Facade emulsion paints:
Silfit Z 91 vs. precipitated calcium carbonate

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Contents

Status Quo

- Excellent optical appearance as well as demands for resistance and functionality are essential characteristics for modern facade emulsion paints.
- High price level for white pigments like titanium dioxide as a result of increased raw material costs und rise in demand.
- Targeting economical and efficient alternatives without performance loss.
- Titanium dioxide extension by precipitated fine calcium carbonate is widely used.

Objective

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Calcined Neuburg Siliceous Earth grade Silfit Z 91 compared to precipitated calcium carbonate in a TiO_2 reduced facade paint.

- Processing properties / Storage stability
- Wet-scrub resistance
- Liquid water permeability and water-vapor transmission rate
- Gloss

Key characteristics:

- Color
- Hiding power (EU Ecolabel)
- Formulation costs

Evaluation in European standard emulsion paint based on a styrene acrylic dispersion.

Base Formulation

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Ingredient	Function	Parts by weight
Water deionized	-	250
Natrosol 250 HR	Thickener	2
Ammonia, conc. 25 %	Neutralising agent	2
Dispex AA 4030	Dispersing additive	2
Calgon N New, 10 % in water	Wetting- / Dispersing	3
Parmetol MBX	Can preservation	2
Foamaster MO 2134	Defoamer	2
Propylene glycol : Butyl diglycol : Texanol = 1 : 1 : 1	Cosolvent	30
Kronos 2190	TiO_2 Pigment	**180**
Omyacarb 5 GU	Filler	180
Finntalc M 15	Filler	50
Precipitated Calcium Carbonate	TiO_2-Extender	**100**
Acronal S 790 (Styrene acrylic)	Emulsion Binder	220
Foamaster MO 2134	Defoamer	3
Acticide MKB 3	Film preservation	10
Rheovis PE 1330	Thickener	12
Water deionized	-	12
Total		**1060**
Solids content w/w	[%]	59.9
PVC	[%]	61.9

Formulation Variations

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

	Control	TiO_2 - Reduction
Kronos 2190	180	150
Precipitated Calcium Carbonate	**100**	**100**

TiO_2 – Extender Replacement 1 : 1

Silfit Z 91	**100**
Kronos 2190	150

TiO_2-Extender

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	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
Other Fillers in Formulation (for comparison only)								
Omyacarb 5 GU	5.5	26	16	2.7	2	96.0	- 0.2	0.7
Finntalc M 15	4.5	17	41	2.8	6	92.8	- 0.5	1.1

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Formulation Data

	Control		
	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91
Precipitated Calcium Carbonate (PCC)	100	100	---
Silfit Z 91	---	---	100
Kronos	180	150	150

Data calculated			
Solids content w/w [%]	59.9	58.7	58.7
PVC [%]	61.9	60.9	61.1
Density wet [g/cm³]	1.50	1.47	1.47
Density dry [g/cm³]	2.25	2.20	2.19

