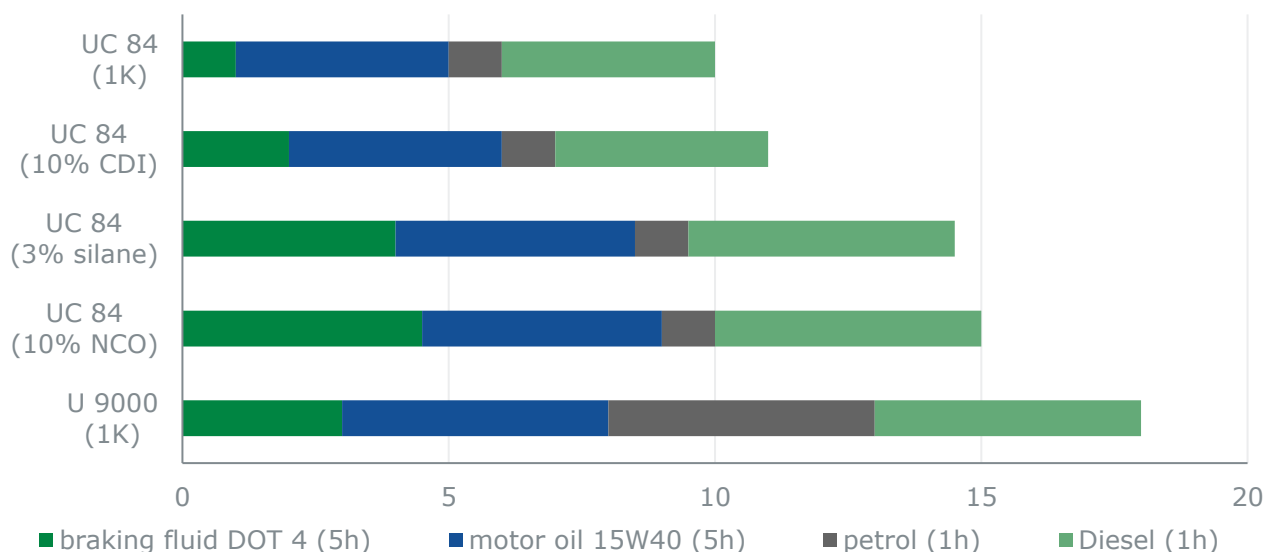
| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|--|
| AC 2420 | 45.0-47.0 | 1,000-3,000 | 8.0-9.0 | 22 | Harder version of ALBERDINGK® AC 2403 , optimized for galvanized surfaces |

Topcoats

Our products for topcoats can be used to obtain better oil and grease resistance by maintaining the anticorrosion properties of the coating underneath. Products for 1K, 2K isocyanate as well as 2K non-isocyanate are available

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|--|
| AC 27401 | 37.0-39.0 | 100-1,500 | 7:5-8:5 | 15 | Very high chemical resistances, especially for matt systems |
| PUR-MATT 910 | 34.0-36.0 | 20-2,000 | 7.0-9.0 | 15 | Inherent matt PUD for low gloss coatings with high resistances |
| UC 84 | 34.0-36.0 | 20-200 | 7.5-8.5 | 42 | Hard PC-Copolymer, for 1K, 2K and 2K-non isocyanate topcoats, superior weathering resistance |
| U 9000 | 28.0-30.0 | 50-1,000 | 7.0-8.5 | 0 | Very hard PC-PUD with superior chemical and weathering resistance |

Chemical resistances with different x-linking technologies:



Rust converter

Rust converters can be formulated by mixing tannic acid and polymer, **ALBERDINGK® AC 2403** is an ideal choice for this kind of product. Novel rust converters such as ASCOTRUST® offer the ability to formulate with high performance resins such as **ALBERDINGK® AC 2403**.

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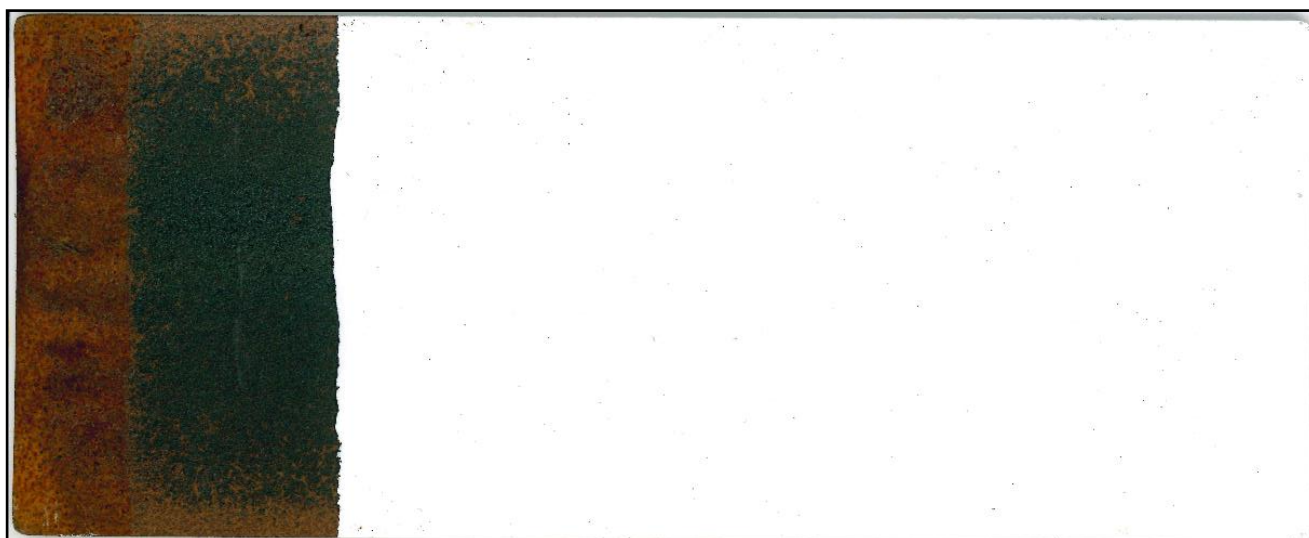
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| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|---|
| AC 2403 | 46.0-48.0 | 200-2,000 | 8.0-9.0 | 16 | For rust converters with ASCOTRUST®, super hydrophobic and excellent corrosion resistance |
| Ren AC 8403 | 46.0-48.0 | 200-2,000 | 8.0-9.0 | 20 | Biobased version of AC 2403 |

Rust converter based on **ALBERDINGK® AC 2403**:



0 | 1 | 2 | 3

Build-up:

- 0: Rusty steel-panel, covered with:
- 1: 1 layer of rust converter based on **ALBERDINGK® AC 2403**
brush applied
- 2: 1 layer of FP 2403-35 (white pigm. anti-corrosive primer), brush applied
- 3: 1 layer of FP 27401-18 (2k-topcoat), brush applied

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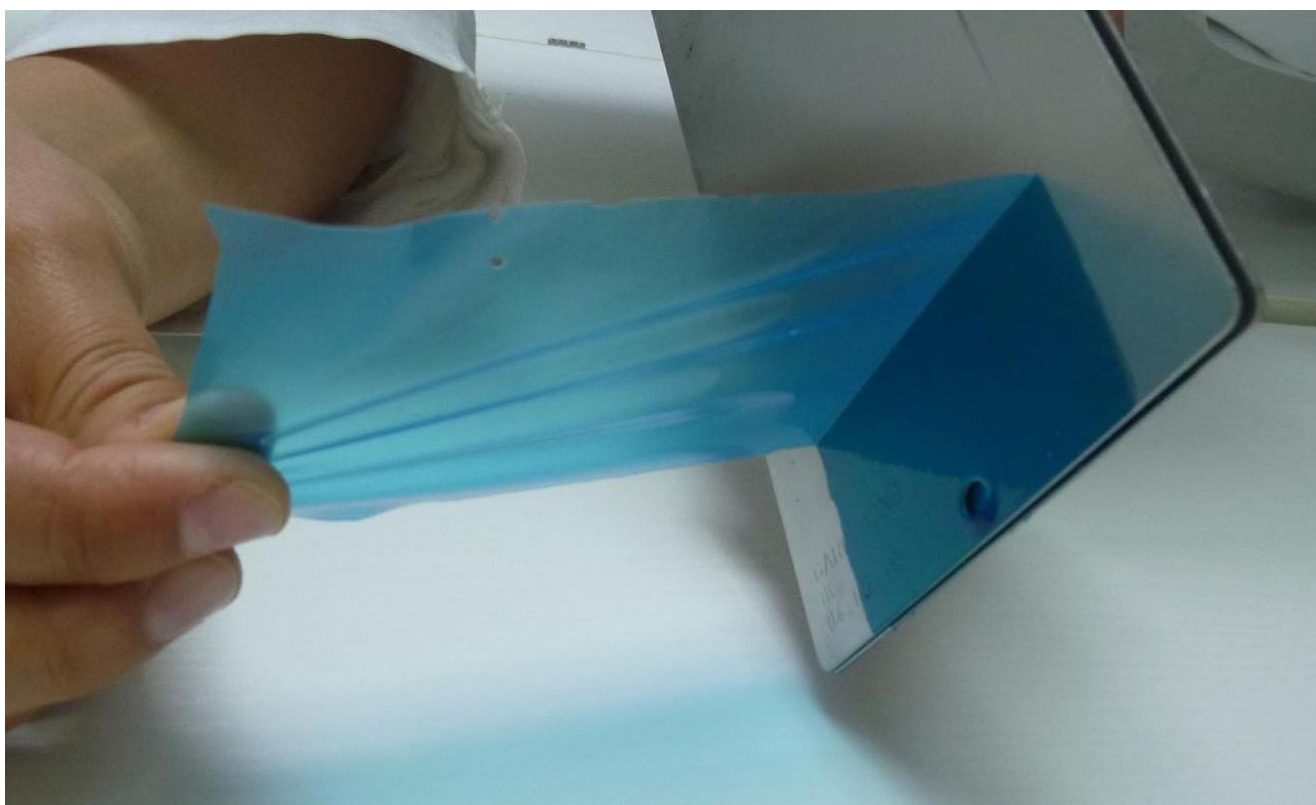
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Peelable coatings

ALBERDINGK® U 502 offers excellent peel properties thank to its high tensile strength in combination with good corrosion protection.

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|---|
| U 502 | 39.0-41.0 | 10-800 | 7.0-8.0 | 0 | High tensile strength, easy to peel, excellent corrosion resistance |
| AC 2003 | 49.0-51.0 | 20-2,000 | 7.0-9.0 | 3 | Economic acrylic with good corrosion resistance |
| Ren AC 8003 | 49.0-51.0 | 20-2,000 | 7.0-9.0 | 3 | Biobased version of AC 2003 |



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Topcoats for electroplated surfaces

Topcoats for electroplated materials can offer improved corrosion resistance and non-iridescent surfaces.

Neutral pH-range

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|--|
| U 6300 | 32.0-34.0 | 10-2,000 | 7.5-8.5 | 0 | Excellent corrosion & chemical resistance |
| U 9000 | 28.0-30.0 | 50-1,000 | 7.0-8.5 | 0 | Highest corrosion & chemical resistance |
| AC 25352 | 50.0-52.0 | 300-800 | 7.0-8.0 | 20 | Economic acrylic with very good corrosion resistance |
| PUR-MATT 910 | 34.0-36.0 | 20-2,000 | 7.0-9.0 | 15 | Inherent matt PUD for low gloss / phosphated look |



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Metal pre-treatment

Metal pre-treatments or thin organic coatings are permanent materials which offer excellent corrosion protection, very good intercoat adhesion and blocking resistance. Our offer ranges from polymer dispersions for highly acidic media (chrome-free) to non-chrome systems with neutral pH level. Due to environmental concerns chrome needs to be replaced by non-chrome alternatives without sacrificing the final properties.



Chrome free metal pre-treatment

Neutral pH

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|--|
| U 6300 | 32.0-34.0 | 10-2,000 | 7.5-8.5 | 0 | Excellent corrosion & good chemical resistance |
| U 9000 | 28.0-30.0 | 50-1,000 | 7.0-8.5 | 0 | Highest level of chemical & corrosion resistance, superior alkaline resistance |
| U 9380 | 31.0-34.0 | 10-250 | 7.5-9.0 | 25 | For low VOC, high chemical resistance, outstanding flexibility |
| PUR-MATT 910 | 34.0-36.0 | 20-2,000 | 7.0-9.0 | 15 | Inherent matt PUD for phosphate look |
| AC 2360 | 46.0-48.0 | 100-3,000 | 7.0-9.0 | 0 | Economic, multiphase, self-x-linking acrylic with very good corrosion resistance |
| AC 2403 | 46.0-48.0 | 200-2,000 | 8.0-9.0 | 16 | Super hydrophobic, multiphase acrylic with superior corrosion resistance |
| Ren AC 8403 | 46.0-48.0 | 200-2,000 | 8.0-9.0 | 20 | Biobased version of AC 2403 |
| AC 2420 | 45.0-47.0 | 1,000-3,000 | 8.0-9.0 | 22 | Harder version of ALBERDINGK® AC 2403 , optimized for galvanized surfaces |

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Acidic

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | pH-value | MFFT [°C] | Features |
|---------------------|------------|------------------|----------|-----------|--|
| CUD 4835 | 34.0-36.0 | 20-200 | 4.0-5.5 | 35 | Harder version of ALBERDINGK® CUD 4820 , higher chemical resistance |

Heavy Corrosion Protection (Tubes / Pipelines)

ALBODUR® polyols are suitable for 100% solids, 2pack coatings for heavy duty applications such as pipeline coatings.

| Alberdingk®-product | Solids [%] | Viscosity [mPas] | OH-value [mg KOH/g] | Features |
|----------------------|------------|------------------|---------------------|--|
| ALBODUR® 921 | 100 | 600 | 218 | used in combination with. ALBODUR® 942 for 2-pack aromatic pipe coatings |
| ALBODUR® 942 | 100 | 500 | 318 | polyol which forms epoxy like hard films with highest hardness and chemical resistance |
| ALBODUR® 1054 | 100 | 2,700-3,200 | 210 | For aliphatic topcoats with excellent UV and chemical resistance |



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Trivia about the corrosion of iron

Corrosion is an oxidation of iron or other metals and requires a presence of oxygen, an electrolyte and water. The known "red rust" is the result of intermediate reactions of iron hydroxide with oxygen.



