Neuburg Siliceous Earth in cleanable low-gloss interior emulsion paints

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Status Quo

- Preserving the decorative appearance is one of the most demanded features of modern interior paints.
- Conventionally low-gloss emulsion paints largely suffer in terms of resistance against soiling, particularly caused by colored liquids.
- Functionalised strategies are needed offering improved and sufficient cleanability:
  - no or reduced penetration of stains into the coating surface

  - sufficient mechanical stability during cleaning process

Objective

This study will present Neuburg Siliceous Earth as functional filler in cleanable matt interior emulsion paints.

A suitable grade like Aktisil MAM has been tested on basis of latest eco-friendly wet-scrub class 1 formulations. These coatings offer high stability for mechanical cleaning but do they necessarily provide sufficient soiling resistance properties?

Consequently and first of all the protection of the surface against previous staining seems to be a promising approach to reduce soiling and cleaning efforts.

Formulation

Guide formulation from BASF

		parts by weight
Water deionized	-	148.4
Natrosol 250 HR	Thickener	2.2
Dispex CX 4320	Dispersing additive	7.0
Acticide MV	In-can preservative	1.0
Silres BS 16, 20 % in water	Water repellent	3.4
Foamaster MO 2150	Defoamer	2.0
Tronox CR 828	White Pigment TiO_2	257.0
Filler	varied	166.0
Acronal PLUS 6282	Emulsion binder, pure acrylic	407.0
Rheovis HS 1212	Rheological additive	2.0
Foamaster MO 2150	Defoamer	4.0
Total		**1000.0**
Dilution with 5 % deionized water		
PVC ~ 41 % Solids content w/w ~ 60 %		

Fillers

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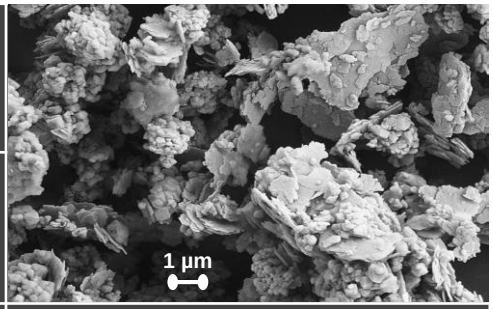
Characteristics

		Control			Neuburg Siliceous Earth
Diatomaceous Earth coarse, flux calcined		**33** pbw			
Nepheline Syenite coarse			**100** pbw		
Nepheline Syenite fine				**33** pbw	**166** pbw **Aktisil MAM**
Particle size	d_{50} [µm]	17	12	4.5	4
	d_{97} [µm]	40	42	19	18
Oil absorption	[g/100g]	130	21	27	45
		Ø 44 of package			
Surface treatment					methacrylic functionalized

Processing Properties & Storage Stability

		Control	Aktisil MAM
Incorporation Pigment / Filler		very good	good
Foam formation		none	
Fineness of grind		35 - 40 µm	< 10 µm
Viscosity 23°C	at 0.1 s^{-1} [Pa*s] 1000 s^{-1} [Pa*s]	167 0.20	193 0.34
Storage stability	23°C / 90 d or 38°C / 42 d	both perfect: no phase separation, settling or sediment	

