Silfit Z 91
vs. Na/Al-silicate and alumosilicate
in low cost, solvent-free straight acrylic paint

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Status Quo

- Features of modern low cost interior emulsion paints:
  - ✓ Attractive price-performance ratio with good opticalproperties and sufficient mechanical resistance and durability.
  - ✓ Low-emission, free of solvents and plastisizers.
- High price level for white pigments like titanium dioxide as a result of increased raw material costs and rise in demand.
- Targeting economical and efficient alternatives without performance loss.
- Titanium dioxide extension by precipitated sodium aluminum silicate or precipitated calcium carbonate is widely used.

Objective

Assessment of the performance of the Calcined Neuburg Siliceous Earth grade Silfit Z 91 compared to precipitated sodium aluminum silicate and an alumosilicate in an interior straight acrylic emulsion paint:

- 6 % Titanium dioxide
- PVC 83 %
- Solids content 58 %
- Solvent-free

Special attention is paid to optical properties as well as resulting formulation costs while evaluating further relevant properties.

Base Formulation

		Parts by weight
Water deionized	-	300
Natrosol 250 HBR	Thickener	4
Sodium hydroxide, 20 % in water	Neutralising agent	2
Joncryl 8078	Dispersing additive	9
Parmetol MBX	Can preservation	1
Foamaster MO 2134	Defoamer	2
Tronox CR-828	TiO_2 Pigment	**60**
Prec. Na/Al-Silicate	TiO_2 Extender	**20**
Special Alumosilicate	Matting agent	**20**
Socal P2	TiO_2 Extender	50
Plustalc H15	Filler	90
Omyacarb 2 GU	Filler	80
Omyacarb 5 GU	Filler	210
Foamaster MO 2134	Defoamer	2
Acronal ECO 6270 (Straight acrylic)	Emulsion binder	84
Water deionized	-	66
Total		**1000**

Formulation Variations

Replacement of Na/Al-Silicate + Alumosilicate / TiO_2 content varied
All other ingredients remain unchanged

Control		Silfit Z 91					
		Full TiO_2			TiO_2 reduced		
					- 10 %	- 15 %	- 20 %
TiO_2	60	60			54	51	48
Na/Al-Silicate	20	---			---		
Alumosilicate	20	---			---		
Silfit Z 91	---	40	60	80	40	60	80
Solids content w/w [%]	58.3	58.3	59.2	59.9	59.2	59.2	59.3
PVC [%]	83.5	83.2	83.8	84.3	83.9	83.9	84.0

