Silfit Z 91
vs. precipitated calcium carbonate and TiO_2 in high-quality, solvent-free VAE paint

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Status Quo

- Features of modern high-quality interior emulsion paints:
  - ✓ Excellent optical properties
  - ✓ Very high 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 calcium carbonate is widely used.

Objective

Assessment of the performance of the Calcined Neuburg Siliceous Earth grade Silfit Z 91 compared to precipitated calcium carbonate and TiO_2 in an interior VAE emulsion paint:

- 18.5 % Titanium dioxide
- PVC 71 %
- Solids content 63 %
- 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	-	291
Tylose MH 30000 YG8	Thickener	4
Calgon N, 10 % in water	Wetting / Dispersing	5
Lopon 895	Dispersing additive	3
Agitan 315	Defoamer	2
Parmetol MBX	Can preservation	1
Sachtleben RDDI	TiO_2 Pigment	**185**
Prec. Calcium Carbonate (PCC)	TiO_2 Extender	**70**
Omyacarb 2 GU	Filler	125
Omyacarb 5 GU	Filler	90
Omyacarb 10 GU	Filler	30
Plastorit 00	Filler	40
Agitan 315	Defoamer	2
Sodium hydroxide, 10 % in water	Neutralising agent	2
Mowilith LDM 1871 (VAE)	Emulsion binder	150
Total		**1000**

Formulation Variations

Variation of the Pigment / TiO_2-Extender package
All other formulation ingredients remain unchanged

	Full TiO_2		- 10 %		- 20 %		
	185		166				148
			Without compensation for reduced TiO_2 content		With compensation for reduced TiO_2 content		
Control	PCC	Silfit	PCC	Silfit	Silfit 1 : 2	Silfit 1 : 3	Silfit 1 : 2
Precipitated Calcium Carbonate	70	---	70	---	70	70	70
Silfit Z 91	---	70	---	70	38	57	74
Solids content w/w [%]	63.0	63.0	62.3	62.3	63.6	64.3	64.3
PVC [%]	70.7	70.8	70.1	70.3	71.7	72.5	72.7

TiO_2-Extender

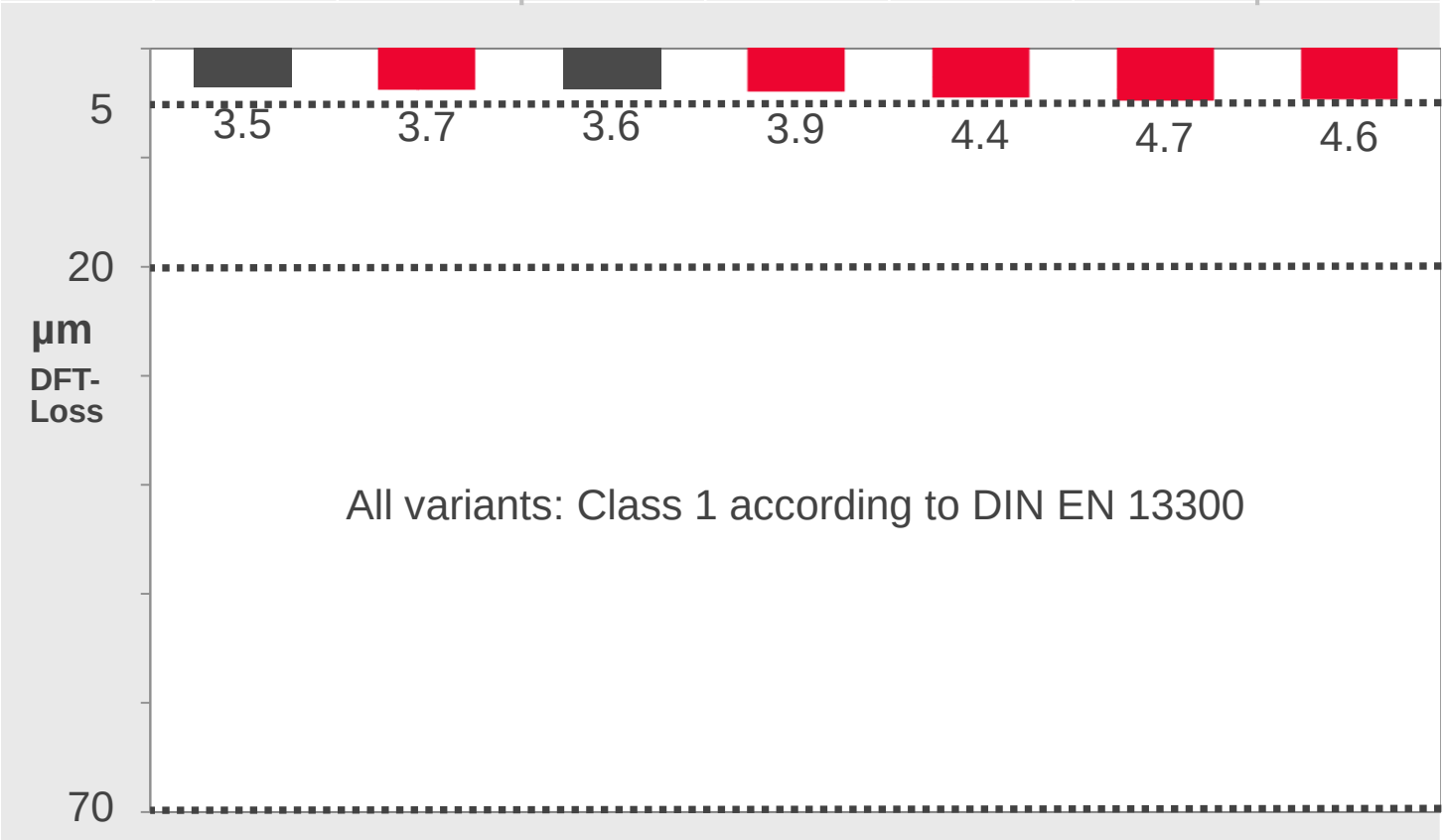
Properties
Without Significant Difference