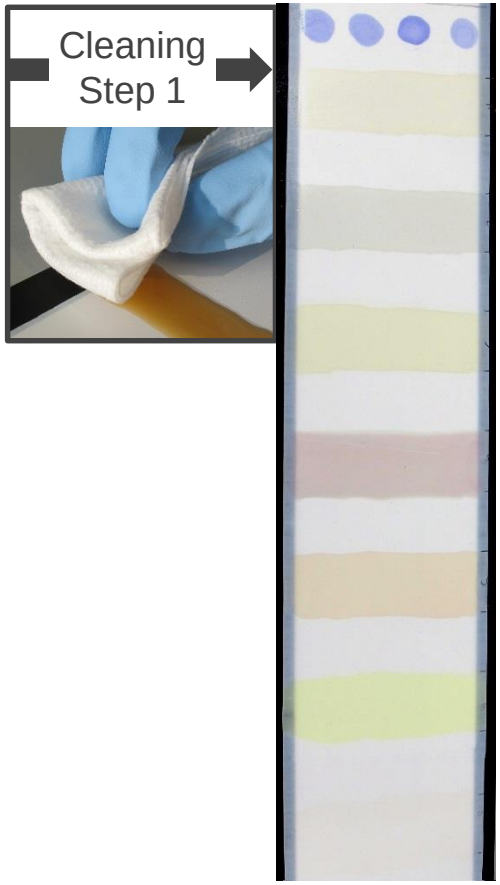
Preparation and Testing

Testing Cleanability

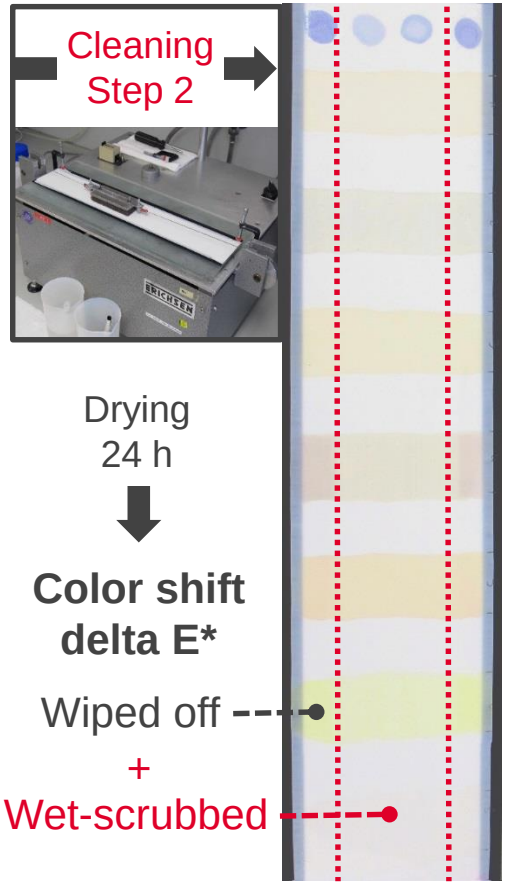
Conditioning paint films 28 days at 23 °C / 50 % r.h.

Exposure time
5 min or 2 h

Wiped off with damp cloth



+ 100 Cycles ISO 11998



Cleanability 5 min Stain Exposure
Aktisil MAM vs. Control

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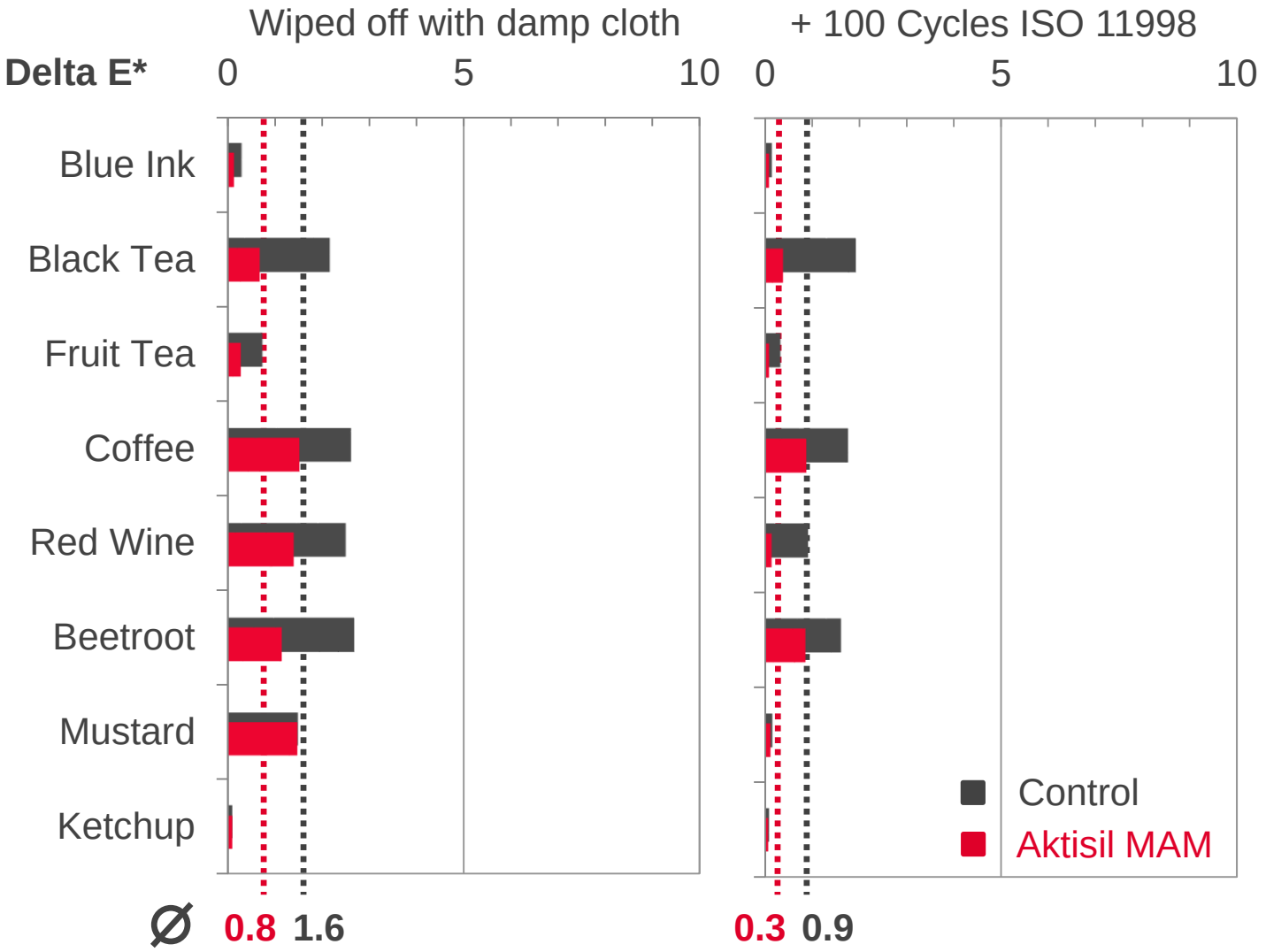