Illustration of corrosion of iron with NaCl solution:

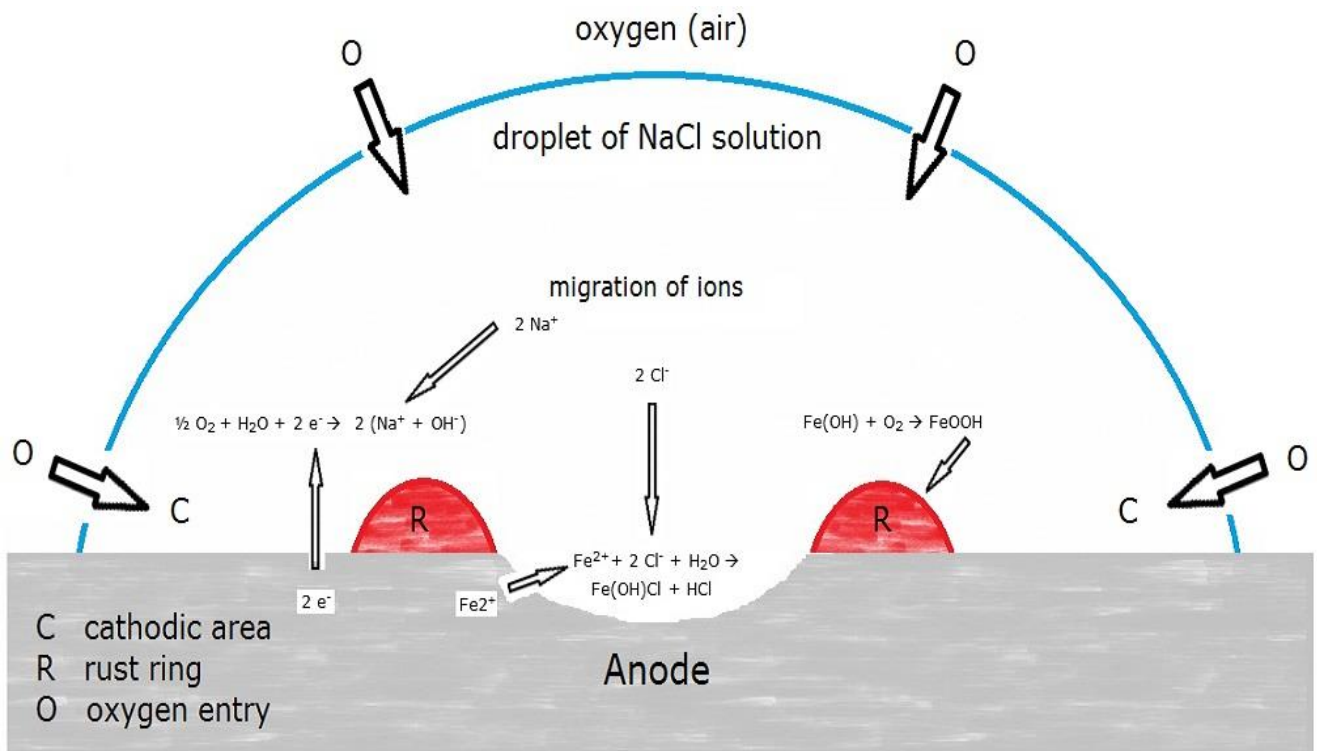


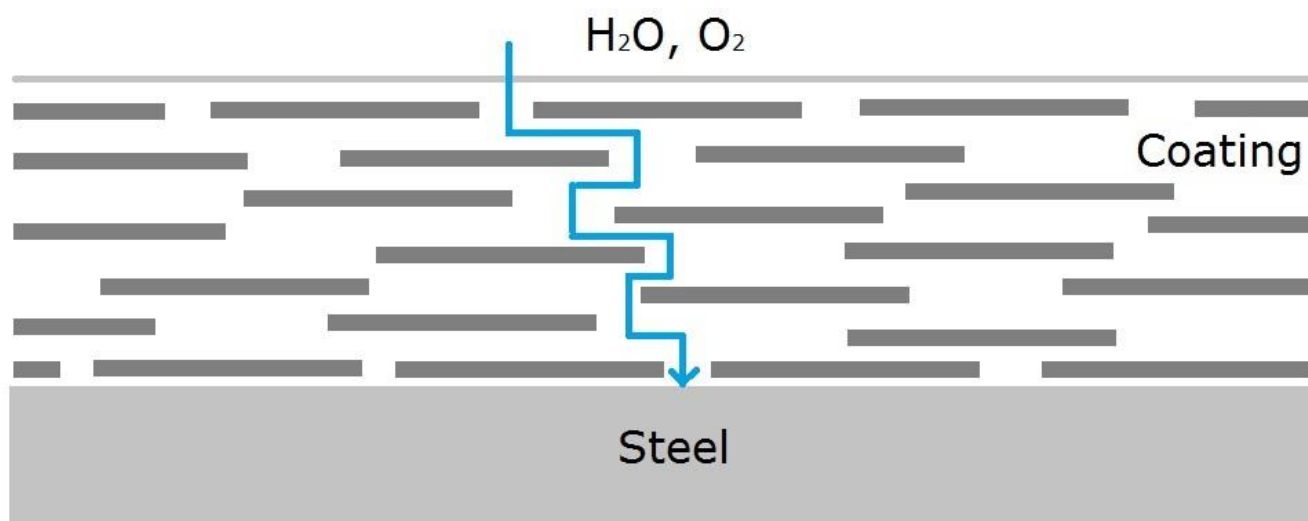
Illustration of corrosion on iron with NaCl solution (U. R. Evans model)

Ways to protect metal?

Passive anti-corrosion pigments (barrier effect, increased diffusion path):

E.g. Disc-shaped pigments like Iron-Glimmer, Calcium-silicate.

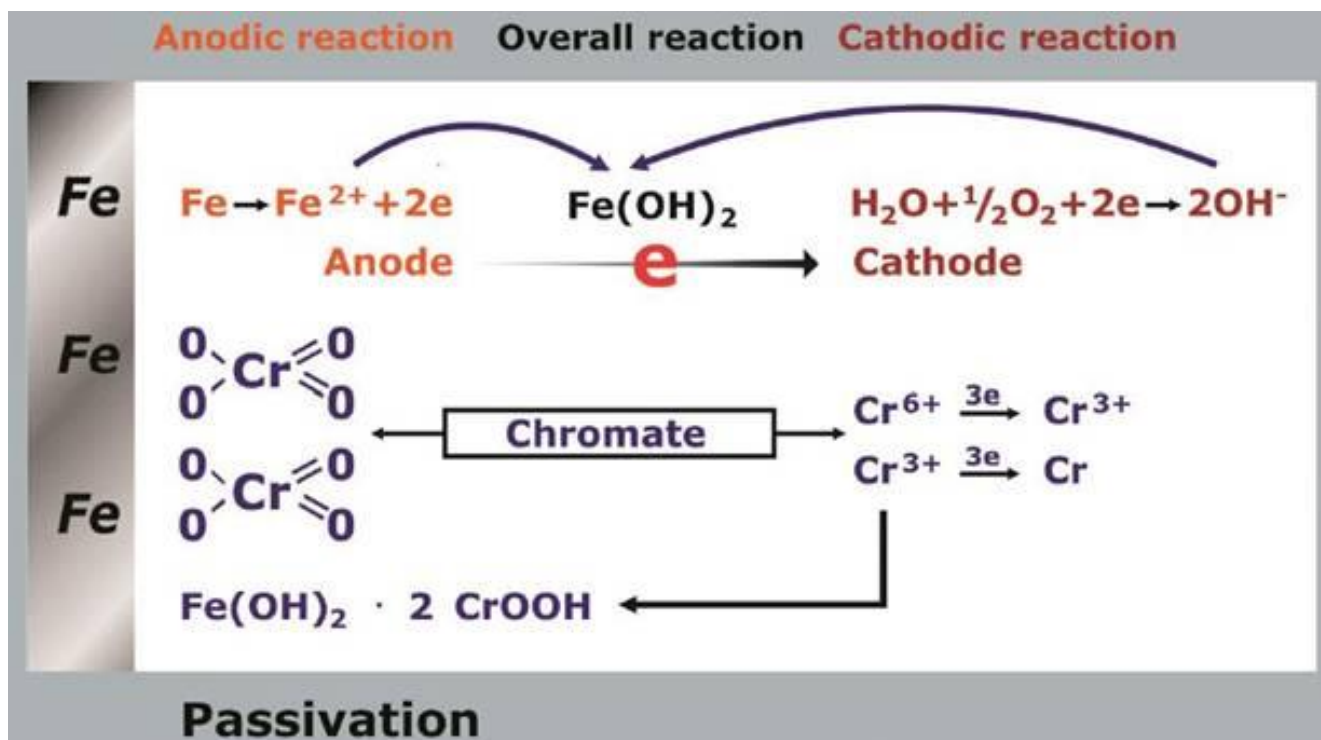
Some of these fillers have a tendency to dissociate into bivalent cations; therefore the binder requires a stable polymer, due to possible interactions of bivalent cations with the particle's surface charge. To counteract these cations the polymer needs more surfactant and surface charge, hence it will be less water resistant.



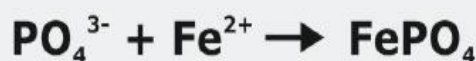
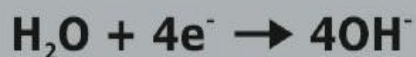
Active anti-corrosion pigments:

Zinc dust (donator-anode), zinc chromate (passivation), zinc phosphate (precipitation), red lead (saponification with alkyd resins) or nitrite salts (reducing agent -> flash rust protection). Analog to the passive anti-corrosion pigments the active pigments can also dissociate into bi- or multivalent cations, weakening the binders polymer stabilization. Labelling of these phosphates or oxides are also an issue and cans have to be classified with the phrase H 410: Very toxic to aquatic life with long lasting effects.

To get the full potential of phosphate pigments the polymer needs to have certain hydrophilic properties to ensure electro chemical reactions between the pigment with the metal surface.