TiO_2-Extender, Matting agent

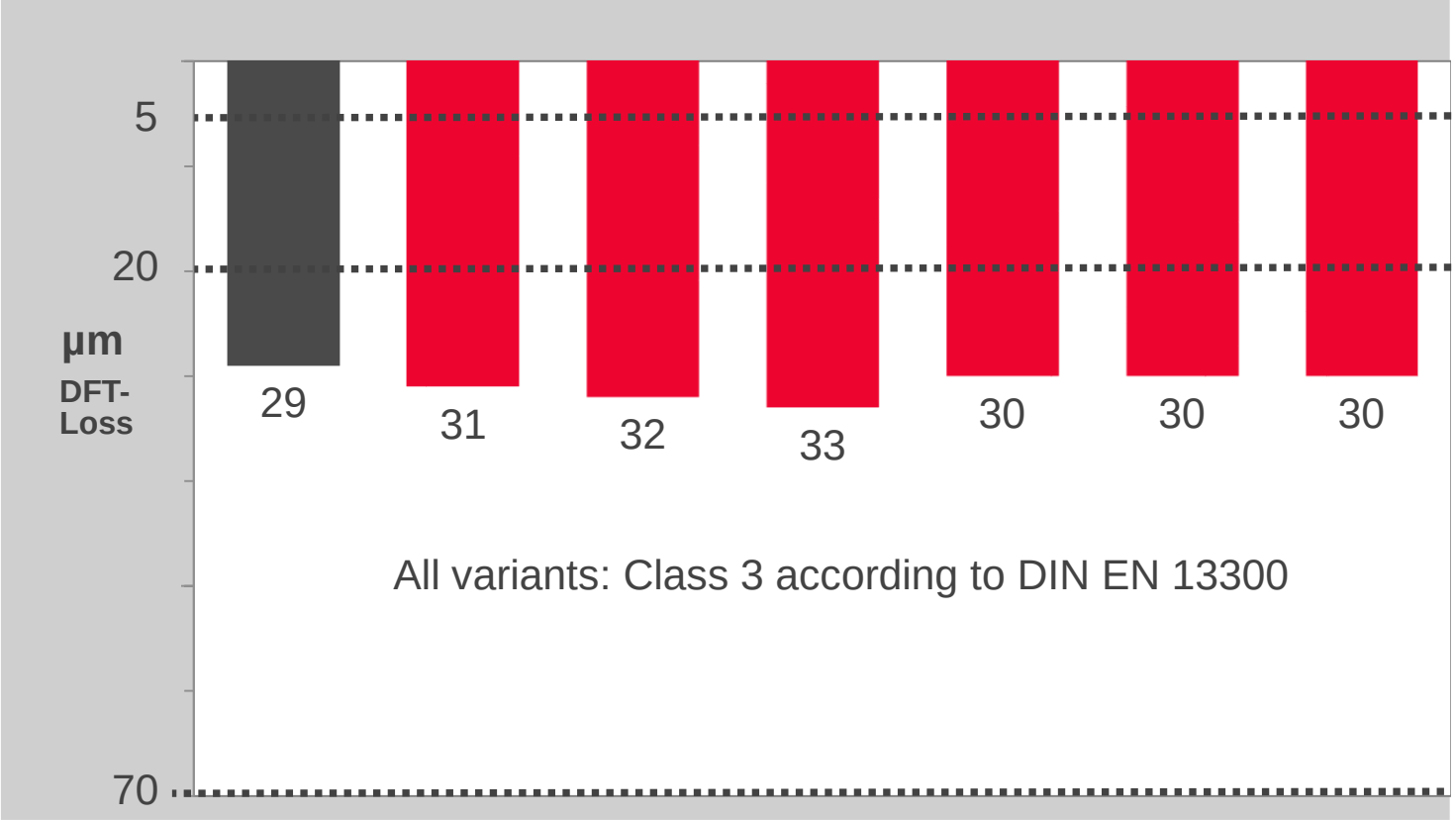
Processing Properties and Storage Stability

Results			
Incorporation Pigment / Filler	moderat (Control) - good (Silfit Z 91)		
Dispersing process 20 min 15 m/s	no agglomerates, no foam formation		
Fineness of grind	30 µm (Control) - 15 µm (Silfit Z 91)		
Viscosity 23°C	Shear rate at	0.1 s^{-1} 1000 s^{-1}	8.6 - 10.7 [Pa*s] 0.09 - 0.13 [Pa*s]
Storage stability 6 months at 23°C	Low phase separation; settling of sediment easy to re-stir and to homogenize		