Cleanability 2 h Stain Exposure
Aktisil MAM vs. Control

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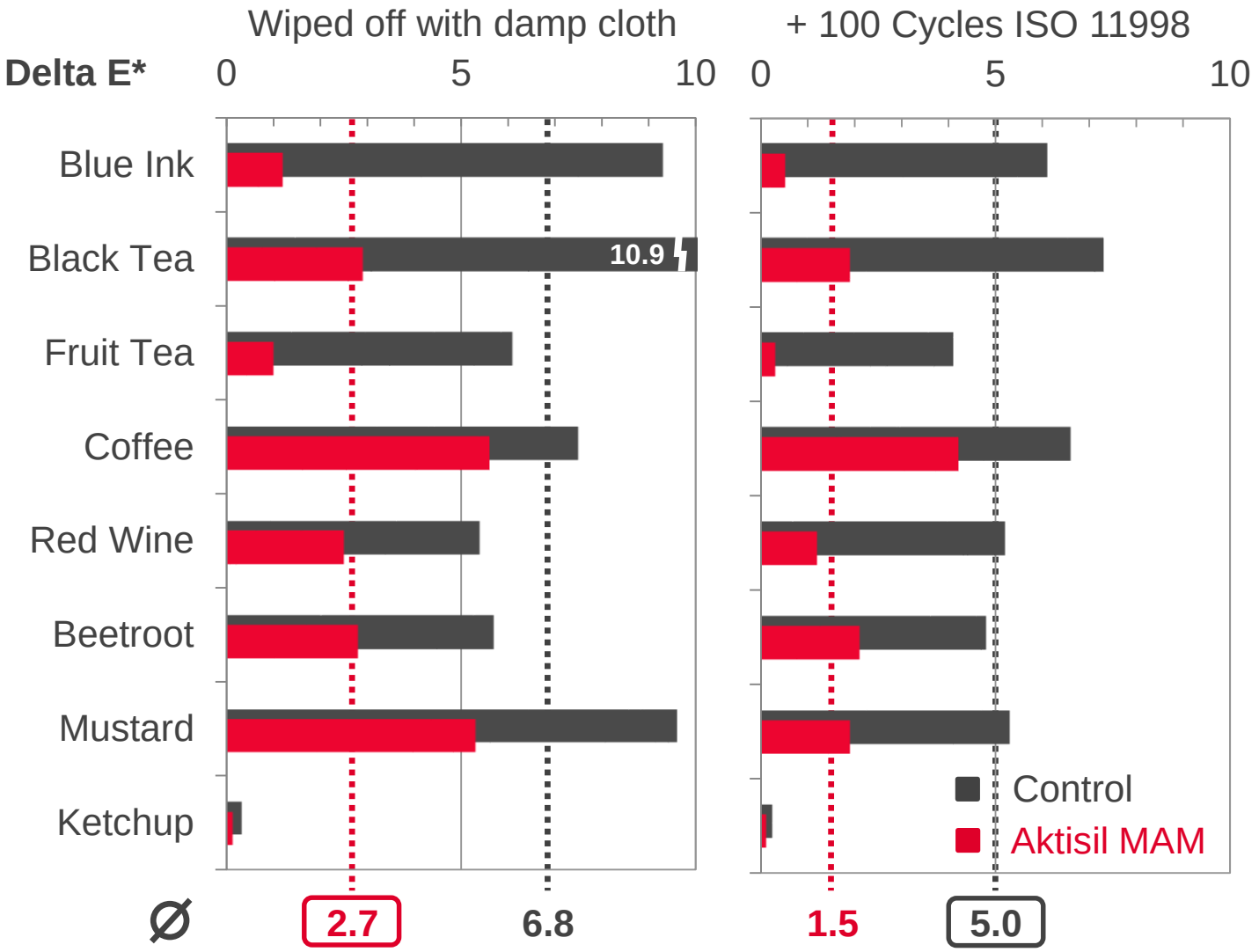