Protective Layer → Iron zinc phosphate complex



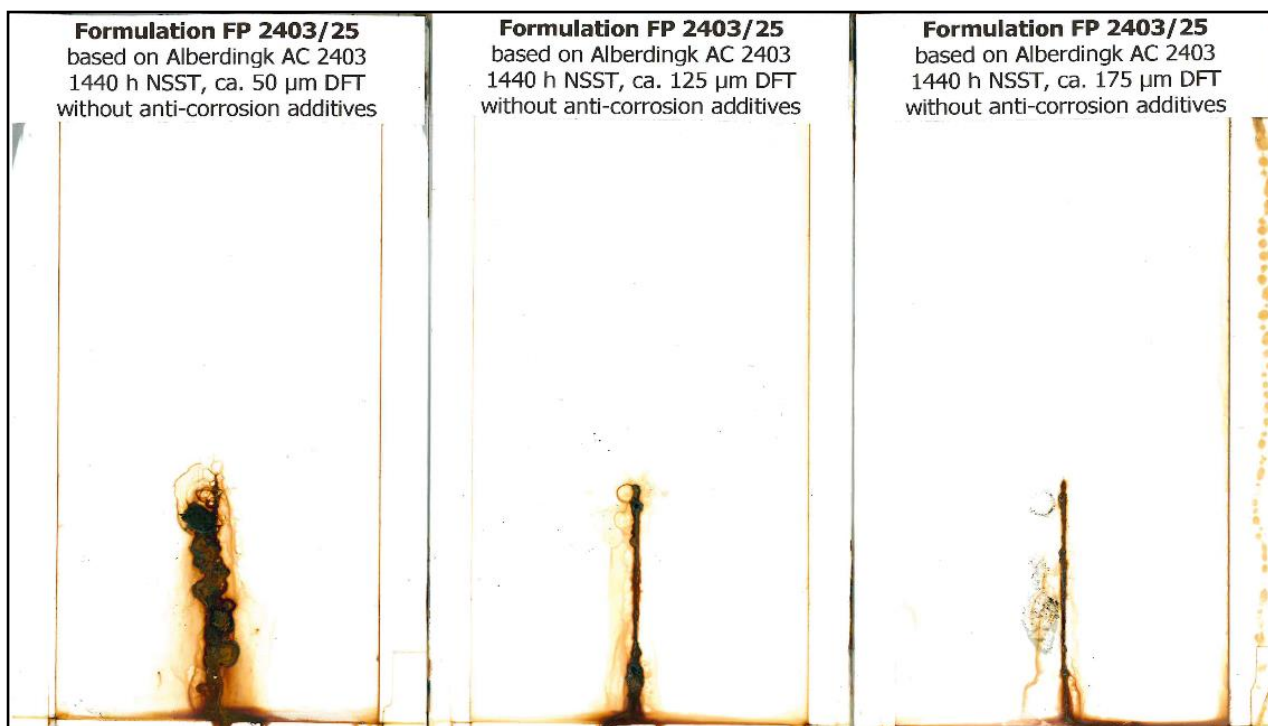
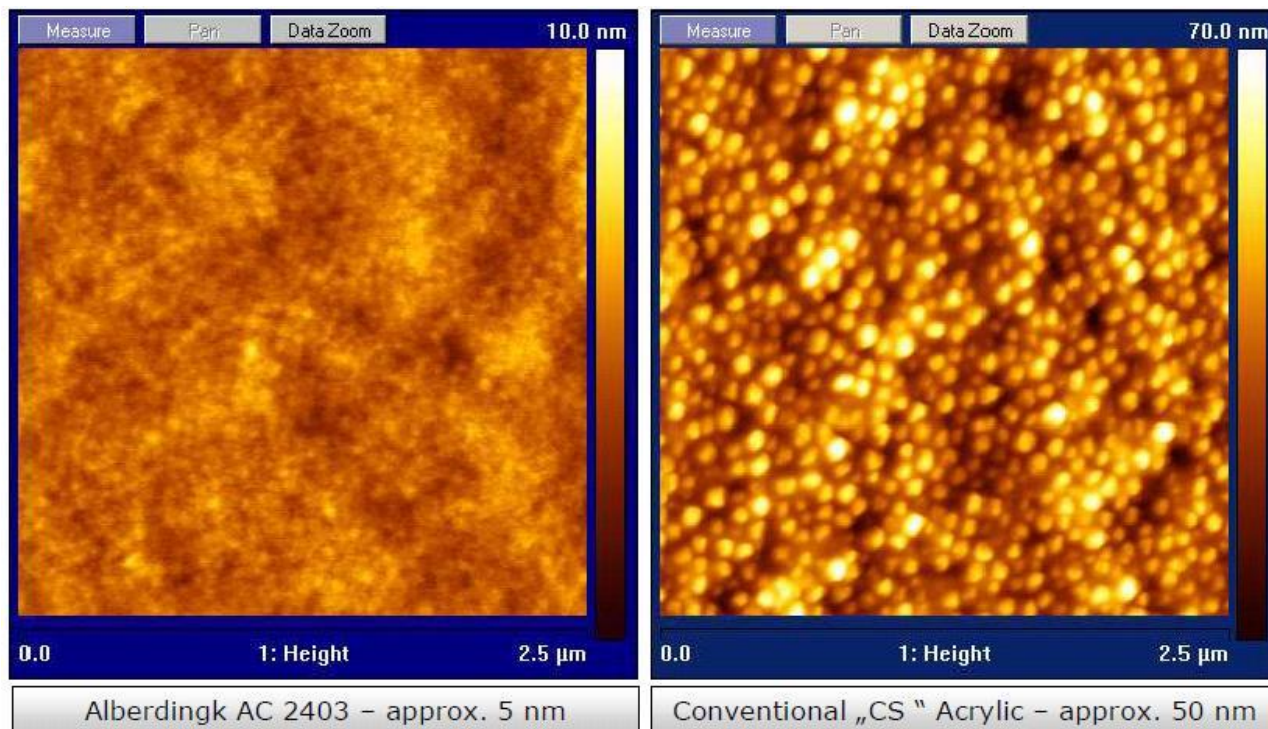
Steel

Source: Heubach

Binders with water barrier effect due to extreme hydrophobic and compact polymer matrix:

ALBERDINGK® AC 2403, 2K PU- and epoxy systems

Illustration of particle size of **ALBERDINGK® AC 2403** and a conventional multi-phase acrylic binder



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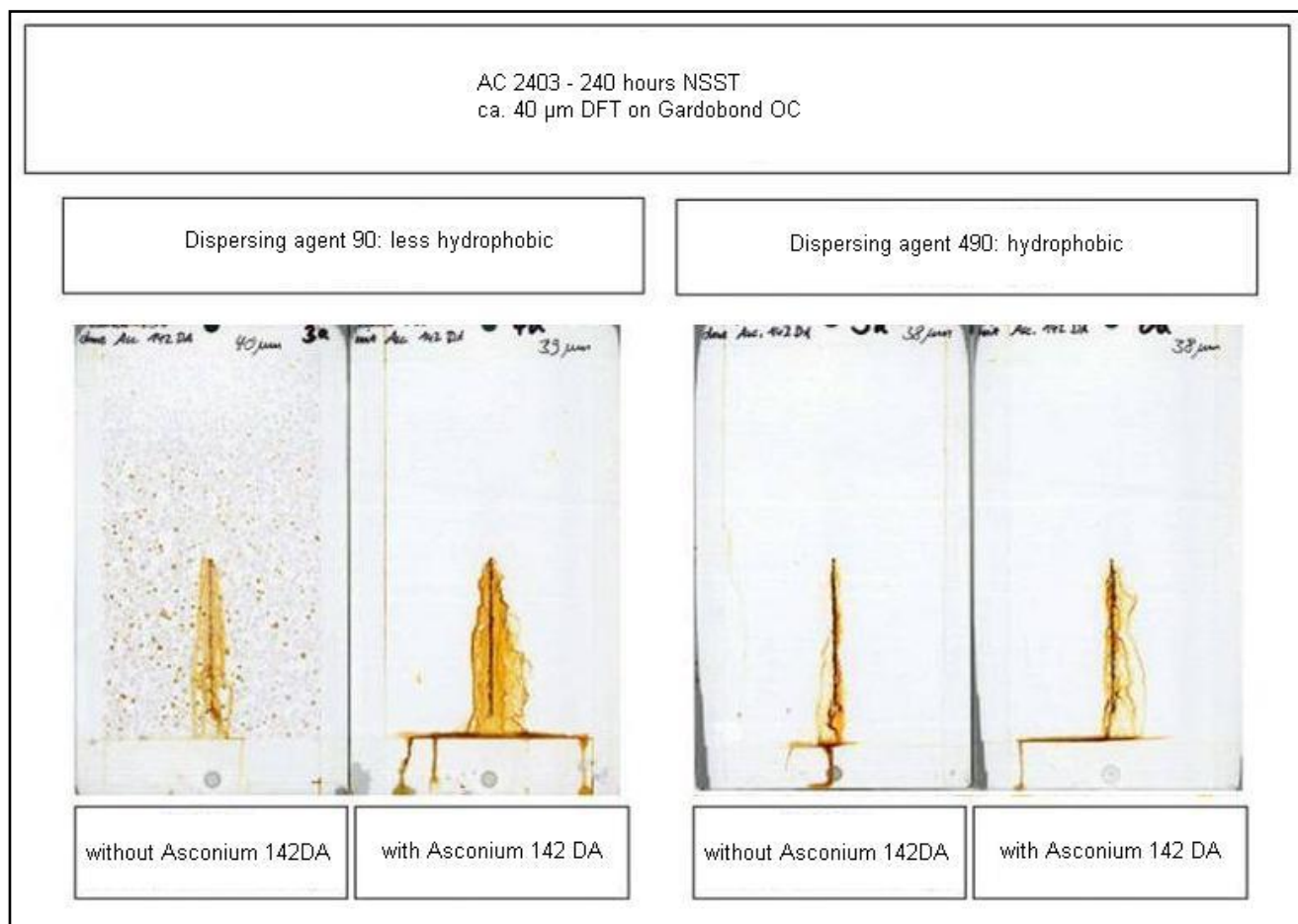
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Right choice of dispersing agents

Dispersing agents have a huge influence on the corrosion protection properties of the coating and the wrong agents can ruin the results of even the best performing binders. Very hydrophobic dispersing agents are the right choice for anti-corrosion paints.



New scribe according to DIN EN ISO 12944-6:2018

The scribe, according to outdated DIN EN ISO 12944-6:1998, e.g. with cutting knife, van Laar pen, is no longer valid.

The new scribe has to be 2 mm wide and has to be put into the cabinet horizontally.

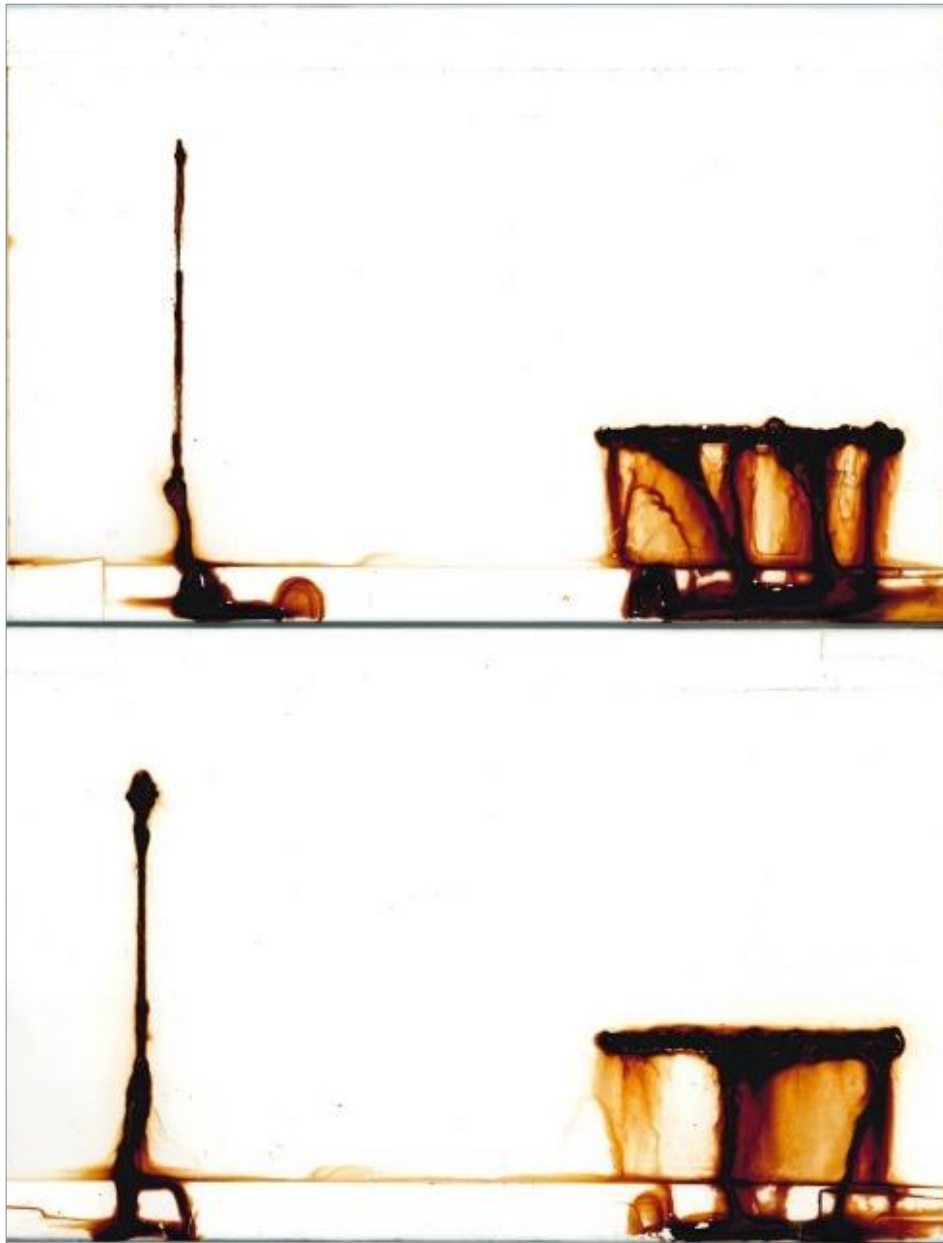
In our tests we could not see big differences in corrosion protection between the scribes.

Photo below:

Left scribe with van Laar pen

right scribe with 2 mm MTV Milling Master.