Preparation and Testing

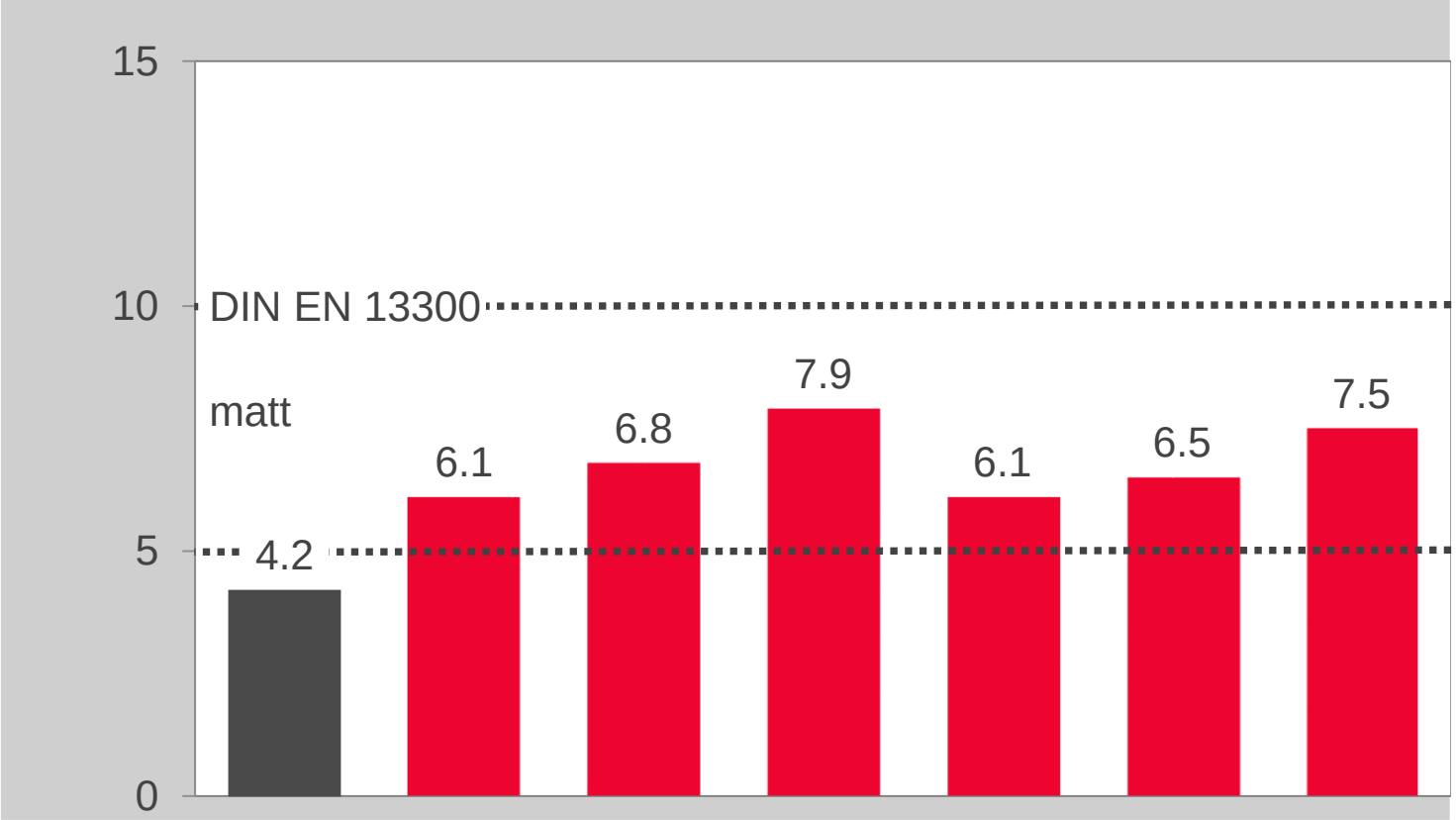
Wet-Scrub Resistance

TiO_2	60	60			54	51	48
Na/Al-Silicate	20	---	---	---	---	---	---
Alumosilicate	20	---	---	---	---	---	---
Silfit Z 91	---	40	60	80	40	60	80