Cleanability
Appearance Wet-Scrubbed Area

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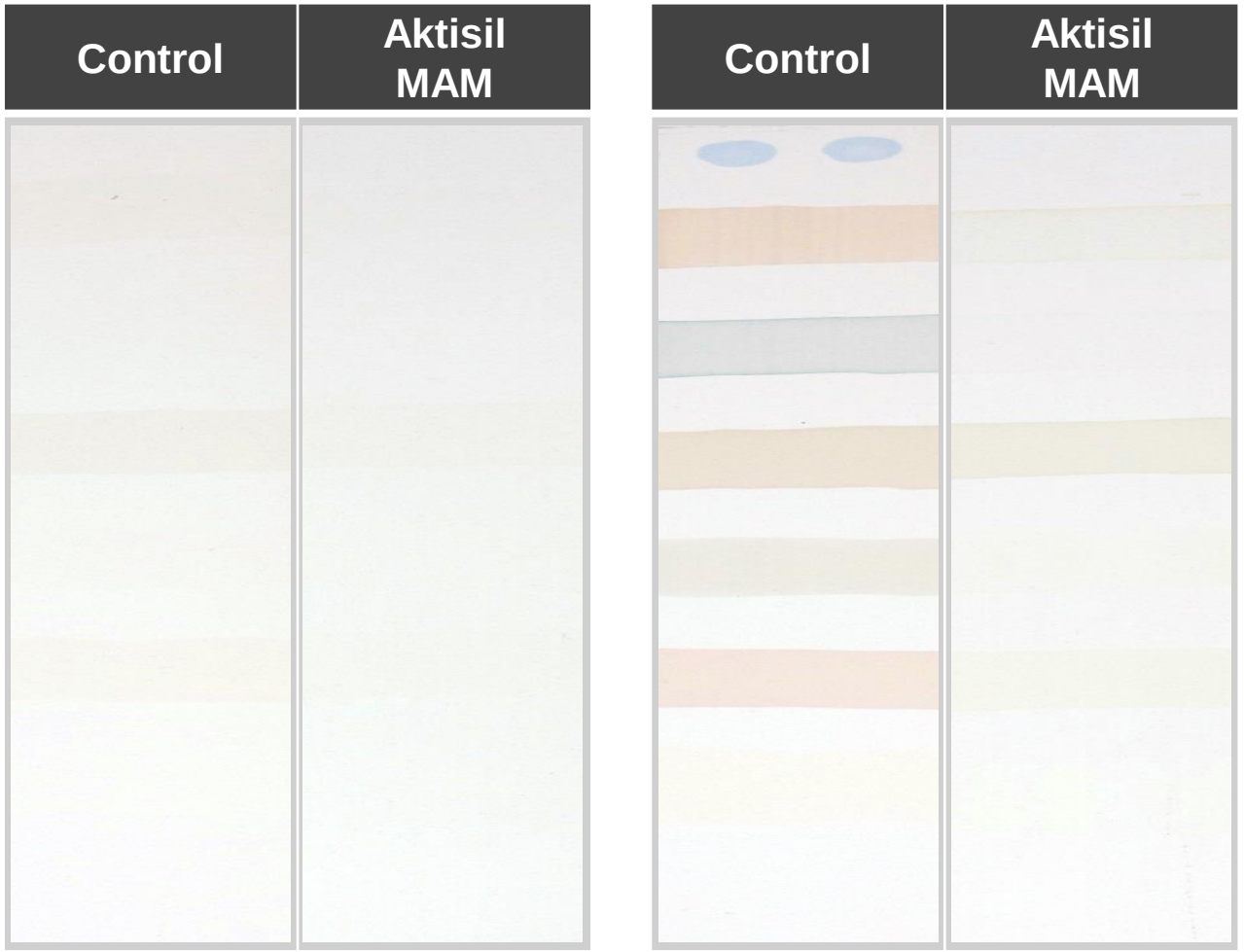
Exposure time 5 min 2 h