Top panel: Gardobond OC - **bottom panel:** Steel grade DC01 (1.0330)



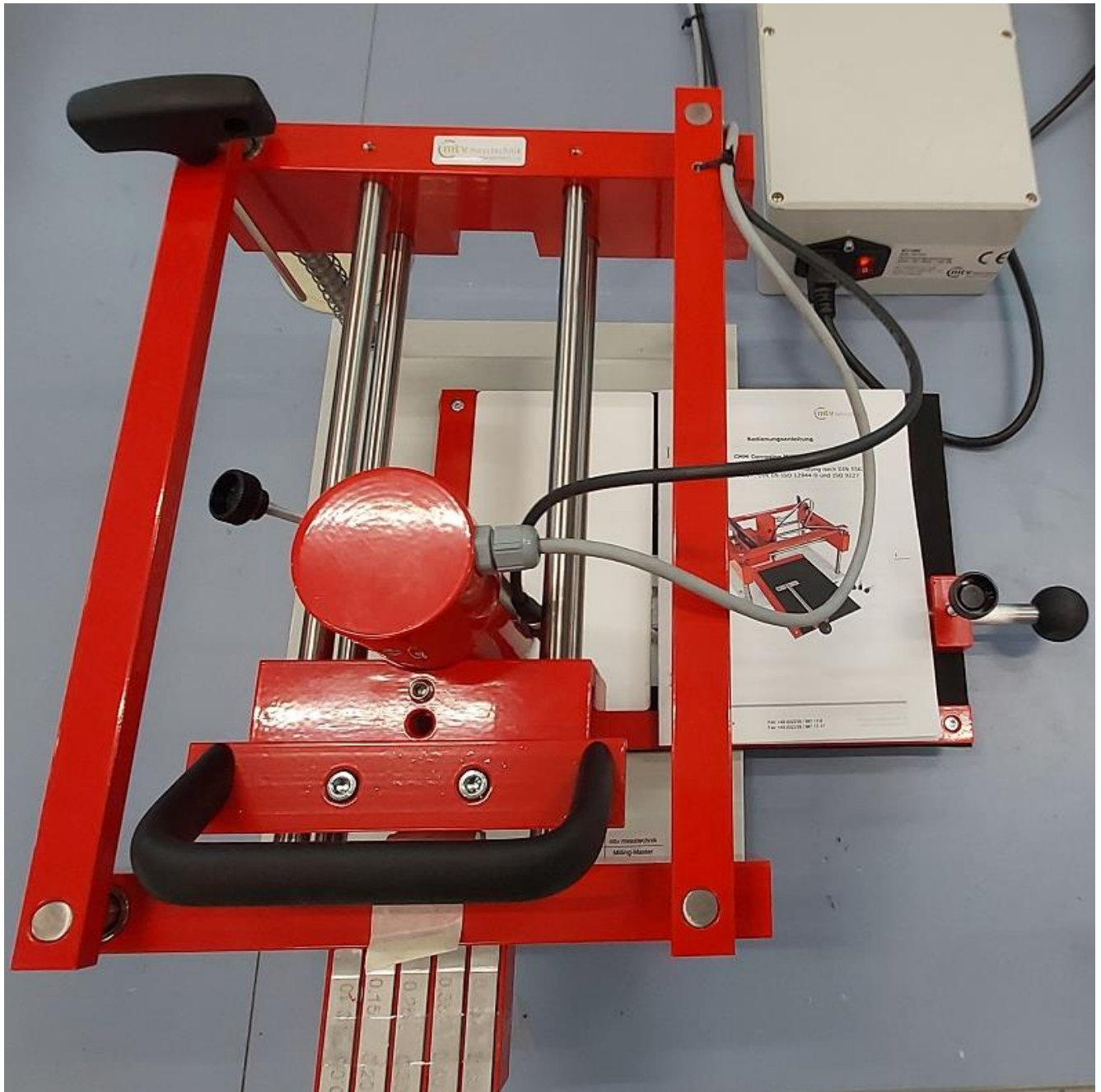
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MTV Milling Master



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Choices of Alberdingk binders for anti corrosion paints

- **ALBERDINGK® AC 2403 / Ren AC 8403**
- **ALBERDINGK® AC 2420**
- **ALBERDINGK® AC 2433**
- **ALBERDINGK® AC 2003 / Ren AC 8003**
- **ALBERDINGK® SC 48**

| Binder | Solids [%] | MFFT [°C] | Type of binder | Properties |
|------------------------------|------------|-----------|----------------|---|
| AC 2403 / Ren AC 8403 | 47 | 16 / 20 | Multi-phase | Best possible corrosion protection, very good adhesion to various substrates. Suited for low DFT applications. Recommended with Asconium anti corrosion additives |
| AC 2420 | 46 | 22 | multi-phase | Superior water-resistance, and vapor-barrier properties, high blocking resistance |
| AC 2433 | 44 | 20 | single-phase | Binder with outstanding wet adhesion, good corrosion protection. Recommended with Asconium anti corrosion additives |
| AC 2003 / Ren AC 8003 | 50 | 3 | single-phase | Very good corrosion protection. |
| SC 48 | 50 | 14 | single-phase | Economic binder with good water resistance and adhesion, soft film. Compatible with Zn pigments |

| Binder | Type of polymer | DTM | Primer | | |
|------------------------------|-----------------|-----|-----------|------------|-----------|
| | | | PVC: < 25 | PVC: 25-35 | PVC: > 35 |
| AC 2403 / Ren AC 8403 | multi phase | X | X | O | - |
| AC 2420 | multi-phase | X | X | O | - |
| AC 2433 | single phase | X | X | X | O |
| AC 2003 / Ren AC 8003 | single phase | X | O | X | X |
| SC 48 | single phase | - | O | X | X |

X = recommended
O = suitable
- = not suitable

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Adhesion to metal:

| Formulation | Gardo-bond OC | Gardo-bond HDG/3 | Gardo-bond 26S 6800 OG | Q-Panel R | ACT steel | Sand blasted steel | Zinc phosphated steel | Aluminum | Zinc plated steel |
|-------------------------------|---------------|------------------|------------------------|-----------|-----------|--------------------|-----------------------|----------|-------------------|
| FP 2403/68 | Gt 0 | Gt 1 | Gt 1 | Gt 0 | Gt 0 | Gt 0 | Gt 1 | Gt 1 | Gt 0 |
| FP 2403/67 | Gt 1 | Gt 1 | Gt 1 | Gt 1 | Gt 0 | Gt 0 | Gt 1 | Gt 1 | Gt 0 |
| FP 2403/67 without Asc. 142DA | Gt 3 | Gt 2 | Gt 2 | Gt 1 | Gt 1 | Gt 0 | Gt 1 | Gt 1 | Gt 0 |
| FP 2420/10 | Gt1 | n.d. | Gt 1 | Gt 2 | Gt 0 | Gt 0 | Gt 1 | Gt 1 | Gt 1 |
| FP 2433/01 | Gt 0 | n.d. | Gt 0 | Gt 0 | Gt 1 | Gt 0 | Gt 0 | Gt 1 | Gt 0 |
| FP 2003/08 | Gt 1 | n.d. | Gt 1 | Gt 1 | Gt 1 | Gt 0 | Gt 1 | Gt 5 | Gt 0 |
| FP 48/02 | Gt 0 | Gt 0 | Gt 0 | Gt 0 | Gt 0 | Gt 0 | Gt 0 | Gt 0 | Gt 0 |
| FP 48/05 | Gt 1 | Gt 0 | Gt 0 | Gt 1 | Gt 2 | Gt 0 | Gt 1 | Gt 1 | Gt 0 |

* Gt 0 = best / Gt 5 = worst

Multi-layer systems

Some applications require a multi-layer system, containing corrosion protection basecoat and a topcoat:

for unique specifications of the end user

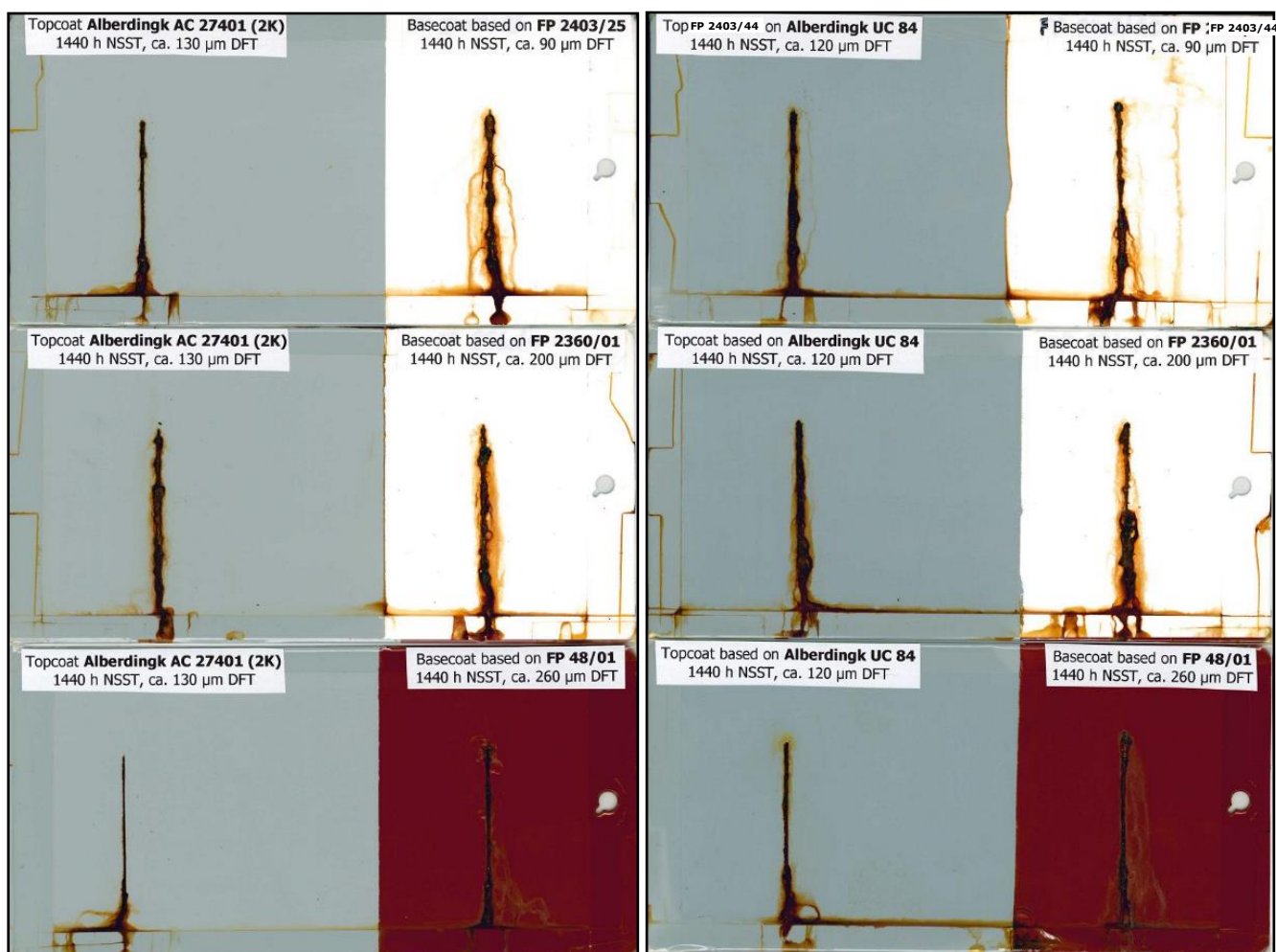
for special colour shades or gloss levels

if the corrosion base coat is soft or if it has poor mechanical resistance

to improve the chemical resistance, e.g. versus solvents, oils, acids and lyes

Topcoat: FP 27401-12
based on: **ALBERDINGK® AC 27401**

FP 84-18
ALBERDINGK® UC 84



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Formulation Proposal

FP 2403-78

anti-corrosion coatings, PVC approx. 11%,
solids approx. 49%, spray application, semi gloss recommended
nozzle size > 2.0 mm,
Gloss: approx. 85 @60°

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|---|---------------|---------------------------|-------------------------|
| 1 | Alberdingk® AC 2403 | 68.50 | acrylic dispersion | Alberdingk Boley |
| 2 | Water (deion.)* | 2.00 | | |
| 3 | Dowanol DPM* | 4.00 | co-solvent | Dow Chemical |
| 4 | BYK-024 | 0.25 | defoamer | BYK-Chemie |
| 5 | <i>Pigment preparation</i> | <i>19.50</i> | | <i>see below</i> |
| 6 | Asconium-142DA** | 1.90 | corrosion inhibitor | Ascotec |
| 7 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 8 | Ascotran-H10 | 0.80 | flash rust inhibitor | Ascotec |
| 9 | BYK-349 | 0.30 | substrate wetting agent | BYK-Chemie |
| 10 | Tego Glide 494 | 0.30 | surface additive | Evonik |
| 11 | CERAFLOUR 927 N | 1.80 | wax powder | BYK-Chemie |
| 12 | Tafigel PUR 61 Solution (20% PUR 61, 20% DPM, 60% water) | 0.50 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

* Premix pos. 2 & 3

** Premix pos. 6 & 7. Use the Asconium 142DA / AMP 90 blend within 1 day or
the Asconium 142DA / DMEA blend within 5 days.

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Pigment preparation

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|----------------|---------------|--------------------|----------------|
| 1 | Water (deion.) | 17.50 | | |
| 2 | Edaplan 490 | 5.10 | dispersing agent | Münzing Chemie |
| 3 | AMP 90 | 0.10 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.50 | defoamer | BYK-Chemie |
| 5 | Kronos 2190 | 76.80 | pigment | Kronos |
| Total | | 100.00 | | |

Test Features

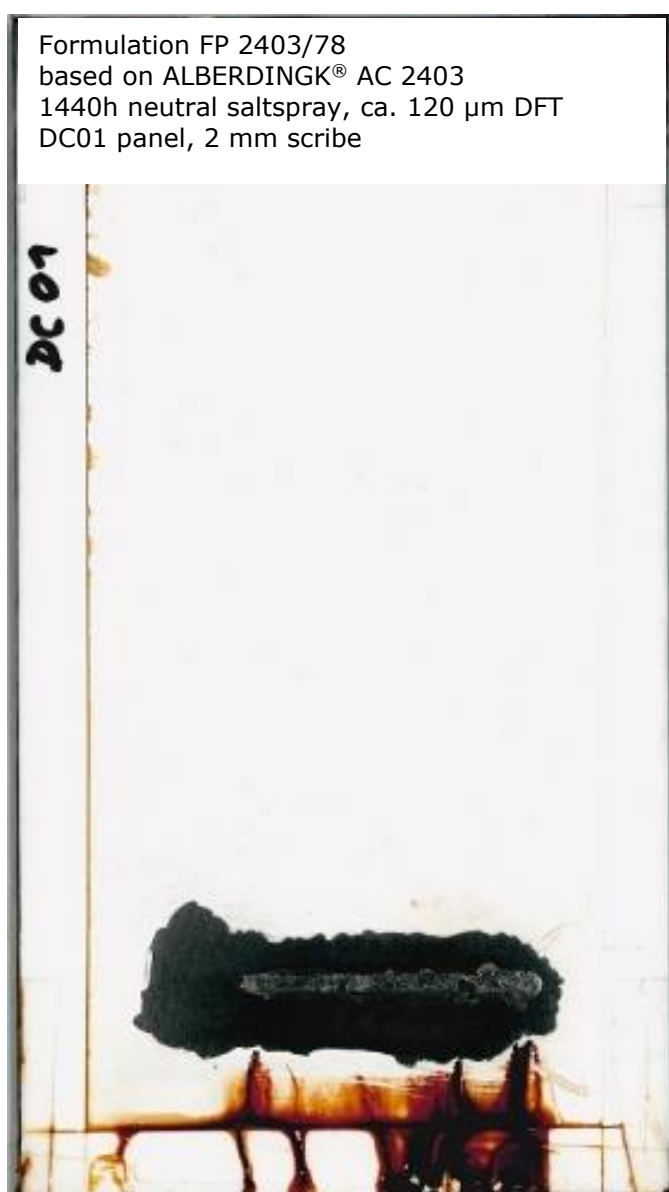
| Feature | Test Conditions | Test Results |
|---|-----------------|--------------|
| Water absorption [%] | | approx. 3.0 |
| Water vapor permeability [g/m ² per day] | wet cup method | approx. 30 |

