Neuburg Siliceous Earth in water-based corrosion protection acrylate single-layer white

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Status Quo

Corrosion protection is a major area of the coating industry and has always been dominated by solvent-based formulations. Despite their high solvent content and the associated occupational health and safety requirements, coatings are considered the first choice for high resistance requirements.

Due to international environmental regulations that focus on limiting VOCs and increasing consumer demand for environmentally friendly solutions, water-based systems are considered the future for this coating sector as well.

Specially developed raw materials are needed to formulate water-based coating systems as efficiently as solvent-based systems. In most cases, these have a hydrophobic character, with the help of which the resulting film can form a barrier against moisture.

Objective

Another way to prevent corrosion is to prevent the diffusion of water, ions and oxygen to the metal surface. This can be realized with the help of a suitable filler.

In this study, the advantages of the functional filler Neuburg Siliceous Earth in a aqueous acrylate formulation in a single-layer design are shown.

The following products will be presented:

Sillitin Z 89, a light-colored, traditional type,

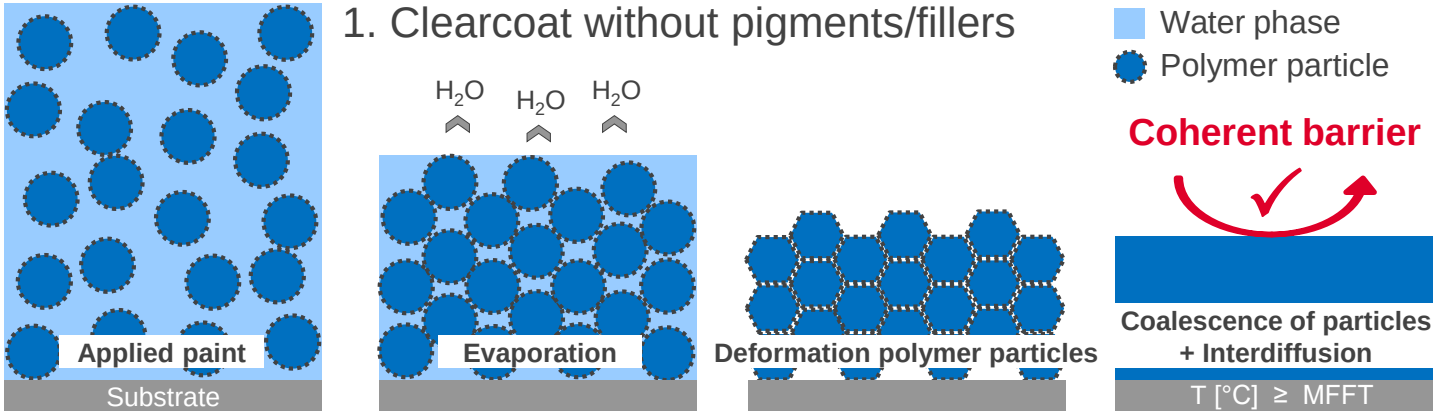
and

Aktifit Q, a hydrophobic, calcined variant of Neuburg Siliceous Earth, produced by modifying the surface with a methacrylic functional group.