Delta E* Ø	**0.9**	**0.3**	**5.0**	**1.5**

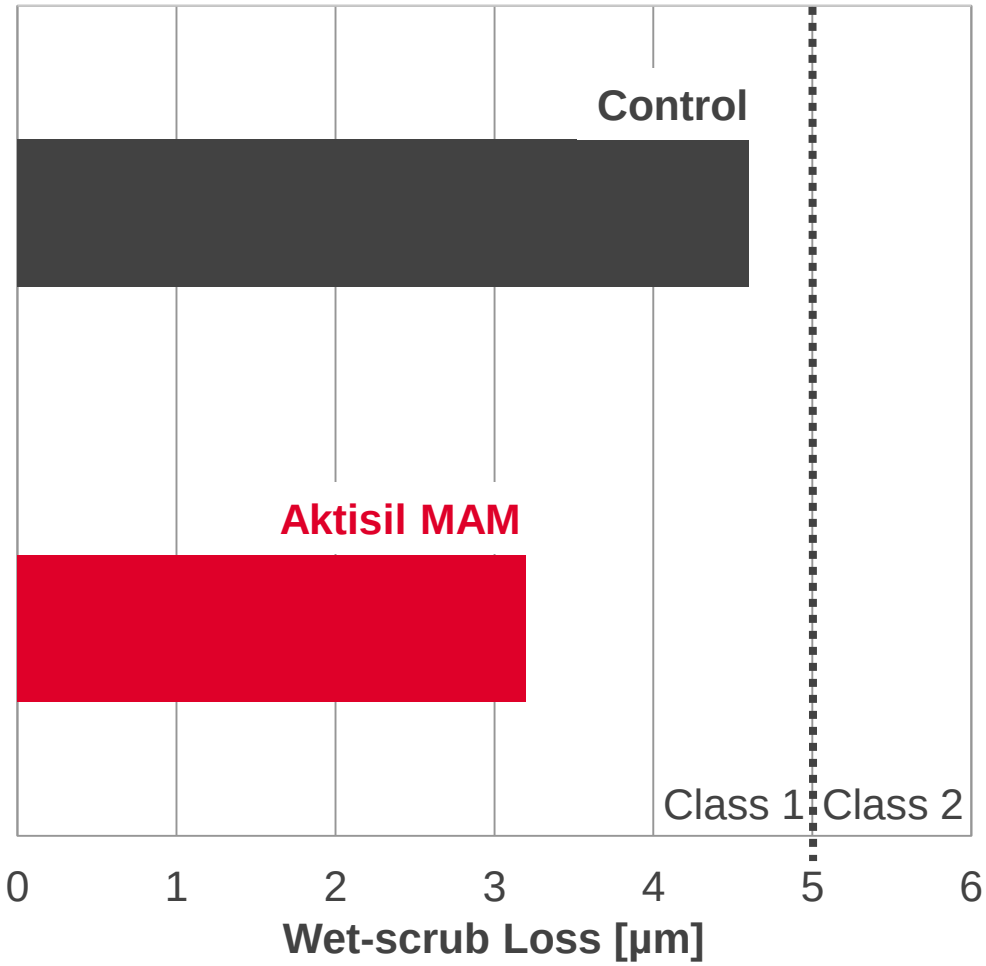
Cleanability of Control Wet-Scrubbed vs. Aktisil MAM Wiped off