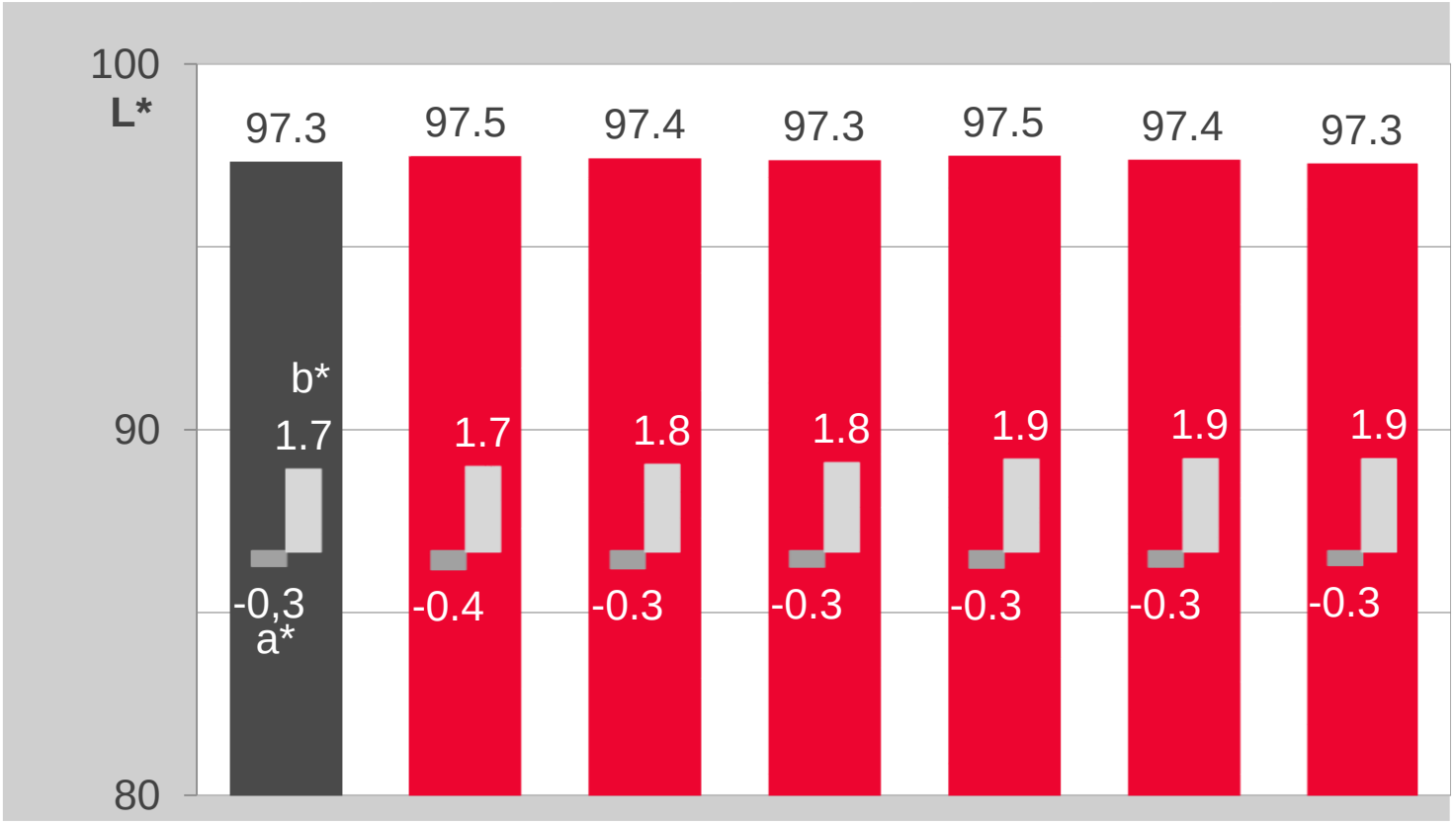
Gloss 85° (Sheen)

TiO_2	60	60			54	51	48
Na/Al-Silicate	20	---	---	---	---	---	---
Alumosilicate	20	---	---	---	---	---	---
Silfit Z 91	---	40	60	80	40	60	80