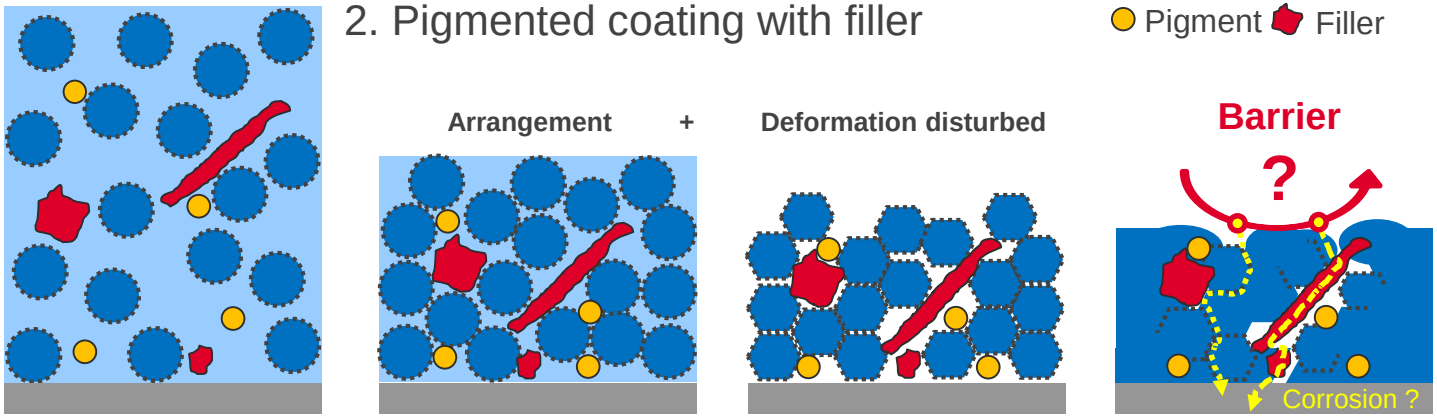
Corrosion Protection Requirements

Film formation process water-based paint

1. Clearcoat without pigments/fillers



2. Pigmented coating with filler



Base Formulation

Pigment Preparation	1	Water demineralized		5.90
	2	Edaplan 490	Dispersing additive	1.20
	3	AMP 90	Neutralizing agent	0.02
	4	Byk 024	Defoamer	0.10
	5	Byk 349	Wetting agent	0.18
	6	Kronos 2190	Pigment white	17.70
	7	**Filler**		**7.50**
	8	Water demineralized		2.90
Let Down	9	Alberdingk AC 2403	Acrylic dispersion	57.90
	10	Byk 024	Defoamer	0.15
	11	premix Asconium 142DA	Org. corrosion inhibitor	1.90
	12	premix AMP 90	Neutralizing agent	0.15
	13	premix Water demineralized		1.90
	14	Optifilm Enhancer 300	Co-Solvent	1.50
	15	Ascotran H10	Flash rust inhibitor	0.50
	16	Tafigel PUR 60 solution (10 % PUR 60; 20 % DPM; 70 % Water)	Thickener	0.50
Total				**100.00 %**
Solids content w/w				56 %
Pigment volume concentration (PVC)				21 %

Filler Characteristics

	Calcium carbonate	Sillitin Z 89	Aktifit Q
Color L*	96	94	94
Color a*	-0.1	0.1	-0.1
Color b*	-0.1	4.0	1.0
Particle size d_{50} [µm]	1.1	1.9	2.0
Particle size d_{97} [µm]	3.5	9	10
Oil absorption [g/100g]	39	55	65
Specific surface area BET [m^2/g]	10	11	9
Surface treatment	---	---	methacrylic functionalized

Preparative Methods

Mixing	Pigment preparation: • Dissolver with toothed disc • 10 min at 10.0 m/s Let Down: • Submission of binder • Addition of remaining ingredients at 5.0 m/s • After dosing thickener finally 5 min at 5.0 m/s
Application	After 35 d maturing time Substrate: cold rolled steel, Q-Panel Typ R 48 Spray application: 10 % diluted with water, nozzle size 3 mm Dry film thickness: ~ 70 µm, single-layer
Conditioning	Drying conditions 23 °C / 50 % relative humidity • Appearance, adhesion: 7 d • Corrosion Tests: 28 d