Exposure time 2 h

	Control	Aktisil MAM
Delta E* Ø	**5.0**	**2.7**

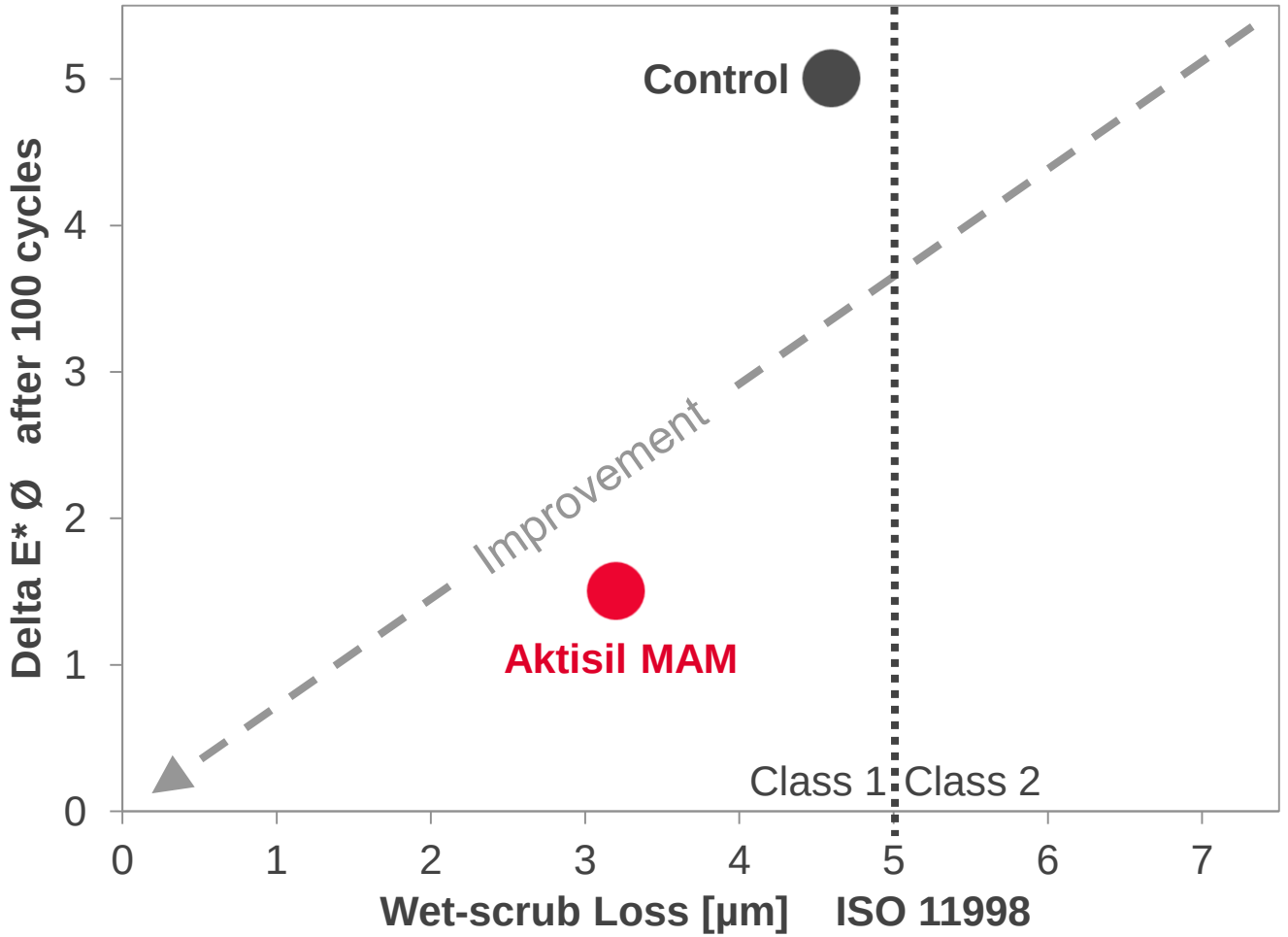
Wet-Scrub Loss

Testing according ISO 11998



Staining vs. Wet-Scrub Loss

Exposure time 2 h



Performance Overview

		Control	Neuburg Siliceous Earth
Diatomaceous Earth		33 pbw	166 pbw
Nepheline Syenite, coarse		100 pbw	
Nepheline Syenite, fine		33 pbw	
			Aktisil MAM
Key features			
Delta E* Ø wiped off	5 min	1.6	0.8
+ wet-scrubbed		0.9	0.3
Delta E* Ø wiped off	2 h	6.8	2.7
+ wet-scrubbed		5.0	1.5
Wet-scrub loss ISO 11998	[µm]	4.6	3.2
Further properties			