Incorporation Pigment / Filler	good to moderate		
Foam formation	none		
Fineness of grind	35 µm		
Storage stability 23°C, 6 months	no phase separation, no settling or sediment		
Viscosity 23°C	Shear rate at	0.1 s^{-1} 1000 s^{-1}	102 - 138 [Pa*s] 0.36 - 0.45 [Pa*s]
Gloss	matt, DIN EN 13300		85° < 10

Preparation and Testing

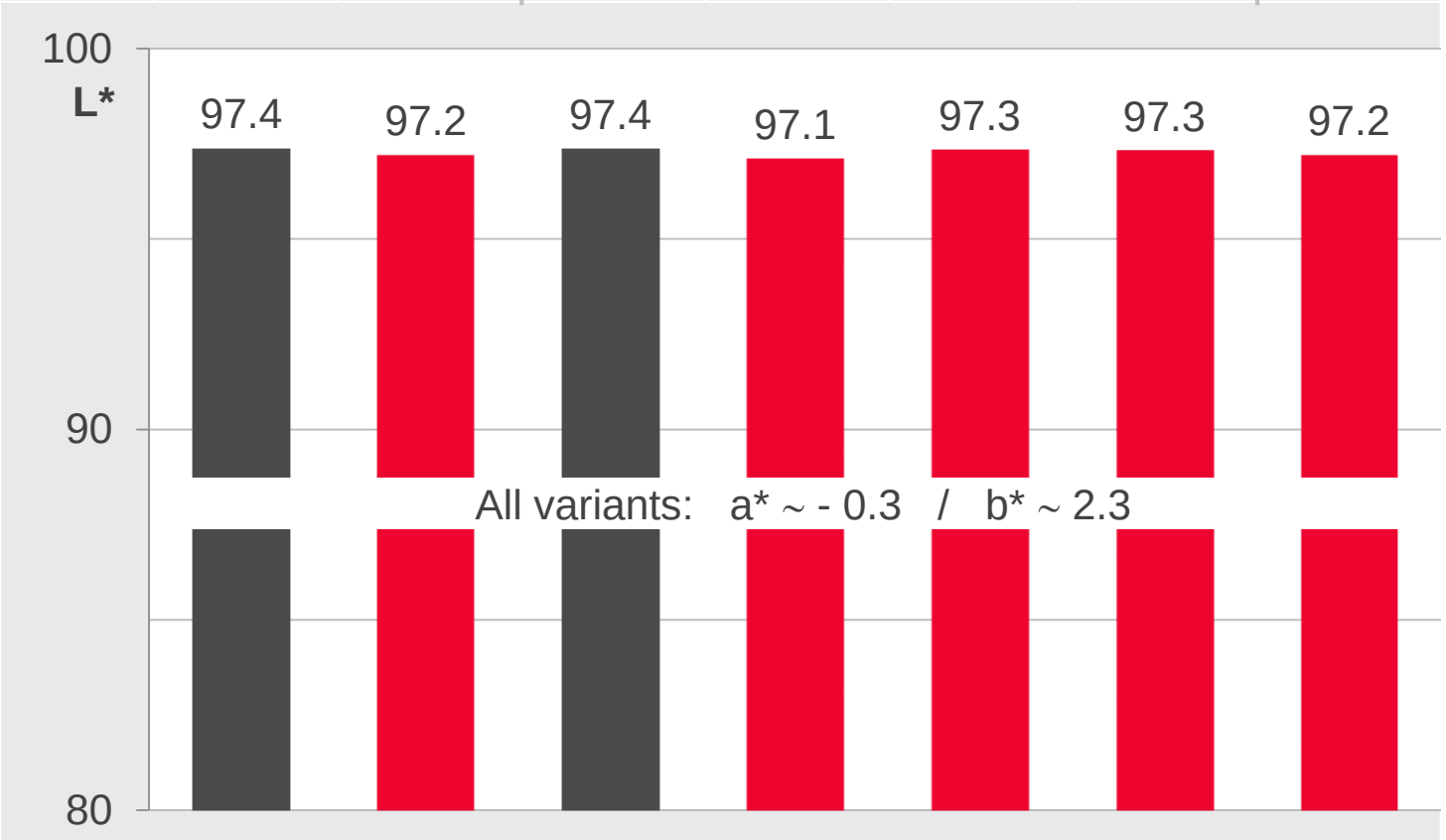
Wet-Scrub Resistance

TiO_2	185		166				148
PCC	70	---	70	---	70	70	70
Silfit Z 91	---	70	---	70	38	57	74



Color

TiO_2	185		166				148
PCC	70	---	70	---	70	70	70
Silfit Z 91	---	70	---	70	38	57	74



Hiding Power
EU Ecolabel

General:

- Identifies products that meet high standards of environmental performance and quality

Criterias relating to interior emulsion paints:

- Spreading rate

  ≥ **8 m² / liter** at contrast ratio 98 %

- Content of white pigments (refractive index ≥ 1.8)

  ≤ **40 g / m²** dried paint film at contrast ratio 98 %
  and wet-scrub resistance class 1