Formulation Proposal

FP 2403-78

anti-corrosion coatings, PVC approx. 11%,
solids approx. 49%, spray application, semi gloss recommended
nozzle size > 2.0 mm,
Gloss: approx. 85 @60°

Test Results (after 1440 hours neutral salt-spray test)



Test report: see pages 53-61

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Formulation Proposal

FP 2403-67

anti-corrosion coatings, PVC approx. 22%,
solids approx. 54%, spray application,
recommended nozzle size > 2.0 mm

| Pos. | Raw Material | Amount | Product | Supplier |
|--|---|---------------|---------------------------|-------------------------|
| 1 | Water (deion.) | 5.30 | | |
| 2 | Edaplan 490 | 1.20 | dispersing agent | Münzing Chemie |
| 3 | AMP 90 | 0.02 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 5 | Kronos 2190 | 17.70 | pigment | Kronos |
| 6 | Calcilit Super | 7.50 | extender | Alpha Calcit |
| Disperse with high shear rate for 10min, then proceed with pos. 7 – 16 | | | | |
| 7 | Water (deion.)* | 4.30 | | |
| 8 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 9 | ALBERDINGK® AC 2403 | 57.90 | acrylic dispersion | Alberdingk Boley |
| 10 | BYK-024 | 0.15 | defoamer | BYK-Chemie |
| 11 | BYK-349 | 0.18 | wetting agent | BYK-Chemie |
| 12 | Asconium-142DA** | 1.90 | corrosion inhibitor | Ascotec |
| 13 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 14 | Ascotran-H10 | 0.60 | flash rust inhibitor | Ascotec |
| 15 | Tafigel PUR 61 solution (20% PUR 61:20% Dowanol DPM: 60% water) | 0.50 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

* Premix pos. 7 + 8

** Premix pos. 12 + 13. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days

Corrosion Class: C5-I long (@80µm DFT)

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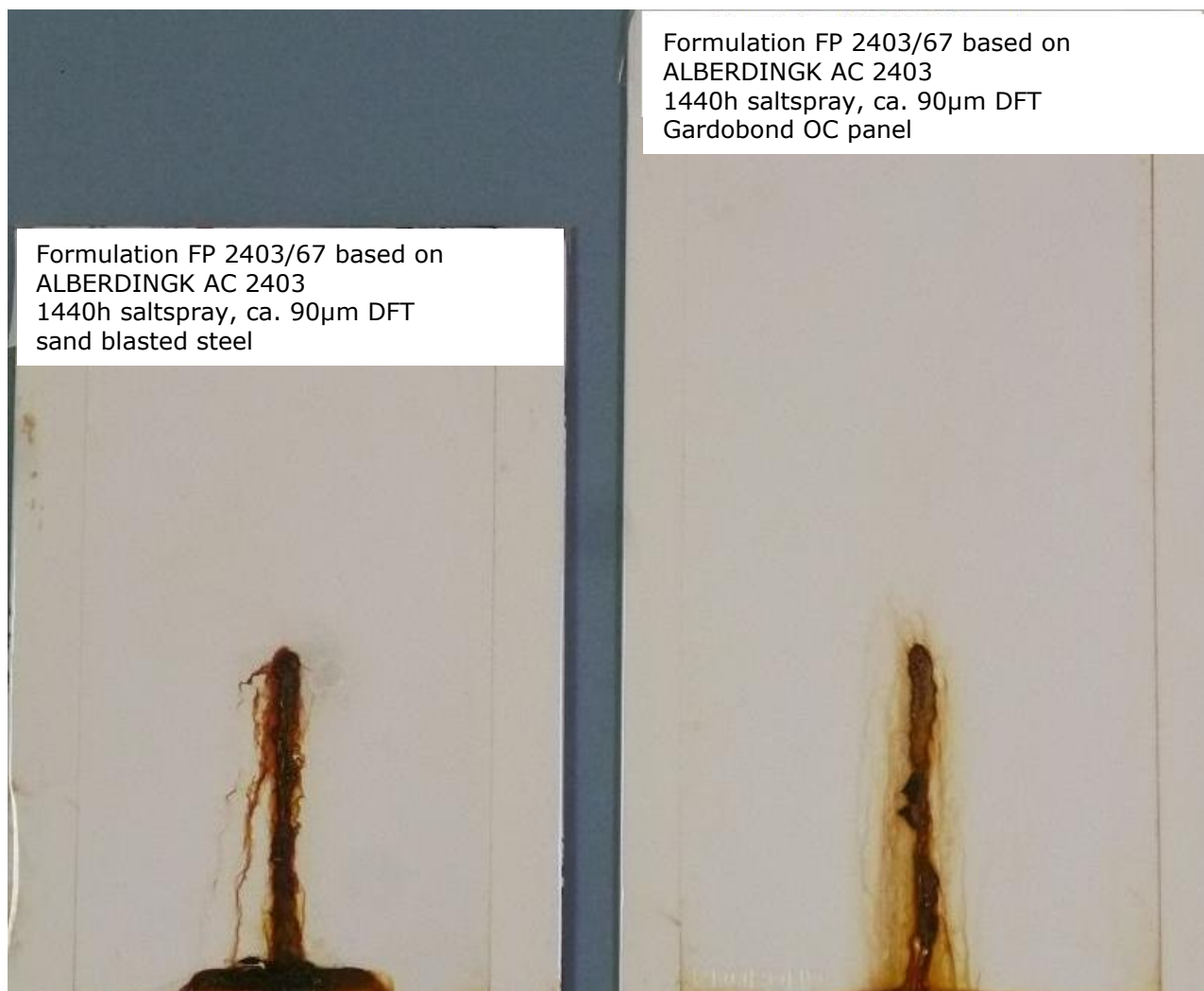
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Test Results (after 1440 hours salt-spray test)

FP 2403-67

anti-corrosion coatings, PVC approx. 22%
also suitable for sandblasted steel



Test features

| Feature | Test Conditions | Test Results |
|---|-----------------|--------------|
| Water absorption [%] | | approx. 3.0 |
| Water vapor permeability [g/m ² per day] | wet cup method | approx. 29 |

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Formulation Proposal

FP 2403-75

anti-corrosion coating,
PVC approx. 35%, solids approx. 56%

| Pos. | Raw Material | Amount | Product | Supplier |
|--|--|---------------|---------------------------|-------------------------|
| 1 | Water (deion.) | 8.00 | | |
| 2 | Edaplan 490 | 1.20 | dispersing agent | Münzing Chemie |
| 3 | AMP 90 | 0.03 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 5 | Kronos 2190 | 5.00 | pigment | Kronos |
| 6 | Durcal 5 | 27.50 | filler | Omya |
| Disperse with high shear rate for 10min, then proceed with pos. 7 – 16 | | | | |
| 7 | Water (deion.)* | 5.00 | | |
| 8 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 9 | ALBERDINGK® AC 2403 | 46.70 | acrylic dispersion | Alberdingk Boley |
| 10 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 11 | BYK-345 | 0.22 | wetting agent | BYK-Chemie |
| 12 | Asconium-142DA** | 2.00 | corrosion inhibitor | Ascotec |
| 13 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 14 | Ascotran-H10 | 1.00 | flash rust inhibitor | Ascotec |
| 15 | Tafigel PUR 61 solution (20% PUR 61:20% Dowanol DPM:60% water) | 0.50 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

* Premix pos. 7 + 8

** Premix pos. 12 + 13. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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Formulation Proposal

FP 2420-10

anti-corrosion coatings, PVC approx. 11%,
solids approx. 50%

| Pos. | Raw Material | Amount | Product | Supplier |
|--|--|-------------------|---------------------------|-------------------------|
| 1 | Water (deion.) | 3.00 | | |
| 2 | Edaplan 490 | 1.00 | dispersing agent | Münzing Chemie |
| 3 | Ammonia (12,5%) | <i>Some drops</i> | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 5 | Kronos 2190 | 15.00 | pigment | Kronos |
| Disperse with high shear rate for 10min, then proceed with pos. 6 – 14 | | | | |
| 6 | Water (deion.)* | 1.50 | | |
| 7 | Dowanol DPM* | 5.00 | co-solvent | Dow Chemical |
| 8 | ALBERDINGK® AC 2420 | 68.90 | acrylic dispersion | Alberdingk Boley |
| 9 | BYK-024 | 0.15 | defoamer | BYK-Chemie |
| 10 | BYK-349 | 0.20 | wetting agent | BYK-Chemie |
| 11 | Asconium-142DA** | 1.90 | corrosion inhibitor | Ascotec |
| 12 | Water (deion.)** | 1.90 | | |
| 13 | DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 14 | Ascotran-H10 | 0.80 | flash rust inhibitor | Ascotec |
| 15 | Tafigel PUR 61 solution (20 % PUR 61 : 20 % Dowanol DPM: 60 % water) | 0.30 | rheology modifier | Münzing Chemie |
| 16 | Tafigel PUR 41 | 0.10 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

* Premix pos. 6 + 7

** Premix pos. 11 - 13. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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Formulation Proposal

FP 2420-10

anti-corrosion coatings, PVC approx. 11%,
solids approx. 50%



1440h NSST,
Gardobond OC panel,
approx. 110µm DFT

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Formulation Proposal

FP 2433-02

anti-corrosion coatings, spray application
PVC approx. 11%, solids approx. 53%

| Pos. | Raw Material | Amount | Supplier |
|--|---|---------------|-------------------------|
| 1 | Water (deion.) | 2.50 | |
| 2 | Edaplan 490 | 1.00 | Münzing Chemie |
| 3 | AMP 90 | 0.02 | Angus Chemie |
| 4 | BYK-024 | 0.10 | BYK-Chemie |
| 5 | Kronos 2190 | 15.00 | Kronos |
| Disperse with high shear rate for 10min, then proceed with pos. 6 – 14 | | | |
| 6 | Water (deion.)* | 3.90 | |
| 7 | Dowanol DPM* | 5.00 | Dow Chemical |
| 8 | ALBERDINGK® AC 2433 VP | 68.90 | Alberdingk Boley |
| 9 | BYK-024 | 0.15 | BYK-Chemie |
| 10 | BYK-349 | 0.18 | BYK-Chemie |
| 11 | Asconium-142DA** | 1.90 | Ascotec |
| 12 | AMP 90 or DMEA** | 0.15 | Angus Chemie / Evonik |
| 13 | Ascotran-H10 | 0.60 | Ascotec |
| 14 | Tafigel PUR 61 solution (20 % PUR 61: 20 % Dowanol DPM: 60 % water) | 0.60 | Münzing Chemie |
| Total | | 100.00 | |

* Premix pos. 8 + 9

** Premix pos. 11 & 12. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

Corrosion Class: C4-I long / C5-I middle (@100µm DFT)

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Test Features

FP 2433-02

anti-corrosion coatings, spray application
PVC approx. 11%, solids approx. 53%

| Feature | Test Conditions | Test Results |
|---|-----------------|--------------|
| Water absorption [%] | | approx. 3.0 |
| Water vapor permeability [g/m ² per day] | wet cup method | approx. 29 |

Test Results (after 672 hours salt-spray test)



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Formulation Proposal

FP 2003-08

anti-corrosion coating, PVC 11%, solids approx. 48%

| Pos. | Raw Material | Amount | Product | Supplier |
|--|----------------------------|---------------|----------------------|-------------------------|
| 1 | Water (deion.) | 5.10 | | |
| 2 | Edaplan 490 | 1.00 | dispersing agent | Münzing Chemie |
| 3 | AMP 90 | 0.02 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 5 | Kronos 2190 | 15.00 | pigment | Kronos |
| Disperse with high shear rate for 10min, then proceed with pos. 6 – 14 | | | | |
| 6 | Water (deion.) | 9.88 | | Alberdingk Boley |
| 7 | Alberdingk® AC 2003 | 64.00 | defoamer | BYK-Chemie |
| 8 | BYK-024 | 0.20 | wetting agent | BYK-Chemie |
| 9 | BYK-349 | 0.15 | | |
| 10 | AMP 90 or DMEA* | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 11 | Asconium-142DA* | 1.90 | corrosion inhibitor | Ascotec |
| 12 | Dowanol DPM* | 1.50 | co-solvent | Dow Chemical |
| 13 | Ascotran-H 10 | 0.80 | flash rust inhibitor | Ascotec |
| 14 | Tafigel PUR 41 | 0.20 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

* Premix pos. 10 - 12. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days

Drain time DIN 6 mm cup: approx. 35 seconds

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Formulation Proposal

FP 2003-08

anti-corrosion coating, PVC 11%, solids approx. 48%



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Formulation Proposal

FP 48-02

anti-corrosion coating, iron oxide red
PVC approx. 30%, solids approx. 54%

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|--------------------------|---------------|---------------------------|-------------------------|
| 1 | ALBERDINGK® SC 48 | 40.00 | acrylic dispersion | Alberdingk Boley |
| 2 | Water (deion.) | 11.05 | | |
| 3 | Pigment preparation | 41.50 | <i>see next page</i> | |
| 4 | Optifilm Enhancer 300 | 1.00 | co-solvent | Eastman |
| 5 | BYK-024 | 0.40 | defoamer | BYK-Chemie |
| 6 | BYK-349 | 0.10 | substrate wetting agent | BYK-Chemie |
| 7 | Ascotran H-10 | 0.50 | flash rust inhibitor | Ascotec |
| 8 | Ammonia (25%) | 0.80 | neutralizing agent | |
| 9 | Resydrol AX 237 W/70 BG | 4.00 | epoxy-alkyd resin | Allnex |
| 10 | Borchi OXY-Coat 1101 | 0.05 | drier | Borchers |
| 11 | Tafigel PUR 40 | 0.60 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

Adjust the pH value of the finalized paint with Ammonia to 8.5.