Viscosity

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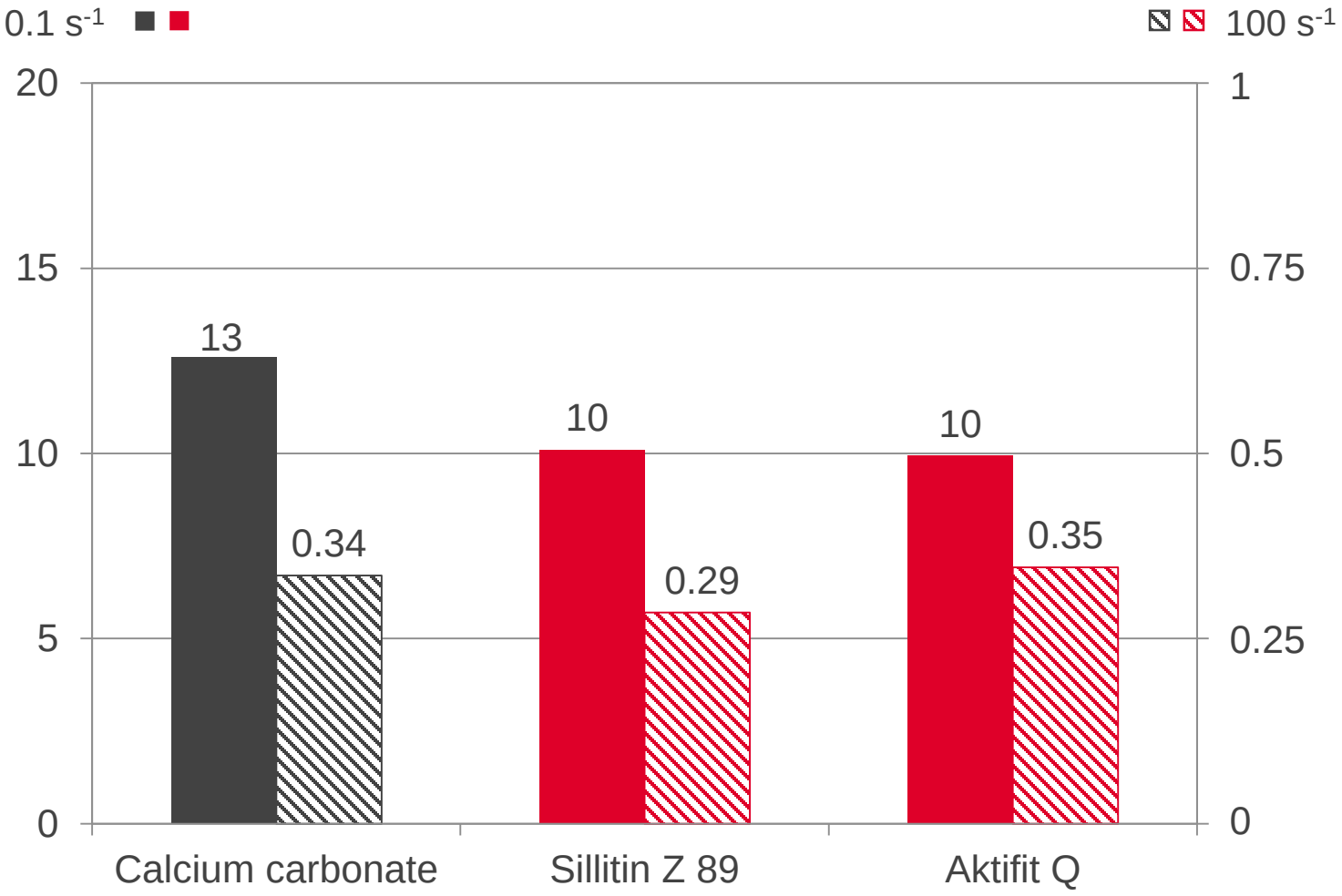
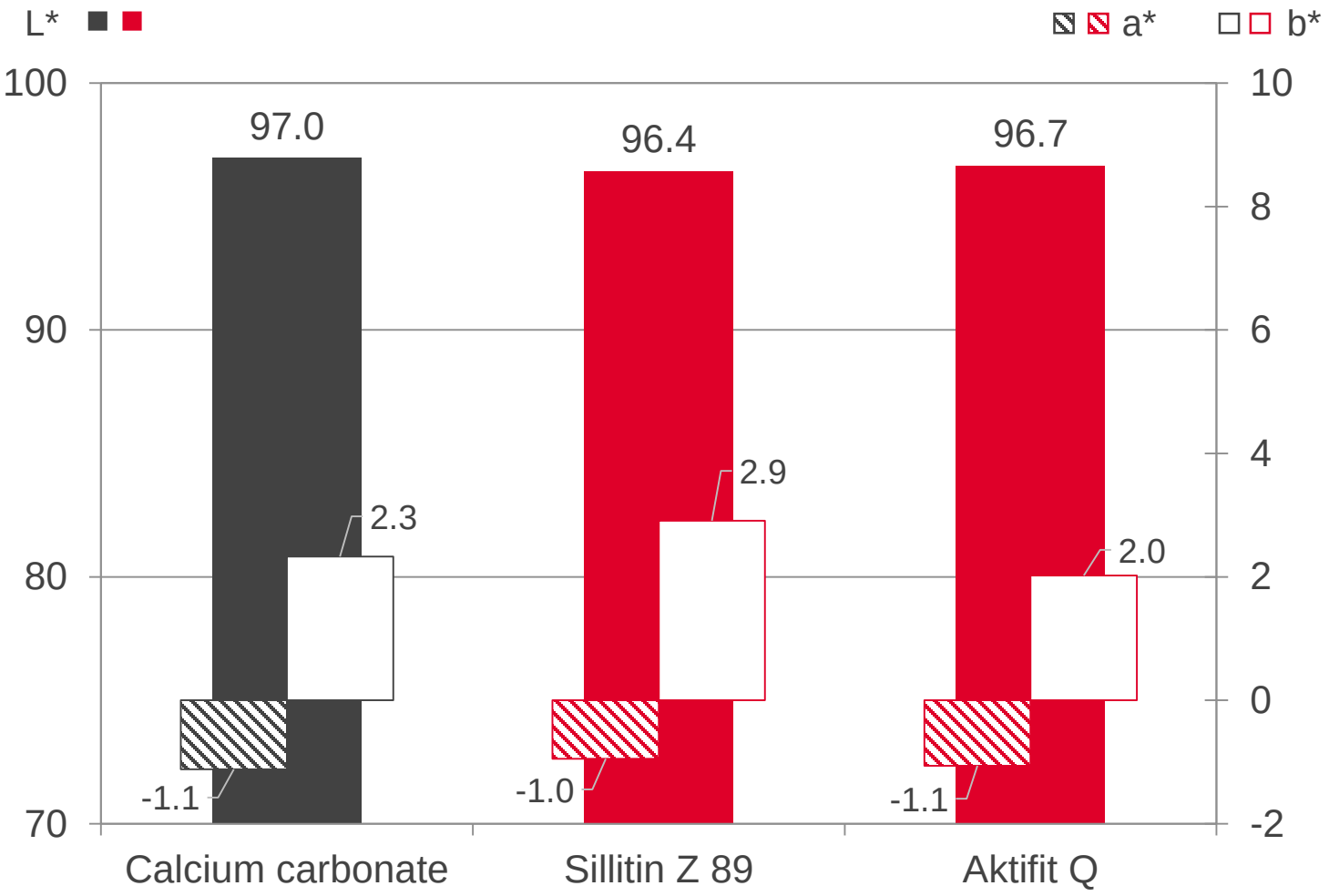
MCR 300 with CC17 after 35d, [Pa·s]