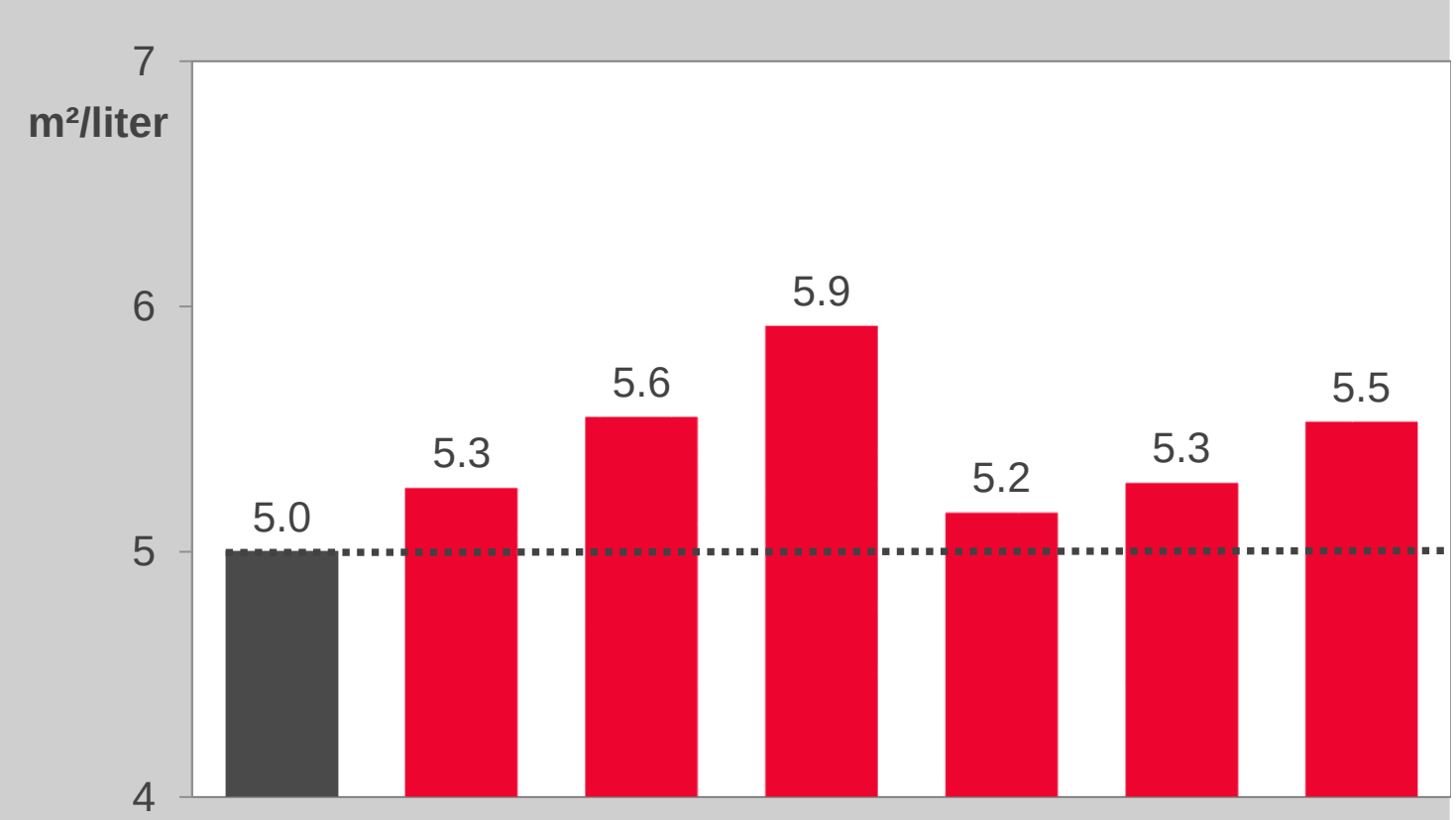
Color

TiO_2	60	60			54	51	48
Na/Al-Silicate	20	---	---	---	---	---	---
Alumosilicate	20	---	---	---	---	---	---
Silfit Z 91	---	40	60	80	40	60	80