Corrosion Class:

C4-I long / C5-I middle (@150µm DFT)

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Formulation Proposal

FP 48-02

pigment preparation

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|-------------------|--------------|------------------------|----------------|
| 1 | Water (deion.) | 7.00 | | |
| 2 | Edaplan 490 | 0.80 | dispersing agent | Münzing Chemie |
| 3 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 4 | Butyl Glycol (BG) | 3.00 | co-solvent | BASF |
| 5 | Bayferrox 130 M | 9.00 | pigment | Lanxess |
| 6 | Micro Talc AT 1 | 3.00 | filler | Mondo Minerals |
| 7 | Calcilit Super | 10.60 | filler | Alpha Calcit |
| 8 | Heucophos ZPO | 7.00 | anti-corrosion pigment | Heubach |
| 9 | Heucorin RZ | 1.00 | anti-corrosion pigment | Heubach |
| Total | | 41.50 | | |

Disperse with high shear rate for 10 min.

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Formulation Proposal

FP 48-05

anti-corrosion coating, iron oxide red
PVC approx. 37%, solids approx. 56%

| Pos. | Raw Material | Amount | Product | Supplier |
|--|--|---------------|---------------------------|-------------------------|
| 1 | Water (deion.) | 8.00 | | |
| 2 | Edaplan 490 | 1.20 | dispersing agent | Münzing Chemie |
| 3 | AMP 90 | 0.02 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 5 | Bayferrox 130 M | 5.00 | pigment | Lanxess |
| 6 | Durcal 5 | 27.50 | extender | Omya |
| Disperse with high shear rate for 10min, then proceed with pos. 7 – 16 | | | | |
| 7 | Water (deion.) | 9.10 | | |
| 8 | ALBERDINGK® SC 48 | 43.90 | acrylic dispersion | Alberdingk Boley |
| 9 | BYK-024 | 0.30 | defoamer | BYK-Chemie |
| 10 | Asconium-142DA* | 2.00 | corrosion inhibitor | Ascotec |
| 11 | AMP 90 or DMEA* | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 12 | Optifilm Enhancer 300 | 1.00 | co-solvent | Eastman |
| 13 | BYK-349 | 0.13 | wetting agent | BYK-Chemie |
| 14 | Ascotran-H10 | 0.80 | flash rust inhibitor | Ascotec |
| 15 | Tafigel PUR 61 (50% in Dowanol DPM) | 0.80 | rheology modifier | Münzing |
| Total | | 100.00 | | |

* Premix pos. 10 + 11.

Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

Corrosion Class:

C4-I long / C5-I middle (@200µm DFT)

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Formulation Proposal

FP 48-05

anti-corrosion coating, iron oxide red
PVC approx. 35%, solids approx. 56%

Formulation Proposal FP 48/05

Based on ALBERDINGK® SC 48
1440h NSST, ca. 170µm DFT

Formulation Proposal FP 48/05

Based on ALBERDINGK® SC 48
1440h NSST, ca. 350µm DFT



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Formulation Proposal

FP 2403-70

anti corrosion, RAL 1007 daffodil yellow
solids approx. 47%, PVC approx. 9%

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|----------------------------|---------------|---------------------------|-------------------------|
| 1 | ALBERDINGK® AC 2403 | 68.90 | acrylic dispersion | Alberdingk Boley |
| 2 | Water (deion.)* | 4.95 | | |
| 3 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 4 | Pigment preparation | 20.00 | | <i>see below</i> |
| 5 | BYK-024 | 0.20 | defoamer | BYK-Chemie |
| 6 | Asconium-142DA** | 2.00 | corrosion inhibitor | Ascotec |
| 7 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 8 | Ascotran-H10 | 0.50 | flash rust inhibitor | Ascotec |
| 9 | Tego Wet KL 245 | 0.20 | wetting agent | Evonik |
| 10 | OPTIFLO-T 1000 | 0.60 | rheology modifier | BYK-Chemie |
| Total | | 100.00 | | |

* Premix pos. 2 + 3

** Premix pos. 6 + 7. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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Pigment preparation RAL 1007 Daffodil yellow / Narzissengelb

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|---------------------------|---------------|--------------------|-------------------|
| 1 | Water (deion.) | 16.40 | | |
| 2 | Borchi Gen 1750 | 4.65 | dispersing agent | Borchers |
| 3 | AMP 90 | 0.05 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.40 | defoamer | BYK-Chemie |
| 5 | Brufablend E 27015 yellow | 65.00 | pigment | Bruchsaler Farben |
| 6 | Tafigel PUR 40 | 0.20 | rheology modifier | Münzing Chemie |
| 7 | Water (deion.) | 13.30 | | |
| Total | | 100.00 | | |



FP 2403/70:
Pos. 2 = Edaplan 490



FP 2403/70:
Pos. 2 = Borchi Gen 1750

100µm DFT
1440h NSST
Brufablend Paste 20%
RAL 1007

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Formulation Proposal

FP 2403-71

anti corrosion, RAL 3001 signal red
solids approx. 44%, PVC approx. 9%

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|----------------------------|---------------|---------------------------|-------------------------|
| 1 | ALBERDINGK® AC 2403 | 68.90 | acrylic dispersion | Alberdingk Boley |
| 2 | Water (deion.)* | 4.85 | | |
| 3 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 4 | Pigment preparation | 20.00 | | <i>see below</i> |
| 5 | BYK-024 | 0.20 | defoamer | BYK Chemie |
| 6 | Asconium-142DA** | 2.00 | corrosion inhibitor | Ascotec |
| 7 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 8 | Ascotran-H10 | 0.60 | flash rust inhibitor | Ascotec |
| 9 | Tego Wet KL 245 | 0.20 | wetting agent | Evonik |
| 10 | OPTIFLO-T 1000 | 0.60 | rheology modifier | BYK-Chemie |
| Total | | 100.00 | | |

* Premix pos. 2 + 3

** Premix pos. 6 + 7. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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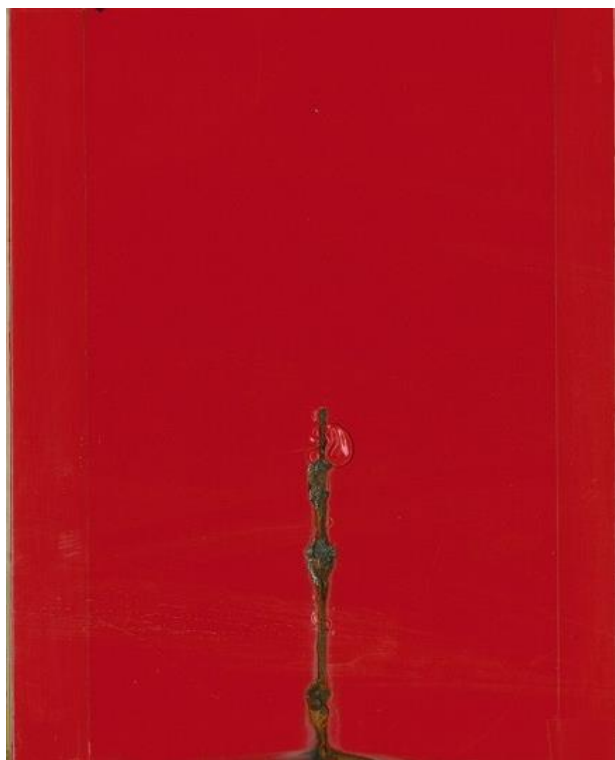
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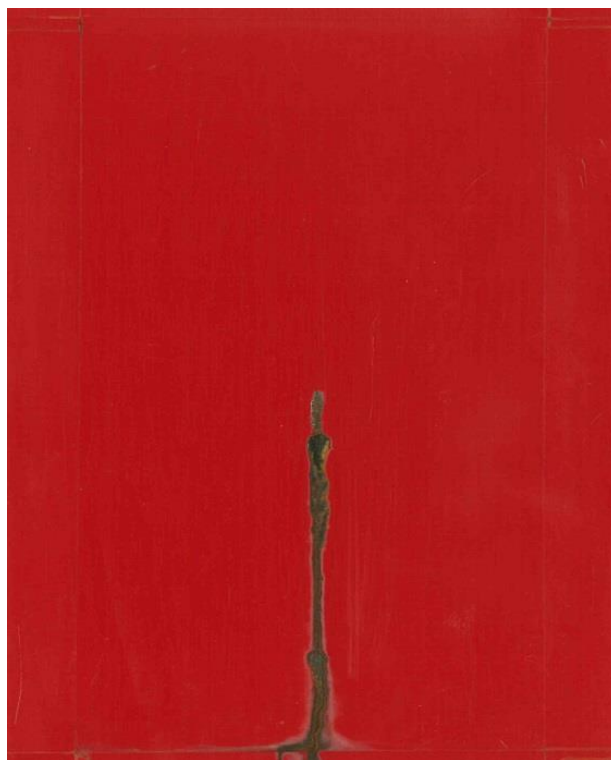
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Pigment preparation RAL 3001 Signal red / Signalrot

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|--------------------------|---------------|--------------------|-------------------|
| 1 | Water (deion.) | 18.70 | | |
| 2 | Borchi Gen 1750 | 4.65 | dispersing agent | Borchers |
| 3 | AMP 90 | 0.05 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.40 | defoamer | BYK-Chemie |
| 5 | Brufablend E 27488 S red | 55.00 | pigment | Bruchsaler Farben |
| 6 | Tafigel PUR 40 | 0.10 | rheology modifier | Münzing Chemie |
| 7 | Water (deion.) | 21.10 | | |
| Total | | 100.00 | | |



FP 2403/71:
Pos. 2 = Edaplan 490



FP 2403/71:
Pos. 2 = Borchi Gen 1750

100µm DFT
1440h NSST
Brufablend Paste 20%
RAL 3001

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Formulation Proposal

FP 2403-72

anti corrosion, RAL 6011 reseda green
solids approx. 48%, PVC approx. 8%

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|----------------------------|---------------|---------------------------|-------------------------|
| 1 | ALBERDINGK® AC 2403 | 68.90 | acrylic dispersion | Alberdingk Boley |
| 2 | Water (deion.)* | 4.85 | | |
| 3 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 4 | Pigment preparation | 20.00 | | see below |
| 5 | BYK-024 | 0.20 | defoamer | BYK-Chemie |
| 6 | Asconium-142DA** | 2.00 | corrosion inhibitor | Ascotec |
| 7 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 8 | Ascotran-H10 | 0.60 | flash rust inhibitor | Ascotec |
| 9 | Tego Wet KL 245 | 0.20 | wetting agent | Evonik |
| 10 | OPTIFLO-T 1000 | 0.60 | rheology modifier | BYK-Chemie |
| Total | | 100.00 | | |

* Premix pos. 2 + 3

** Premix pos. 6 + 7. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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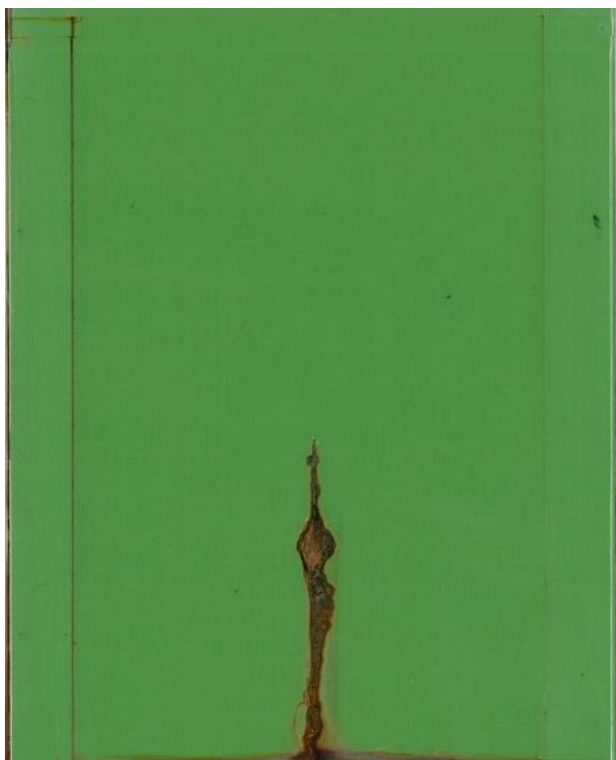
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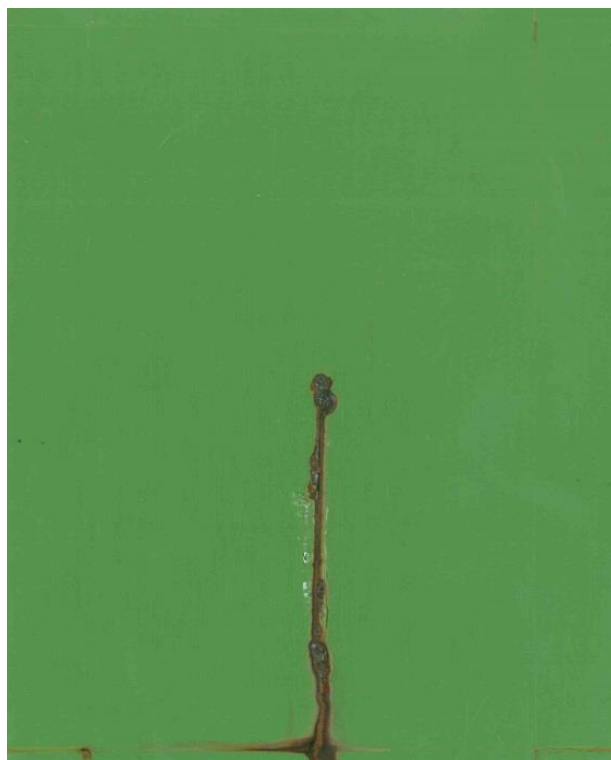
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Pigment preparation RAL 6011 Reseda green / Resedagrün