Gloss 85°	[GU]	3.7	9.7
Dry Burnish	+ [GU]	0.7	1.4
Brightness L*		96.3	96.4
Spreading rate at contrast ratio 98 %	[m²/l]	9.5	11.8

Variation of Binder

To evaluate transferability of Aktisil MAM effects, the binder of the given formulation was switched to

Acronal ECO 6270

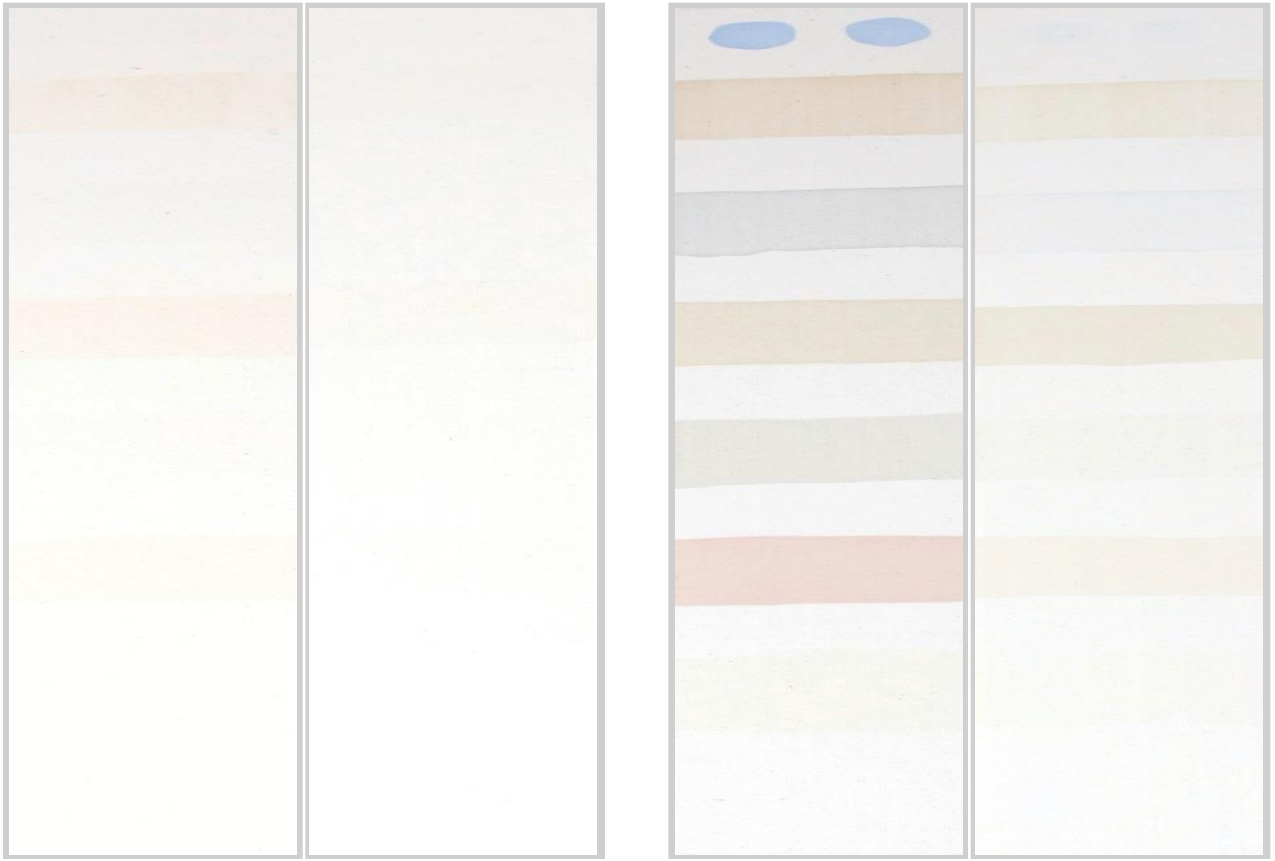
- ➢ Eco-friendly pure acrylic emulsion
- ➢ Widely used for high quality interor and exterior paints
- ➢ Similar physical properties
- ➢ Already part of formulations internally & beneficially tested with Neuburg Siliceous Earth for partial TiO_2 replacement