Color

X-Rite, d/8°



Gloss 60°

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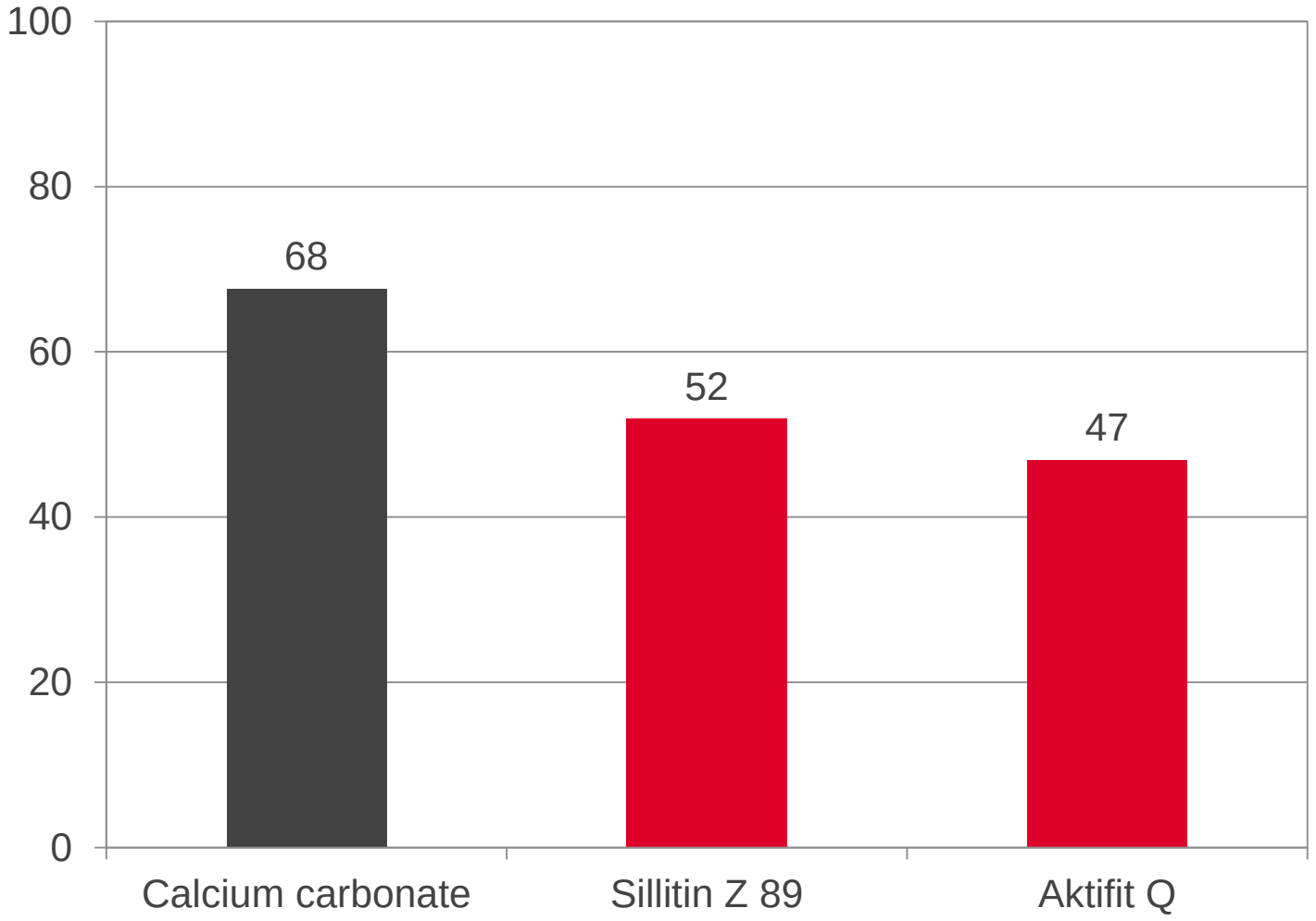
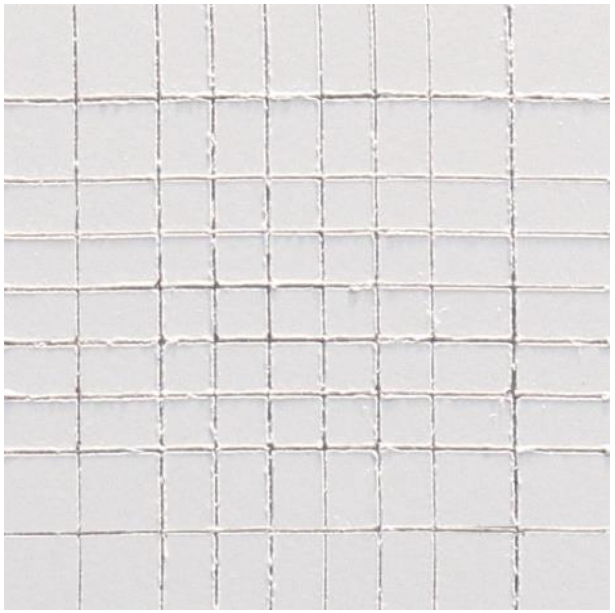
micro-TRI-gloss, [GU]