Spreading Rate
at Contrast Ratio 98 %

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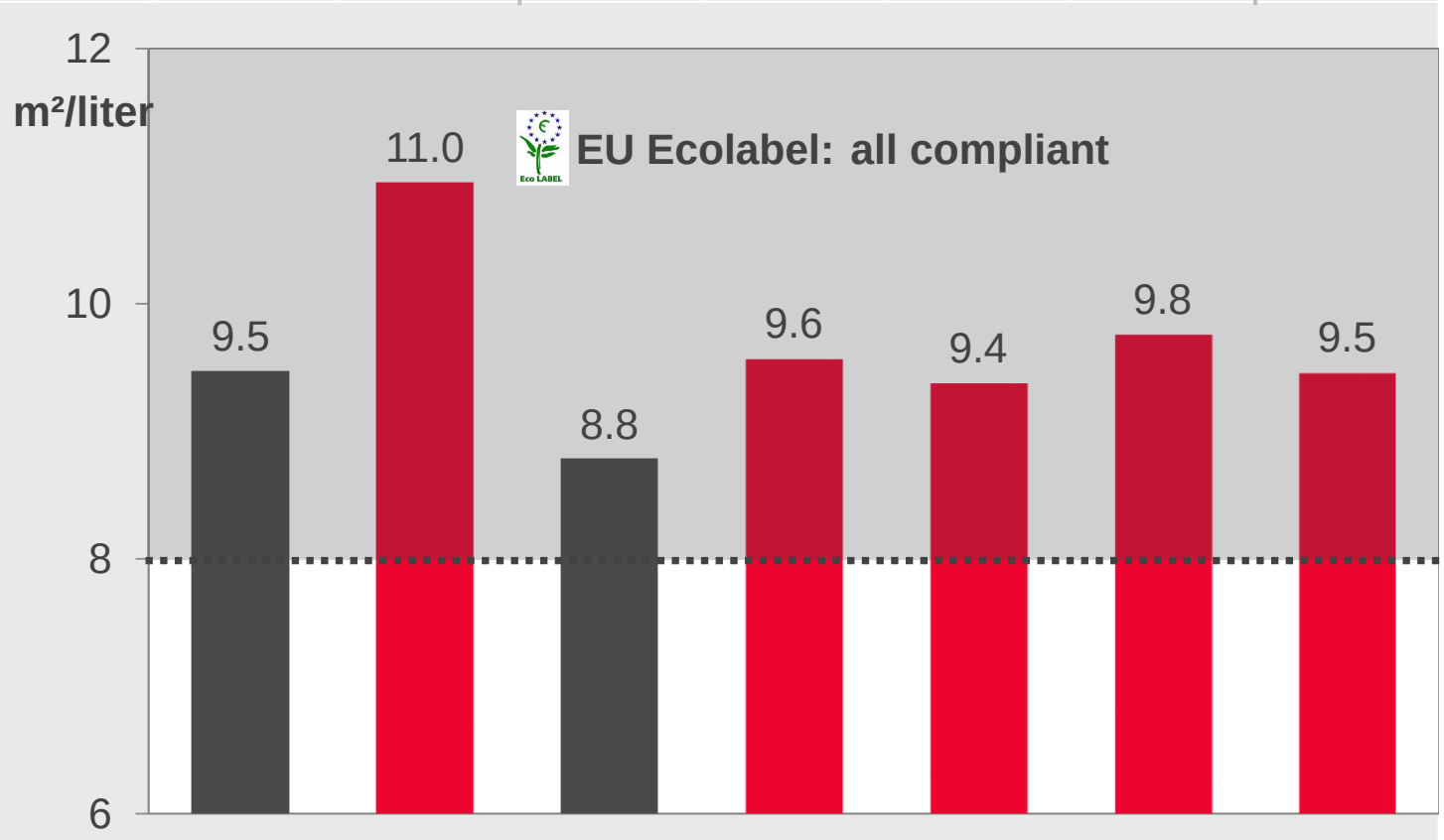