Spreading Rate at Contrast Ratio 98 %

TiO_2	60	60			54	51	48
Na/Al-Silicate	20	---	---	---	---	---	---
Alumosilicate	20	---	---	---	---	---	---
Silfit Z 91	---	40	60	80	40	60	80



Cost / Performance

Germany 2019 / Contrast Ratio 98 %

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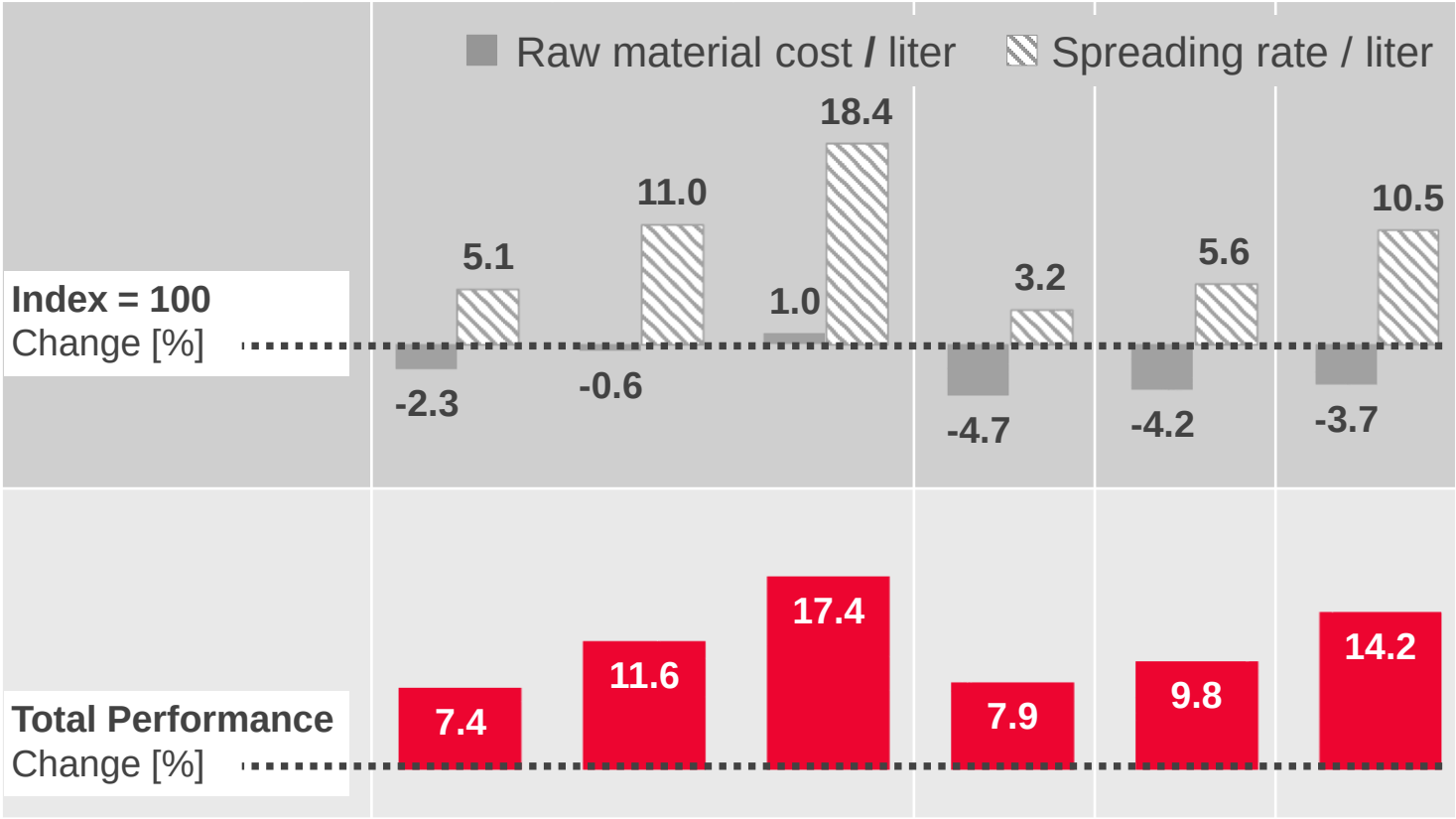
TiO_2	60	60			54	51	48
Na/Al-Silicate	20	---	---	---	---	---	---
Alumosilicate	20	---	---	---	---	---	---
Silfit Z 91	---	40	60	80	40	60	80