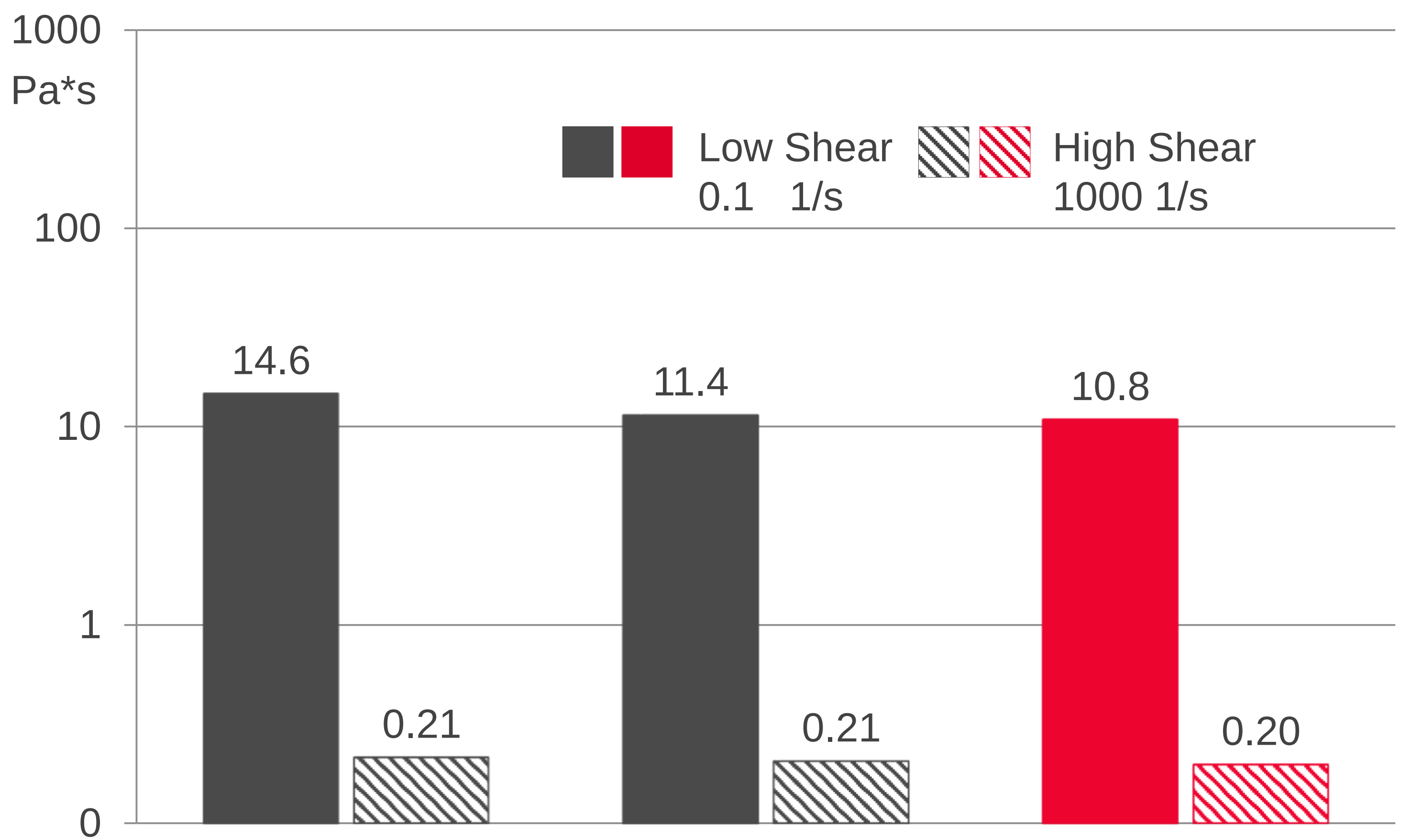
Processing Properties & Storage Stability

	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91
	Results		
Incorporation Pigment / Filler	good		
Foam formation	none		
Fineness of grind	20 µm		
Storage stability 23°C, 6 months	perfect: no phase separation, settling or sediment		