Adhesion

Cross-cut test 2 mm with tape

All formulations show excellent adhesion to the substrate, cross-cut rating: GT 0



Corrosion Protection

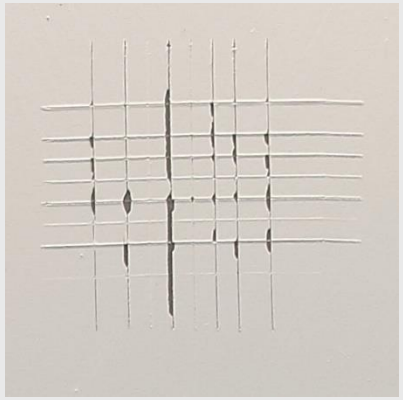
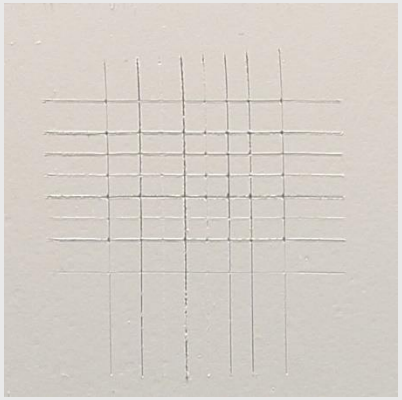
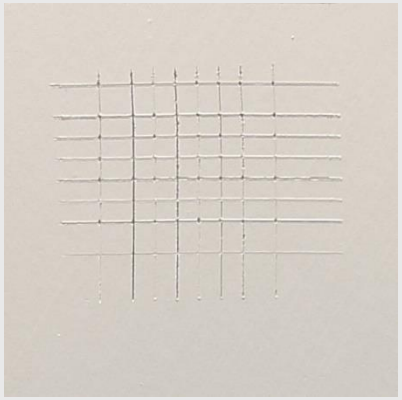
Evaluation criteria

Humidity test 1000 h, DIN EN ISO 6270-2 CH	
Panel without scribe	• Adhesion • Blistering • Under-film corrosion (stripped)

Salt spray test 1000 h, DIN EN ISO 9227 NSS	
Panel without scribe	• Adhesion • Blistering • Under-film corrosion (stripped)
Panel with scribe Sikkens 1 mm 10 cm long	• Blistering • Delamination • Rust Creep

Humidity Test 1000 h
Adhesion

Cross-cut test 2 mm with tape, after 24 h at 23 °C / 50 % RH

Calcium carbonate	Sillitin Z 89	Aktifit Q
		
GT 1 - 2	GT 0 - 1	

Humidity Test 1000 h
Blistering

DIN EN ISO 4628-2

All formulations

blister-free

→ 0 – 0(S0)