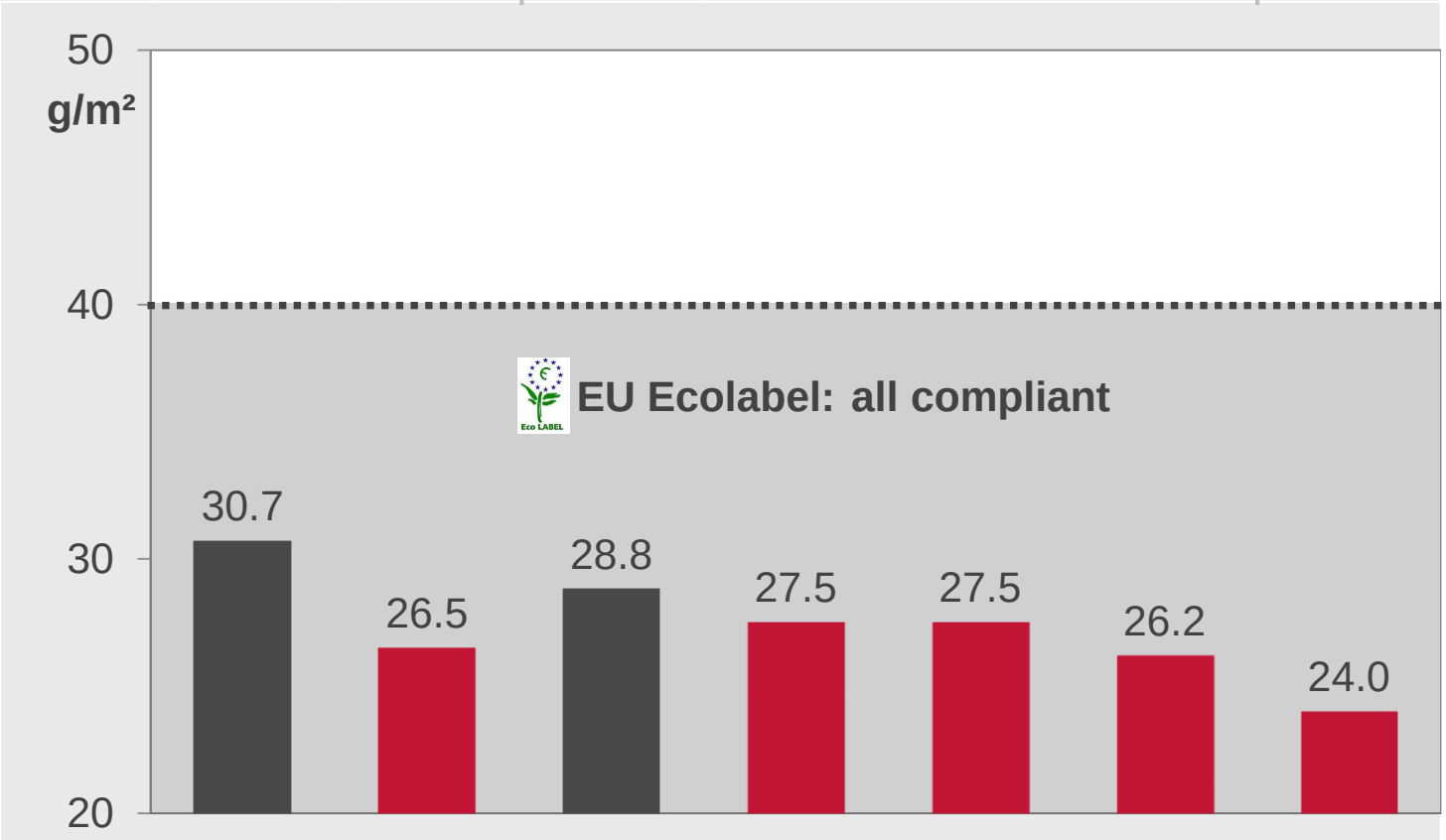
TiO_2	185		166				148
PCC	70	---	70	---	70	70	70
Silfit Z 91	---	70	---	70	38	57	74