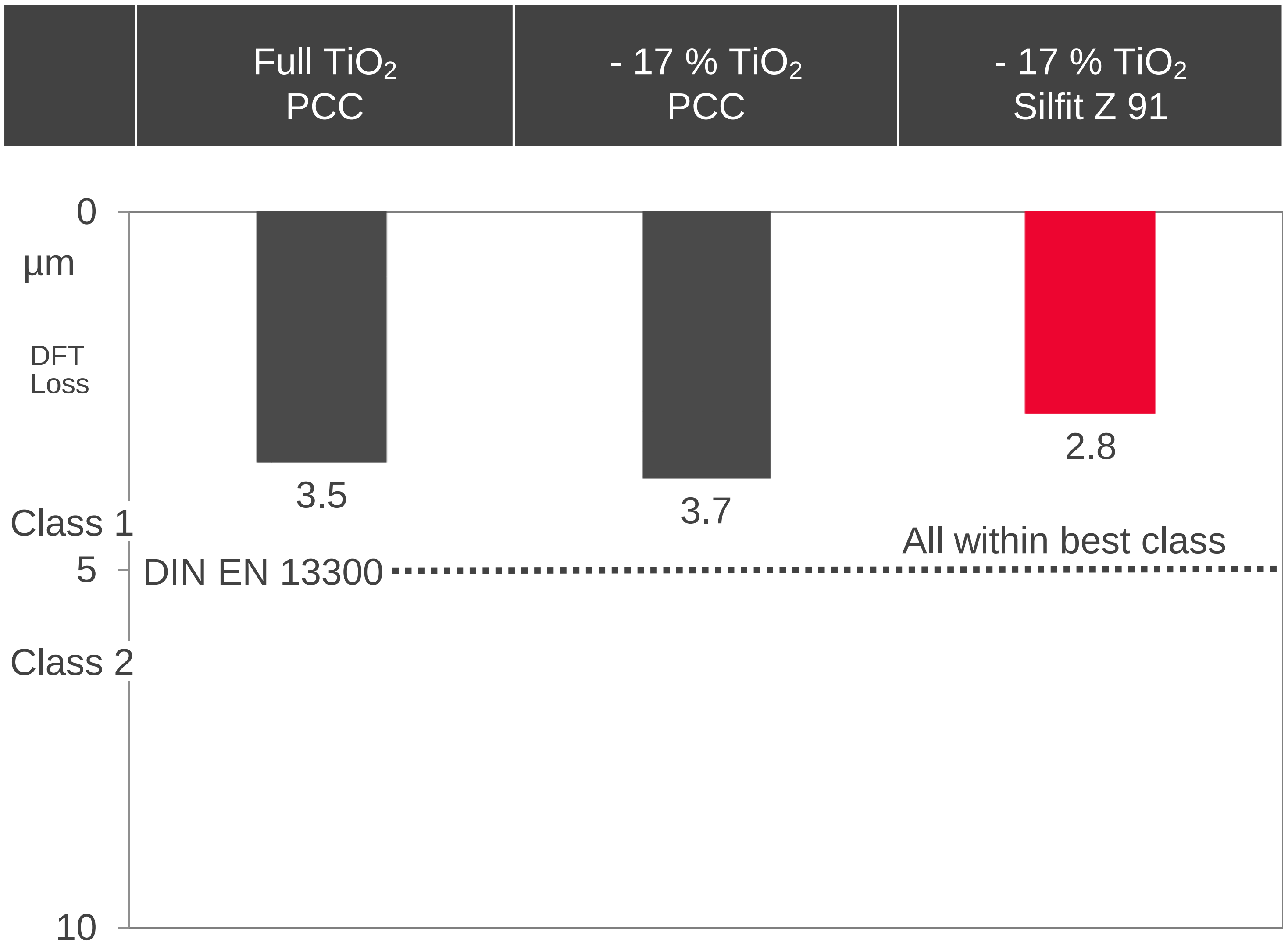
Preparation and Testing

Viscosity

	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91

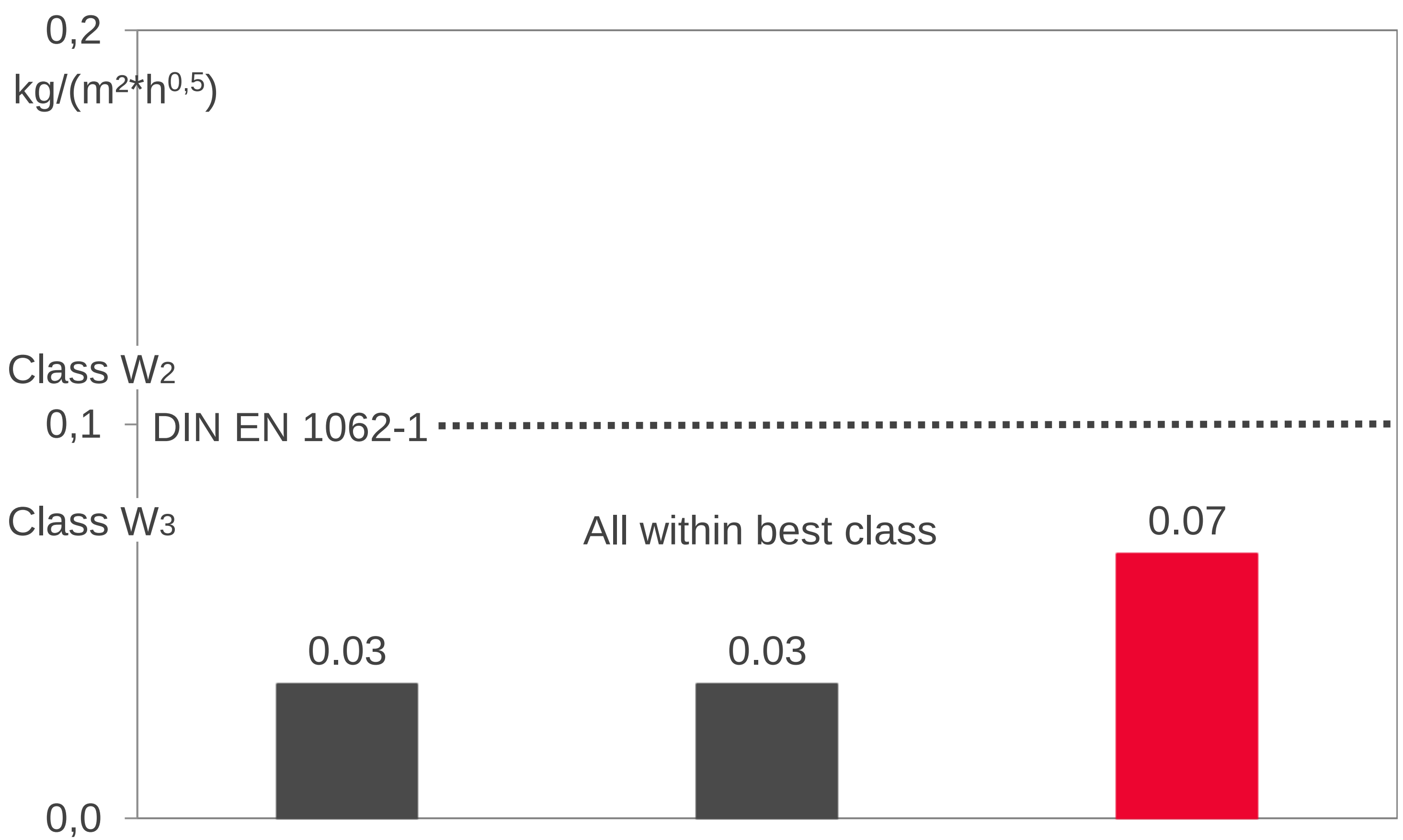