Humidity Test 1000 h
Under-film Corrosion

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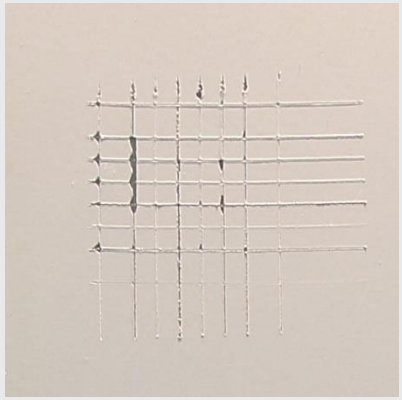
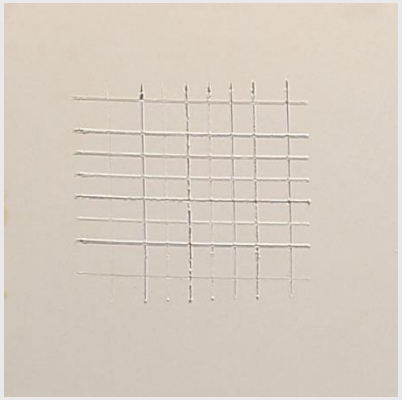
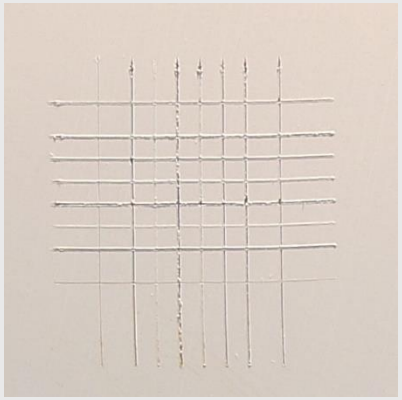
stripped

Calcium carbonate	Sillitin Z 89 & Aktifit Q
	
incipient corrosion	no corrosion

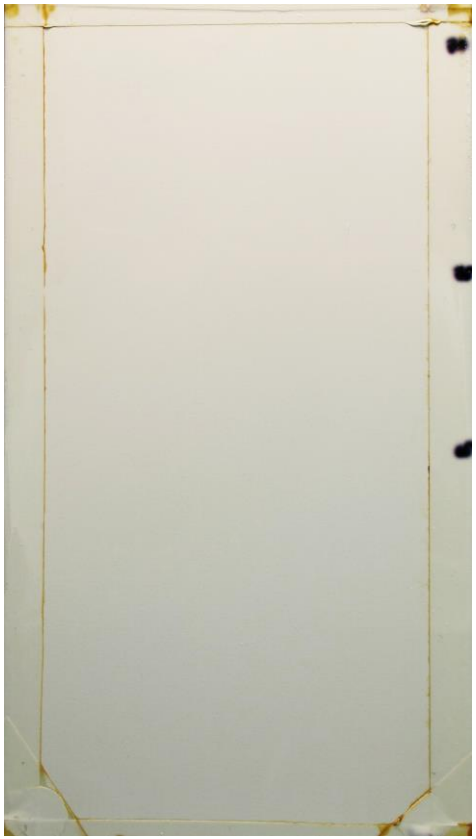
Salt Spray Test 1000 h
Adhesion

Cross-cut test 2 mm with tape, after 1 h at 23 °C / 50 % RH

Calcium carbonate	Sillitin Z 89	Aktifit Q
		
GT 0 - 1	GT 0	

Salt Spray Test 1000 h
Blistering & Under-film Corrosion

DIN EN ISO 4628-2



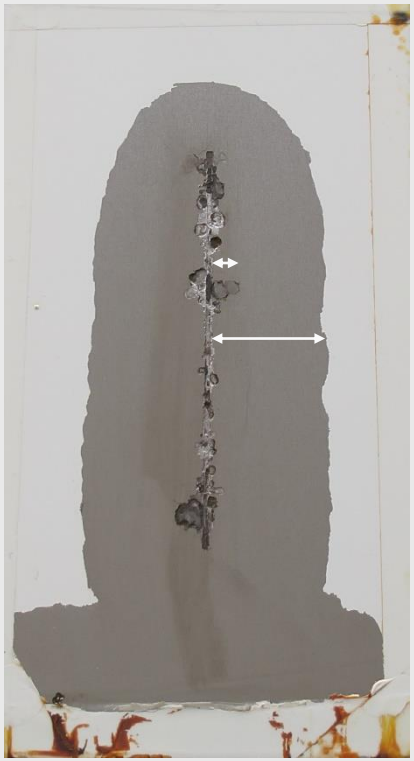
stripped

All formulations no blistering or under-film corrosion.