Summary

Compared to a combination of Na/Al-Silicate and Alumosilicate Silfit Z 91 leads to:

- Almost equal processing properties, storage stability, color and wet-scrub resistance.
- Slightly higher gloss level; matting with adaptive dosage of natural cellulosic fibers such as “Arbocel B 600” if needed.

Silfit Z 91 additionally offers:

- Marked improvement of hiding power and spreading rates whilst at the same time lowering formulation cost.
- Despite 10 - 20 % white pigment reduction even better efficiency with additional cost-saving effect.

Silfit Z 91 gains the following benefits when used as TiO_2 extender:

- ✓ Improved performance, regardless of further TiO_2 reduction.
- ✓ Real high cost-cutting potential for even more cost-effective interior emulsion paints.

Starting Formulations

[1] Highest brightness and matting * [2] Best hiding power / spreading rate [3] TiO_2-reduction for high cost saving with good hiding power		[1]	[2]	[3]
Water deionized			300	
Natrosol 250 HBR			4	
Sodium hydroxide, 20 % in water			2	
Joncryl 8078			9	
Parmetol MBX			1	
Foamaster MO 2134			2	
Tronox CR-828		60	60	48 (to 54)
Silfit Z 91		40	80	(40 to) 80
Socal P2			50	
Plustalc H15			90	
Omyacarb 2 GU			80	
Omyacarb 5 GU			210	
Foamaster MO 2134			3	
Acronal ECO 6270 (Straight acrylic)			84	
Water deionized			66	
Solids content w/w	[%]	58.3	59.9	59.3
PVC	[%]	83.2	84.3	84.0

**** Dosage of +/- 20 pbw Arbocel B 600 if required***

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Preparation

Mixing and dispersing	Mixing 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. = 60°C
Let Down	With Binder and further additives
Maturation	Over night
Application	Undiluted with doctor blade on automated film applicator or as indicated
Substrate	As indicated, depending on testing
Conditioning	Drying conditions before / during tests: 23 °C / 50 % relative humidity (RH) Drying time before testing: 28 days for wet-scrub resistance, otherwise 7 d

Testing

Paint Preparation	
Incorporation, Foam formation	Subjective assessment
Wet Paint	
Fineness of grind	Grindometer 0 – 50 µm
Viscosity	1d after preparation, Rheometer 23°C, Searle system
Storage stability	Undiluted in 1l-metal can, 6 months 23°C
Application with doctor blade gap 300 µm on Leneta film, DFT* ~ 120 µm	
Wet-scrub resistance	200 Cycles on automated wet-scrub resistance tester according to ISO 11998. Classification along with DIN EN 13300
Application: gap 100 - 400 µm gradually with doctor blade on cardboard	
Color / Gloss	L*, a*, b* over white, 85°-Gloss (Sheen) at full hiding film with DFT 120 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, contrast ratio at given spreading rate respectively

*** Dry film thickness**

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Characteristics
Extender, Matting Agent

	Particle size		Oil absorption	Density	Specific Surface BET	Color		
	d_{50} [µm]	d_{97} [µm]	[g/100g]	[g/cm³]	[m²/g]	L*	a *	b*
Precipitated Na/Al-Silicate	5.0	18	140	2.1	95	98.9	-0.1	0.6
Special Alumosilicate	28	84	174	2.0	1.6	90.5	1.0	3.3
Silfit Z 91	2.0	10	55	2.6	8	95.5	- 0.1	0.7

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