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|--------------------------|---------------|--------------------|-------------------|
| 1 | Water (deion.) | 14.00 | | |
| 2 | Borchi Gen 1750 | 4.65 | dispersing agent | Borchers |
| 3 | AMP 90 | 0.05 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.40 | defoamer | BYK-Chemie |
| 5 | Brufablend E 26971 green | 70.00 | pigment | Bruchsaler Farben |
| 6 | Tafigel PUR 40 | 0.20 | rheology modifier | Münzing Chemie |
| 7 | Water (deion.) | 10.70 | | |
| Total | | 100.00 | | |



FP 2403/72:
Pos. 2 = Edaplan 490



FP 2403/72:
Pos. 2 = Borchi Gen 1750

100µm DFT
1440h NSST
Brufablend Paste 20%
RAL 6011

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Formulation Proposal

FP 2403-73

anti corrosion, RAL 9005 jet black
solids approx. 38

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|----------------------------|---------------|---------------------------|-------------------------|
| 1 | ALBERDINGK® AC 2403 | 74.30 | acrylic dispersion | Alberdingk Boley |
| 2 | Water (deion.)* | 12.00 | | |
| 3 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 4 | Pigment preparation | 7.50 | | see below |
| 5 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 6 | Asconium-142DA** | 2.00 | corrosion inhibitor | Ascotec |
| 7 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 8 | Tego Wet KL 245 | 0.20 | wetting agent | Evonik |
| 9 | Ascotran-H10 | 0.60 | flash rust inhibitor | Ascotec |
| 10 | Tego Glide 494 | 0.15 | surface additive | Evonik |
| 11 | Tafigel PUR 45 | 0.50 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

* Premix pos. 2 + 3

** Premix pos. 6 + 7. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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Pigment preparation RAL 9005 jet black

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|--------------------|---------------|--------------------|--------------------------|
| 1 | Water (deion.) | 68.85 | | |
| 2 | Borchi Gen 1750 | 15.00 | dispersing agent | Borchers |
| 3 | Ammonia (25%) | 0.65 | neutralizing agent | |
| 4 | Agitan 351 | 0.50 | defoamer | Münzing Chemie |
| 5 | Color black FW 200 | 15.00 | pigment | Orion Engineered Carbons |
| Total | | 100.00 | | |



FP 2403/73:
Pos. 2 = Edaplan 490



FP 2403/73:
Pos. 2 = Borch Gen 1750

approx. 110µm DFT
1440h NSST
FW 200 Paste 7.5%
RAL 9005

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Formulation Proposal

FP 2403-74

anti corrosion, RAL 5011 steel blue
solids approx. 48%, PVC approx. 8%

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|----------------------------|---------------|---------------------------|-------------------------|
| 1 | ALBERDINGK® AC 2403 | 68.90 | acrylic dispersion | Alberdingk Boley |
| 2 | Water (deion.)* | 4.85 | | |
| 3 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 4 | Pigment preparation | 20.00 | | see below |
| 5 | BYK-028 | 0.20 | defoamer | BYK-Chemie |
| 6 | Asconium-142DA** | 2.00 | corrosion inhibitor | Ascotec |
| 7 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 8 | Ascotran-H10 | 0.60 | flash rust inhibitor | Ascotec |
| 9 | Tego Wet KL 245 | 0.20 | wetting agent | Evonik |
| 10 | OPTIFLO-T 1000 | 0.60 | rheology modifier | BYK-Chemie |
| Total | | 100.00 | | |

* Premix pos. 2 + 3

** Premix pos. 6 + 7. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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Pigment preparation RAL 5011 steel blue

| Pos. | Raw Material | Amount | Product | Supplier |
|--------------|-------------------------|---------------|--------------------|-------------------|
| 1 | Water (deion.) | 14.00 | | |
| 2 | Borchi Gen 1750 | 4.65 | dispersing agent | Borchers |
| 3 | AMP 90 | 0.05 | neutralizing agent | Angus Chemie |
| 4 | BYK-028 | 0.20 | defoamer | BYK-Chemie |
| 5 | Brufablend E 27352 blue | 70.00 | pigment | Bruchsaler Farben |
| 6 | Tafigel PUR 40 | 0.20 | rheology modifier | Münzing Chemie |
| 7 | Water (deion.) | 10.90 | | |
| Total | | 100.00 | | |



FP 2403/74:
Pos. 2 = Edaplan 490



FP 2403/74:
Pos. 2 = Borchi Gen 1750

approx. 100µm DFT
1440h NSST
Brufablend Paste 20%
RAL 5011

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Formulation Proposal

FP 2403-76

anti-corrosion coatings, PVC approx. 11%, **nitrite-free**
solids approx. 50%, spray application,
recommended nozzle size > 2.0mm

| Pos. | Raw Material | Amount | Product | Supplier |
|--|--|---------------|---------------------------|-------------------------|
| 1 | Water (deion.) | 2.50 | | |
| 2 | Borchi Gen 1750 | 1.00 | dispersing agent | Borchers |
| 3 | AMP 90 | 0.02 | neutralizing agent | Angus Chemie |
| 4 | BYK-024 | 0.10 | defoamer | BYK-Chemie |
| 5 | Kronos 2190 | 15.00 | pigment | Kronos |
| Disperse with high shear rate for 10min, then proceed with pos. 6 – 15 | | | | |
| 6 | Water (deion.)* | 6.20 | | |
| 7 | Dowanol DPM* | 2.50 | co-solvent | Dow Chemical |
| 8 | ALBERDINGK® AC 2403 | 68.90 | acrylic dispersion | Alberdingk Boley |
| 9 | BYK-024 | 0.15 | defoamer | BYK-Chemie |
| 10 | BYK-349 | 0.18 | wetting agent | BYK-Chemie |
| 11 | Asconium-142DA** | 1.90 | corrosion inhibitor | Ascotec |
| 12 | AMP 90 or DMEA** | 0.15 | neutralizing agent | Angus Chemie / Evonik |
| 13 | Habikor FRI 1001 | 0.80 | flash rust inhibitor | Habich GmbH |
| 14 | Tafigel PUR 61 solution (20% PUR 61: 20% Dowanol DPM: 60% water) | 0.60 | rheology modifier | Münzing Chemie |
| Total | | 100.00 | | |

* Premix pos. 6 + 7

** Premix pos. 11 + 12. Use the Asconium 142DA / AMP 90 blend within 1 day or the Asconium 142DA / DMEA blend within 5 days.

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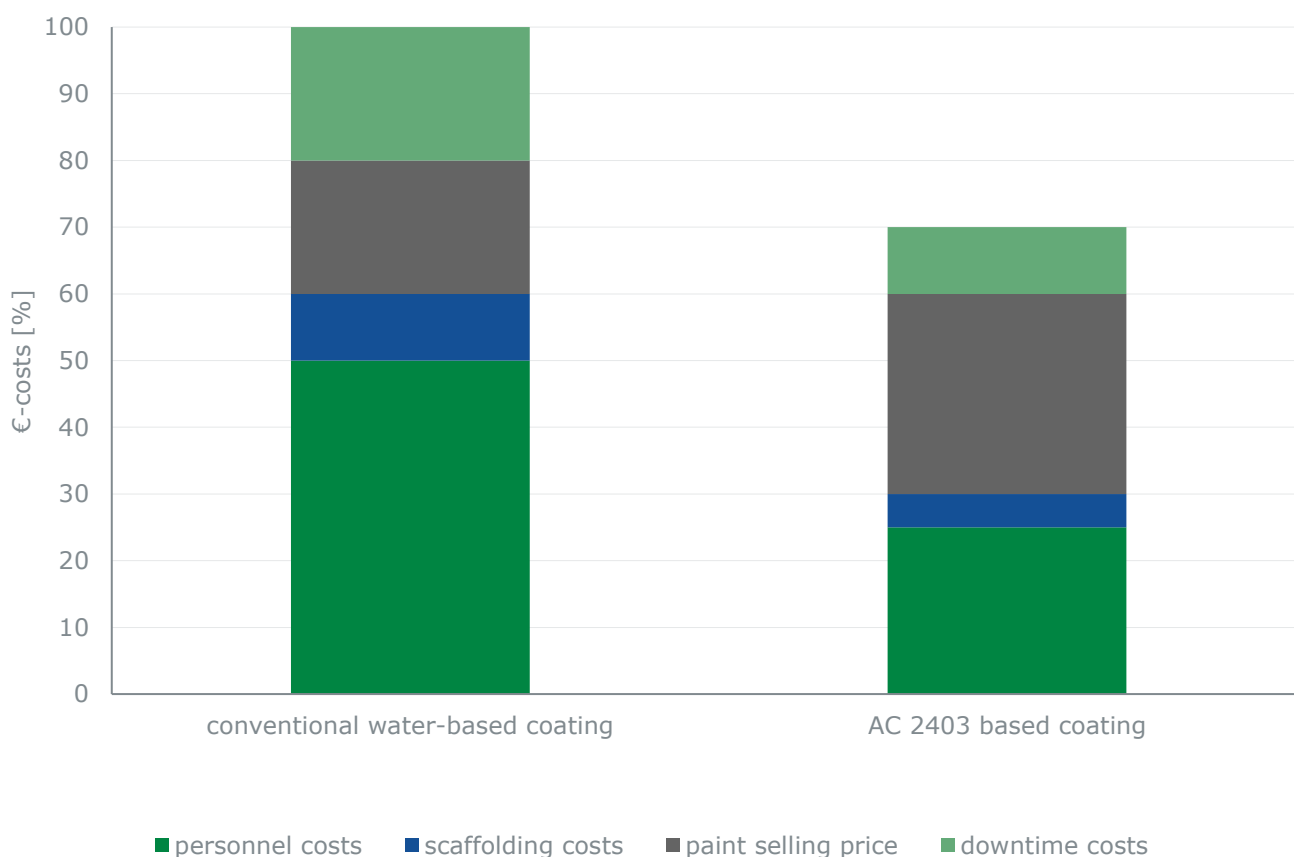
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Conclusion

Today's challenge of Paint producers are cost efficient solutions at a very high level of quality.

ALBERDINGK® AC 2403 is a prominent example for a high quality dispersion which combines all these advantages with the objective target of high corrosion protection performance at a maximum of efficiency.

Schematical cost calculation for a 1000m² corrosion protection renovation project:



ALBERDINGK® AC 2403 advantages at a glance:

- Less working hours, due to 1 coat system
- Less downtime, due to 1-coat system
- Reduced scaffolding costs
- Primer and topcoat are combined in one single coating
- Higher security due to a maximum of corrosion protection performance
- Eco-friendly (water-based, without Zn^{2+} -ions), low VOC
- Less weight due to lower dry film thickness

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External test results ALBERDINGK® AC 2403

| | | |
|---|---|---|
| Test report no. 20DE-03227OR01 | |  |
| <u>Kiwa GmbH, Voltastraße 5, 13355 Berlin</u> | | Kiwa GmbH MPA Berlin-Brandenburg Voltastr. 5 13355 Berlin |
| Alberdingk Boley GmbH Düsseldorfer Straße 53 47829 Krefeld | | T: +49 (0) 30 467761 – 0 F: +49 (0) 30 467761 – 10 E: de.info.kiwaberlin@kiwa.com www.kiwa.com |
| Project: | Testing of a corrosion protection | |
| Plant: | Alberdingk Boley GmbH Düsseldorfer Straße 53 47829 Krefeld | |
| Order date: | March 16th, 2021 | |
| Request for testing: | Testing of a corrosion protection according to DIN EN ISO 12944-6:2018 in the category "C5 very high" | |
| Sample description: | see section 1 | |
| Number of samples: | see section 1 | |
| Sample(s) taken by: | a representative of Alberdingk Boley GmbH. If the test material has not been used up, it will be stored for 4 weeks. A longer storage period requires a written agreement. | |
| Sample(s) received: | May 21st, 2021 | |
| Test period: | May – October 2021 | |
| Berlin, October 21st, 2021 | | |
|  <small>- Digitally signed see http://cs.kiwa-deutschland.de for more details -</small> i.V. Dr. Ronny Stadie Unit leader |  |  <small>- Digitally signed see http://cs.kiwa-deutschland.de for more details -</small> i.A. Thorben Strate Project engineer |
| OMF P A 101_B_R_18.05.2021 | | |
| <small>The test results refer exclusively to the test items mentioned. No part of the test report may be reproduced without the written permission of the testing laboratory. ⓘ Information from the client. ⓘ Change.</small> | | |
| <small>Managing Directors: Prof. Dr. Roland Hüttl, Dr. Gero Schönwaßer Hamburg Local Court, HRB 130568, St.Nr.: 46/736/03268</small> | | |
| 1 / 9 | | |

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Test report no. 20DE-03227OR01



1. General

Kiwa GmbH, MPA Berlin-Brandenburg was commissioned by Alberdingk Boley GmbH to carry out the tests in the category "C5 very high" on with the corrosion protection systems

"FP 2403/78" 3-layered on the basis of "ALBERDINGK® AC 2403"

coated panels according to DIN EN ISO 12944-6:2018-06 "Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 6: Laboratory performance test methods; German Version".