TiO_2-Content per m² at Contrast Ratio 98 %

TiO_2	185		166				148
PCC	70	---	70	---	70	70	70
Silfit Z 91	---	70	---	70	38	57	74



Cost / Performance

Germany 2019 / Contrast Ratio 98 %

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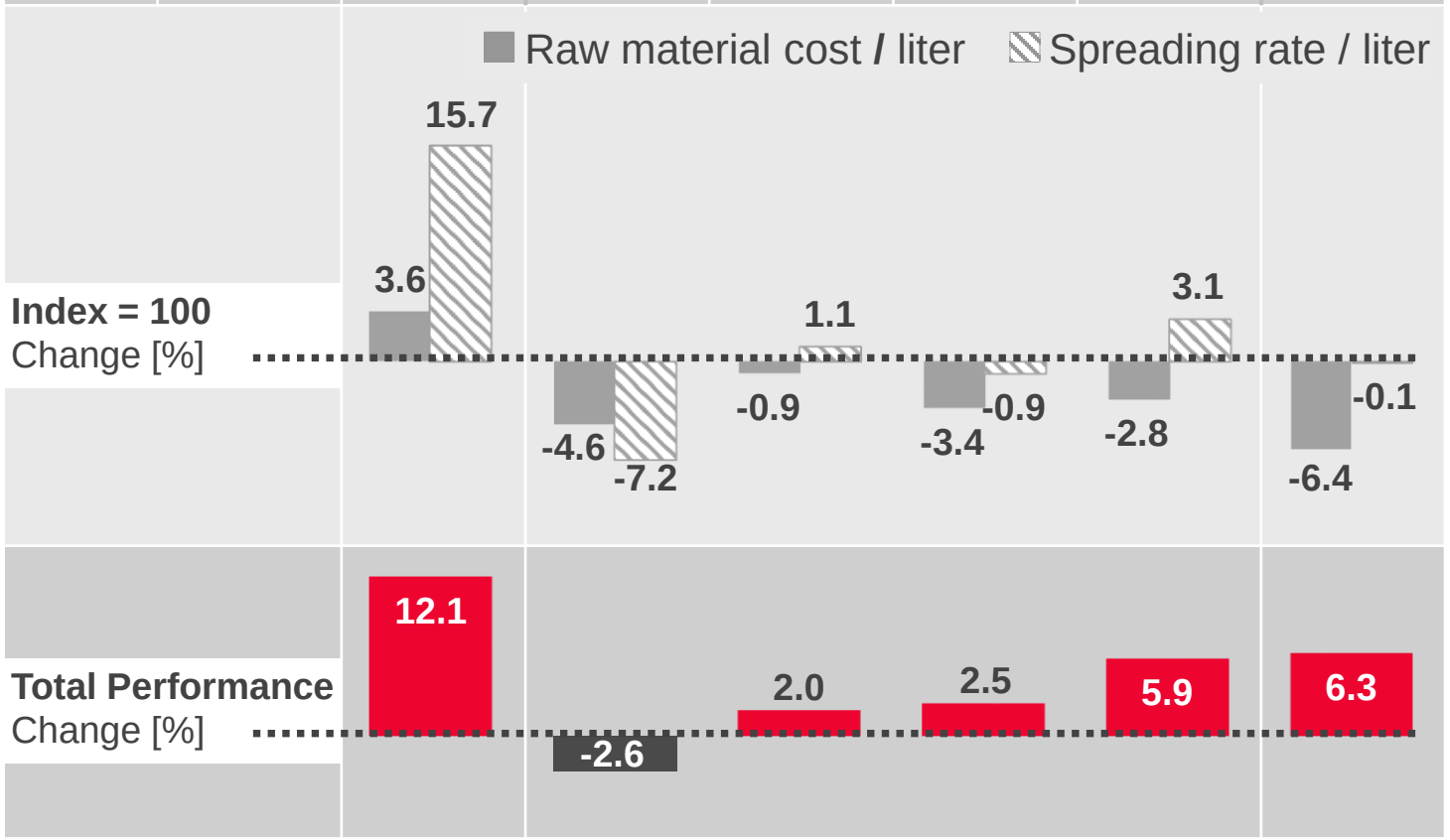
TiO_2	185		166				148
PCC	70	---	70	---	70	70	70
Silfit Z 91	---	70	---	70	38	57	74



Summary

Silfit Z 91 appears comparable to PCC with respect to:

Equal processing properties, storage stability, color, gloss and wet-scrub resistance

Silfit Z 91 additionally offers:

Marked improvement of hiding power and spreading rates

- More than compensating slightly higher formulation cost
- 10 to 20 % TiO_2 reduction without loosing efficiency whereas significant loss in hiding power with just PCC

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

✓ Improved performance, even at reduced TiO_2 level

✓ Real cost cutting potential

✓ White pigment savings and thus contribution to more eco-friendly interior emulsion paints

Starting Formulations

[1] Very high hiding power / spreading rate [2] TiO_2-reduction + good hiding power [3] High cost savings		[1]	[2]	[3]
Water deionized			291	
Tylose MH 30000 YG8			4	
Calgon N, 10 % in water			5	
Lopon 895			3	
Agitan 315			2	
Parmetol MBX			1	
Sachtleben RDDI		185	166	148
Socal P2		---	70	70
Omyacarb 2 GU			125	
Omyacarb 5 GU			90	
Omyacarb 10 GU			30	
Plastorit 00			40	
Agitan 315			2	
Silfit Z 91		70	(38 to) 57	74
Sodium hydroxide, 10 % in water			2	
Mowilith LDM 1871 (VAE)			150	
Solids content w/w	[%]	70.8	72.5	72.7
PVC	[%]	63.0	64.3	64.3

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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* ~ 170 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

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*** Dry film thickness**

TiO2-Extender

	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 Calcium Carbonate	0.3	10	26	2.7	8	97.9	0.0	0.6
Silfit Z 91	2.0	10	55	2.6	8	95.5	- 0.1	0.7

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