Wet-Scrub Resistance



Liquid Water Permeability W

	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91



Water-Vapor Transmission Rate V

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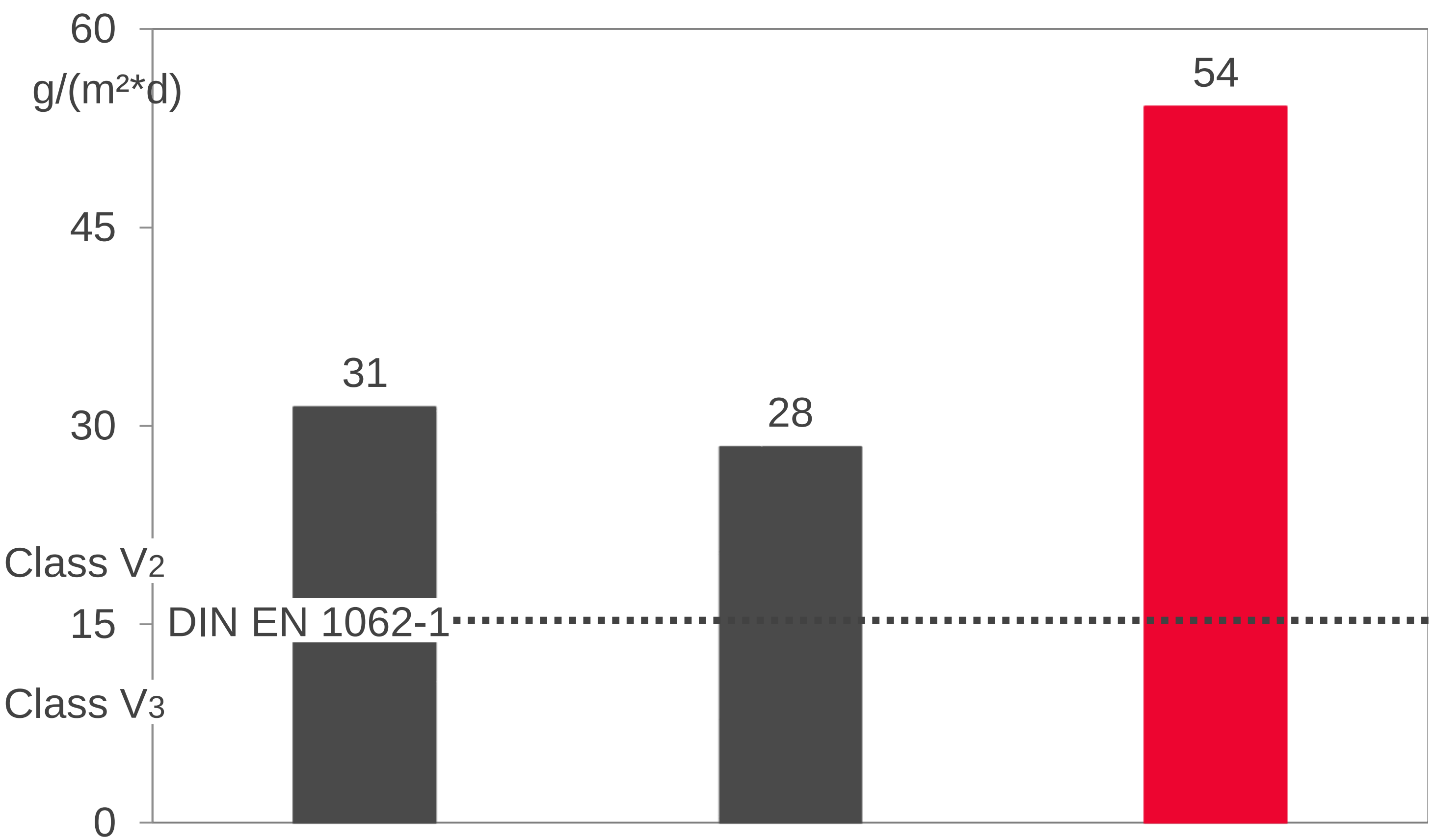
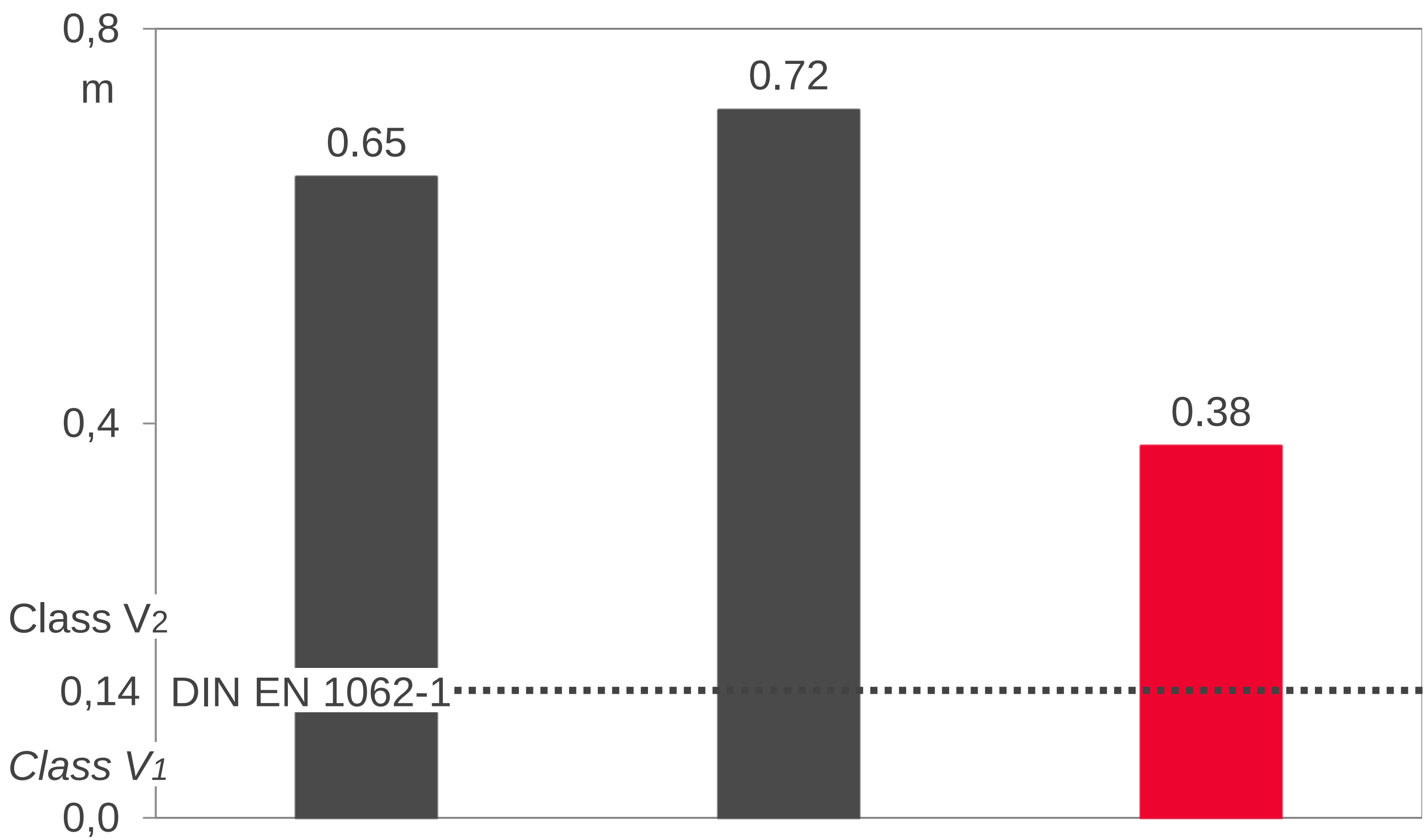
	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91