Salt Spray Test 1000 h
Blistering at Scribe

Calcium carbonate	Sillitin Z 89	Aktifit Q
		

Salt Spray Test 1000 h
Delamination & Rust Creep

Calcium carbonate	Sillitin Z 89	Aktifit Q
		

Salt Spray Test 1000 h
Delamination

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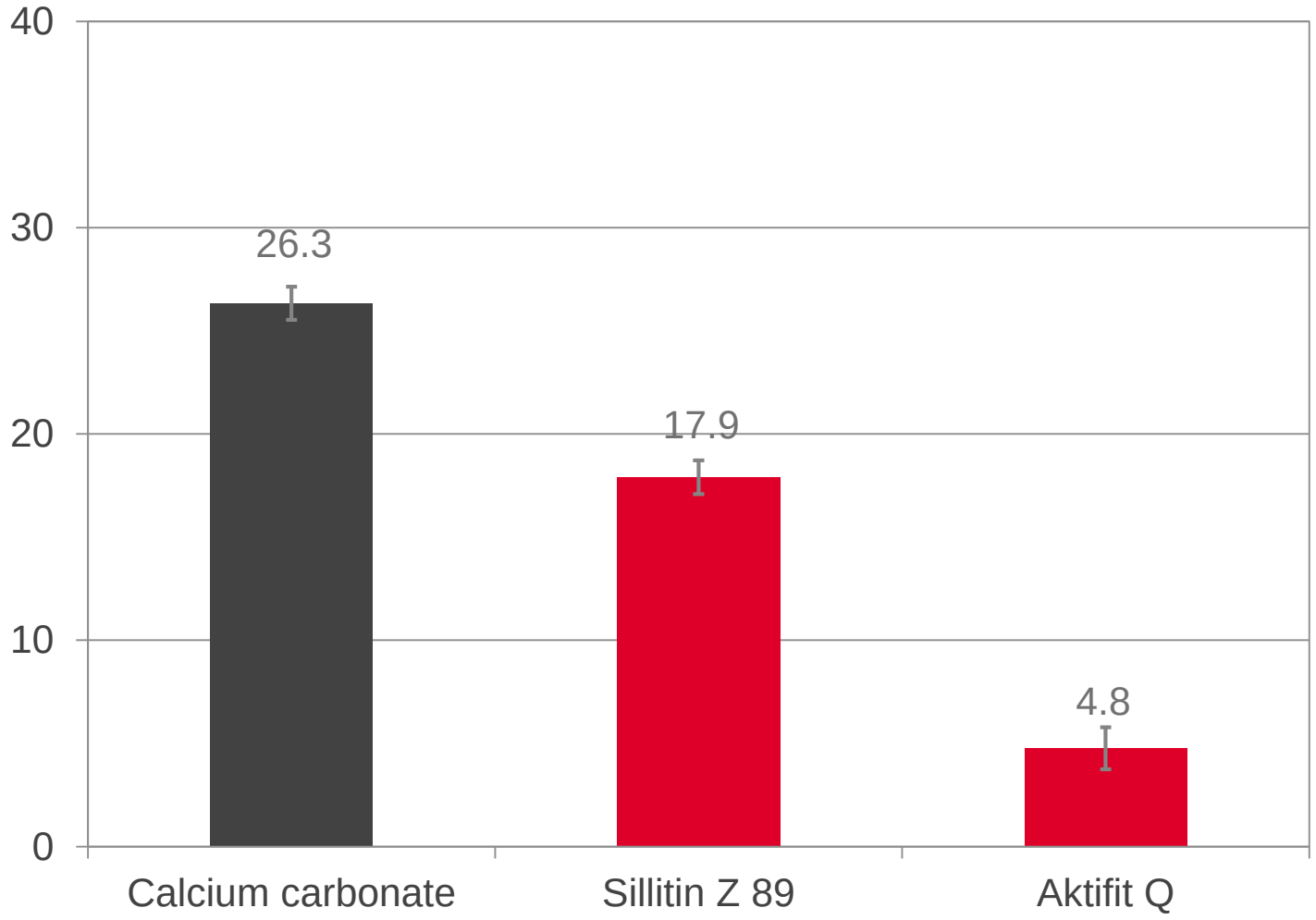
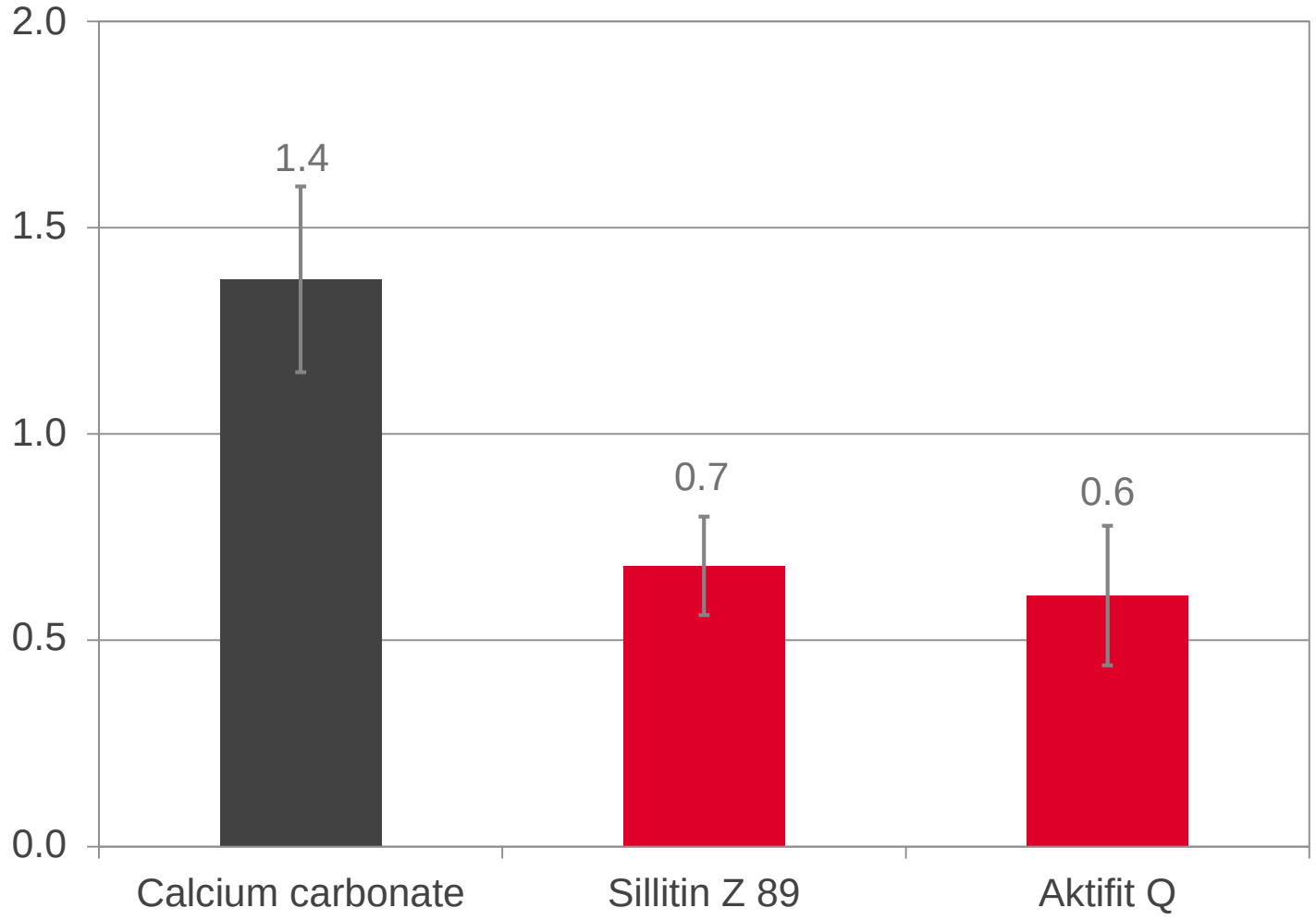
Mean value of 2 panels, [mm]