For this purpose, the coated panels were subjected to the cyclic ageing test according to Annex B of DIN EN ISO 12944-6:2018-06 in accordance with test programme 2 of Table 1 of DIN EN ISO 12944-6:2018-06.

1.1 Material

Kiwa GmbH, MPA Berlin-Brandenburg was handed over nine panels coated with corrosion protection.

| Coating | |
|---------------------------------------|--|
| Layer thickness in [µm] ^{a)} | 280 – 320; 300 – 340; 290 – 325; 300 – 335; 295 – 340; 300 – 340; 300 – 345; 295 – 315; 295 – 325 |
| Stahlplatte | |
| Steel grade ^{a)} | S235JR |
| Material number ^{a)} | 1.0038 |
| Surface roughness ^{a)} | "medium G" |
| Surface texture ^{a)} | Sa 2 ½ (sandblasted) |

1.2 Scope of testing

Table 1 Scope of testing

| Test | Test basis | Product |
|--|---|---------------|
| Assessment before artificial ageing | | |
| Pull-off test | DIN EN ISO 4624:2016-08 | coated panels |
| Evaluation after artificial ageing | | |
| Evaluation according to ISO 4628 and corrosion at the incision | DIN EN ISO 4628-2:2016-07, DIN EN ISO 4628-3:2016-07, DIN EN ISO 4628-4:2016-07, DIN EN ISO 4628-5:2016-07, DIN EN ISO 12944-6:2018-06 Annex A | coated panels |
| Pull-off test | DIN EN ISO 4624:2016-08 | coated panels |

1.3 Basis of evaluation

The properties / requirements are taken from DIN EN ISO 12944-6: 2018-06.

^{a)} Information from the client. ^{b)} Change. ^{c)} The conformity statement is made according to the requirements of the specifications mentioned and according to the first binary Kiwa decision rule and the respective confidence level. This assessment is a pure statement of conformity by the testing body. It does not replace the subsequent assessment and evaluation of the certification body or the confirmation of conformity...

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2. Test results

2.1 Evaluation before artificial ageing

2.1.1 Pull-off test

Manufacturing, storage and testing conditions:

| | |
|----------------------------|---|
| Test basis: | DIN EN ISO 4624:2016-08 |
| Examination(s) on: | coated panels |
| Testing device: | Freundt F20D EASY |
| Storage: | (23 ± 2) °C and (50 ± 10) % r.h |
| Testing conditions: | (23 ± 2) °C and (50 ± 10) % r.h Testing stamp: 20 mm diameter Method B Glue on basis of epoxy (2 days curing time) |

Test results:

Table 2 Pull-off test before artificial ageing

| Specimen | Test spot | Bond strength [N/mm²] | Separation case with division in [%] | | | | | |
|---------------------------------|-----------|--------------------------|---|-----|-----|-----|---|-----|
| | | | A | A/B | B | B/Y | Y | Y/Z |
| 2.1 | 1 | 8,13 | | | 100 | | | |
| | 2 | 9,59 | | | 100 | | | |
| 2.2 | 1 | 10,00 | | | 100 | | | |
| | 2 | 7,71 | | | 100 | | | |
| 2.2 | 1 | 8,07 | | | 100 | | | |
| | 2 | 10,90 | | | 100 | | | |
| Mean | | 9,07 | Requirement: 2,5 N/mm² with 0 % separation case A/B 5,0 N/mm² otherwise | | | | | |
| min. value | | 7,71 | | | | | | |
| Standard deviation | | 1,28 | | | | | | |
| Limit | | 2,5 (5,0) | | | | | | |
| Evaluation ²⁾ | | passed | | | | | | |

Legend:

Cohesive failure in:

A: Substrate
B: Corrosion protection
Y: Glue

Adhesive failure between:

A/B: Substrate and corrosive protection
B/Y: Corrosive protection and glue
Y/Z: Glue and stamp

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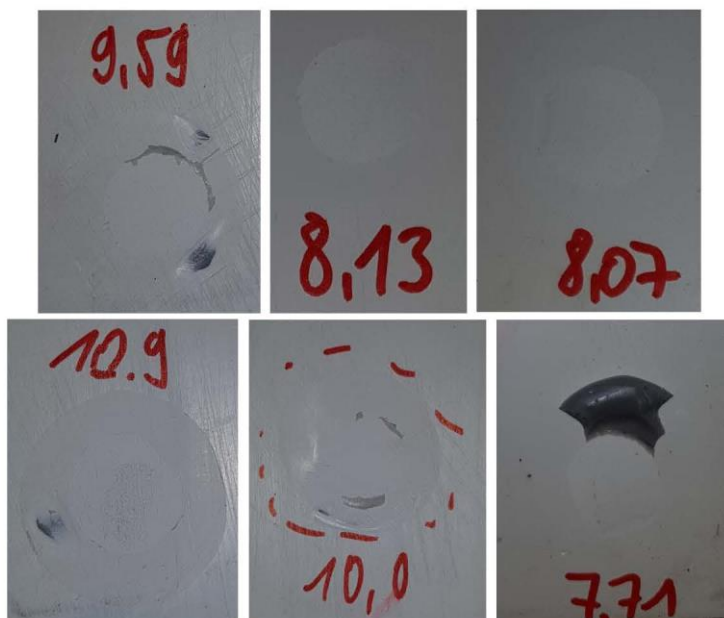


Figure 1 Failure patterns of the conditioned samples

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2.2 Evaluation after artificial ageing

2.2.1 Evaluation according to ISO 4628 and corrosion at the incision

Manufacturing, storage and testing conditions:

| | |
|----------------------------|---|
| Test basis: | DIN EN ISO 4628-2:2016-07 (degree of blistering) DIN EN ISO 4628-3:2016-07 (degree of rusting) DIN EN ISO 4628-4:2016-07 (degree of cracking) DIN EN ISO 4628-5:2016-07 (degree of flaking) DIN EN ISO 12944-6:2018-06, Annex A (corrosion at the incision) |
| Examination(s) on: | coated panels |
| Storage: | 2.688 h cyclic ageing according to DIN EN ISO 12944-6:2018-06, Annex B Cycle: a) 72 h UV-conditioning and condensation according to ISO 16474-3:2013, Method A, Cycle 1: 4 h radiation, 4 h condensation b) 72 h neutral salt spray according to DIN EN ISO 9227:2017-07 c) 24 h at $(-20 \pm 2) ^\circ\text{C}$ |
| Testing conditions: | $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 10) \% \text{ r.h}$ |

Test results:



Figure 2 Panels before artificial ageing



Figure 3 Panels after artificial ageing

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Table 3 Evaluation according to ISO 4628 after artificial ageing

| Specimen | Degree of blistering | Degree of rusting | Degree of cracking | Degree of flaking |
|---------------------------------|----------------------|-------------------|--------------------|-------------------|
| 1.1 | 0 (S0) | Ri 0 | 0 (S0) | 0 (S0) |
| 1.2 | 0 (S0) | Ri 0 | 0 (S0) | 0 (S0) |
| 1.3 | 0 (S0) | Ri 0 | 0 (S0) | 0 (S0) |
| 1.4 | 0 (S0) | Ri 0 | 0 (S0) | 0 (S0) |
| 1.5 | 0 (S0) | Ri 0 | 0 (S0) | 0 (S0) |
| Requirement | 0 (S0) | Ri 0 | 0 (S0) | 0 (S0) |
| Evaluation ²⁾ | passed | passed | passed | passed |

The corrosion protection softened after artificial ageing. The coated panels thus partially stuck to the frame. The rust spot visible on plate P 1.2 is due to this and was not included in the assessment.

Table 4 Corrosion at the incision after artificial ageing

| Specimen | corrosion at the incision [mm] | |
|---------------------------------|--------------------------------|---------------|
| | Single value | Mean |
| P 1.1 | 0,7 | 0,7 |
| P 1.2 | 0,5 | |
| P 1.3 | 0,6 | |
| P 1.4 | 0,9 | |
| P 1.5 | 0,6 | |
| Requirements | | ≤ 3,0 |
| Evaluation ²⁾ | | passed |

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2.2.2 Pull-off test

Manufacturing, storage and testing conditions:

| | |
|----------------------------|---|
| Test basis: | DIN EN ISO 4624:2016-08 |
| Examination(s) on: | coated panels |
| Testing device: | Freundl F20D EASY |
| Storage: | 2 688 h cyclic ageing according to DIN EN ISO 12944-6:2018-06, Annex B Cycle: a) 72 h UV-conditioning and condensation according to ISO 16474-3:2013, Method A, Cycle 1: 4 h radiation, 4 h condensation b) 72 h neutral salt spray according to DIN EN ISO 9227:2017-07 c) 24 h at $(-20 \pm 2) ^\circ\text{C}$ |
| Testing conditions: | $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 10) \% \text{ r.h}$ Testing stamp: 20 mm diameter Method B Glue on basis of epoxy (2 days curing time) |

Test results:

Table 5 Pull-off test after artificial ageing

| Specimen | Test spot | Bond strength [N/mm ²] | Separation case with division in [%] | | | | | |
|---------------------------------|-----------|---------------------------------------|---|-----|-----|-----|---|-----|
| | | | A | A/B | B | B/Y | Y | Y/Z |
| P1.3 | 1 | 3,08 | | | 100 | | | |
| | 2 | 9,14 | | | 100 | | | |
| P1.4 | 1 | 6,75 | | | 100 | | | |
| | 2 | 10,30 | | | 100 | | | |
| P1.5 | 1 | 6,55 | | | 100 | | | |
| | 2 | 9,07 | | | 100 | | | |
| Mean | | 7,48 | Requirement: 2,5 N/mm ² with 0 % separation case A/B 5,0 N/mm ² otherwise | | | | | |
| min. value | | 3,08 | | | | | | |
| Standard deviation | | 2,61 | | | | | | |
| Limit | | 2,5 (5,0) | | | | | | |
| Evaluation ²⁾ | | erfüllt | | | | | | |

Legend:

Cohesive failure in:

- A: Substrate
B: Corrosion protection
Y: Glue

Adhesive failure between:

- A/B: Substrate and corrosive protection
B/Y: Corrosive protection and glue
Y/Z: Glue and stamp

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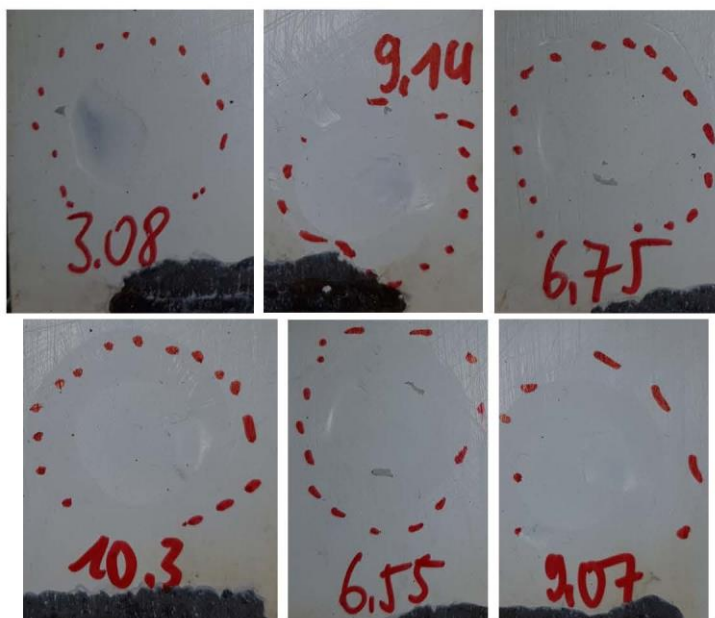


Figure 4 Failure patterns of the conditioned samples

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3. Summary and conclusion

Kiwa GmbH, MPA Berlin-Brandenburg was commissioned by Alberdingk Boley GmbH to carry out the tests in the category "C5 very high" on with the corrosion protection systems

"FP 2403/78" 3-layered on the basis of **"ALBERDINGK® AC 2403"**

coated panels according to DIN EN ISO 12944-6:2018-06 *"Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 6: Laboratory performance test methods; German Version"*.

For this purpose, the coated panels were subjected to the cyclic ageing test according to Annex B of DIN EN ISO 12944-6:2018-06 in accordance with test programme 2 of Table 1 of DIN EN ISO 12944-6:2018-06.

The coated panels with the coating system "FP2403/78" meet all the requirements of the tests required in DIN EN ISO 12944-6:2018-06 for the corrosivity category "C5" (very strong) according to DIN EN ISO 12944-2 in conjunction with the protection duration range "Very high" (> 25 years) according to DIN EN ISO 12944-1. The coating system is thus suitable as corrosion protection for the category "C5 very high" according to Table 1 of DIN EN ISO 12944-6:2018-06.

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