- Substitution of binder by equal weight resulting in closely comparable PVC and solids content of formulation
- All other ingredients remain unchanged

Cleanability with Acronal ECO 6270 Appearance Wet-Scrubbed Area

Exposure time 5 min 2 h

	Control	Aktisil MAM	Control	Aktisil MAM
Blue Ink				
Black Tea				
Fruit Tea				
Coffee				
Red Wine				
Beetroot				
Mustard				
Ketchup				
Delta E* Ø	**1.1**	**0.4**	**5.5**	**2.2**



Summary

In comparison to control fillers, the Neuburg Siliceous Earth grade Aktisil MAM enhances the performance of cleanable matt interior paints.

- superior stain resistance and significantly reduced soiling
- easier and gentle stain removal already by damp wiping
- optimized wet-scrub resistance
- good dry burnish resistance
- low gloss
- better hiding power & spreading rates at high brightness

- formulation with just one filler despite free combinability with other fillers
- transferability of results

Starting Formulations

Easy-to-clean interior dispersion paint without co-solvent **cleanable, highly wet-scrub resistant, dry burnish resistant, matt, top hiding**	
Water deionized	148.4
Natrosol 250 HR	2.2
Dispex CX 4320	7.0
Acticide MV	1.0
Silres BS 16, 20 % in water	3.4
Foamaster MO 2150	2.0
Tronox CR 828	257.0
Aktisil MAM	166.0
Acronal PLUS 6282	407.0
Rheovis HS 1212	2.0
Foamaster MO 2150	4.0
Total Dilution with 5 % deionized water	**1000.0**
PVC [%]	41.4
Solids content w/w [%]	60.1

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Preparation & Testing (1)

Paint Preparation	
Mixing and dispersing	With dissolver, in sequence of mentioning in the formulation Peripheral speed of toothed disc (Cowles blade) 15 m/s for 20 min, water cooling with T max. = 50°C Subjective assessment of filler incorporation and foam formation
Let Down	With binder and further additives
Maturation	Over night
Dilution	Deionized water, 5 %
Wet Paint	
Fineness of grind	Grindometer 0 – 50 µm
Viscosity	1d after preparation, Rheometer 23°C, Searle system
Storage stability	Diluted in 375 ml-metal can, 23°C / 90 d or 38°C / 42 d
Application	With doctor blade on automated film applicator, speed 12 mm/s

Preparation & Testing (2)

Dry Paint	
Conditioning	Drying conditions before / during tests: 23°C / 50% rel. humidity Drying time before testing: 28 days
Application with gap 300 µm on black leneta film, DFT* ~ 80 µm	
Cleanability	Color shift delta E* of soiled surface after wiping off with damp cloth and after additional wet-scrub
Wet-scrub	Weight loss after 200 Cycles on wet-scrub resistance tester according ISO 11998, Classification along with DIN EN 13300
Application with gap 100 - 225 µm gradually on cardboard, DFT ~ 35 - 80 µm	
Color / Gloss	L*, a*, b* over white, 85°- Gloss (Sheen) at full hiding film with DFT 80 µm
Dry Burnish	Gloss increase after 200 cycles with dry cloth on automated wet-scrub resistance tester derived from ISO 11998, DFT ~ 80 µm
Hiding Power	Contrast ratio over black/white depending on dry film thickness. Calculation of minimum dry film thickness to comply with DIN EN 13300 classifications and resulting spreading rates.

*** Dry film thickness**