Salt Spray Test 1000 h
Rust Creep

Mean value of 2 panels, [mm]



Summary

In the aqueous acrylate corrosion protection lacquer presented here, used in single layer system (DTM),
Neuburg Siliceous Earth provides the following advantages over fine calcium carbonate:

Sillitin Z 89 & Aktifit Q

- Improvement of the adhesion after Humidity test and Salt spray test
- No under-film corrosion in the Humidity test

Sillitin Z 89

- Reduced blistering at scribe in the Salt spray test
- Less delamination and rust creep at scribe

Aktifit Q

- No blistering at scribe in the Salt spray test,
- Minimal delamination and rust creep at scribe

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Preparation Method (1)
Pigment Preparation

Pos.		Description	
1	Water demineralized		5.90
2	Edaplan 490	Dispersing additive	1.20
3	AMP 90	Neutralizing agent	0.02
4	Byk 024	Defoamer	0.10
5	Byk 349	Wetting agent	0.18
6	Kronos 2190	Pigment white	17.70
7	**Filler**		**7.50**
8	Water demineralized		2.90
	Total		**35.50%**

Add pos. 1 - 5 and pos. 6 - 7 while stirring with toothed disc,
disperse 10 min at 10.0 m/s,
complete with pos. 8

Preparation Method (2)
Let Down

Pos.			Description	
	Pigment preparation			35.50
9	Alberdingk AC 2403		Acrylic dispersion	57.90
10	Byk 024		Defoamer	0.15
11	premix	Asconium 142DA	Org. corrosion inhibitor	1.90
12	premix	AMP 90	Neutralizing agent	0.15
13	premix	Water demineralized		1.90
14	Optifilm Enhancer 300		Co-Solvent	1.50
15	Ascotran H10		Flash rust inhibitor	0.50
16	Tafigel PUR 60 solution (10% PUR 60; 20% DPM; 70% Water)		Thickener	0.50
	Total			**100.00 %**

Add pos. 9 to 16 one after the other at 5.0 m/s.

Prepare premix in advance, pos. 11 & 12 and add pos. 13, solution must be clear, if not discard, add clear premix to the formulation,
prepare pos. 16 in advance by mixing, add to formulation,
finally mix 5 min

Value for Money

Formulation cost vs. corrosion protection