Air Layer Equivalent of Diffusion s_d

	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91



Facade Protection
Künzel Theory

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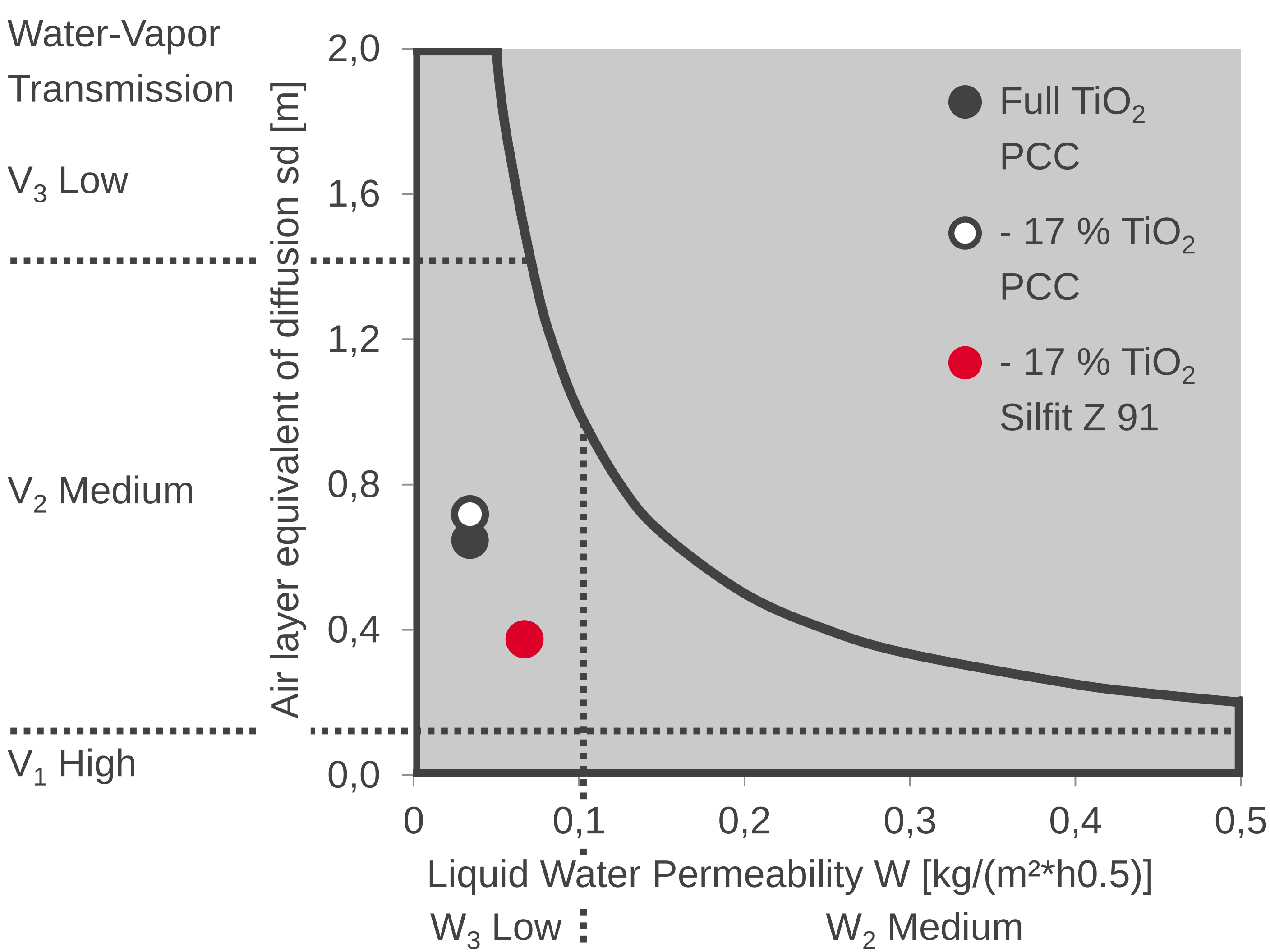
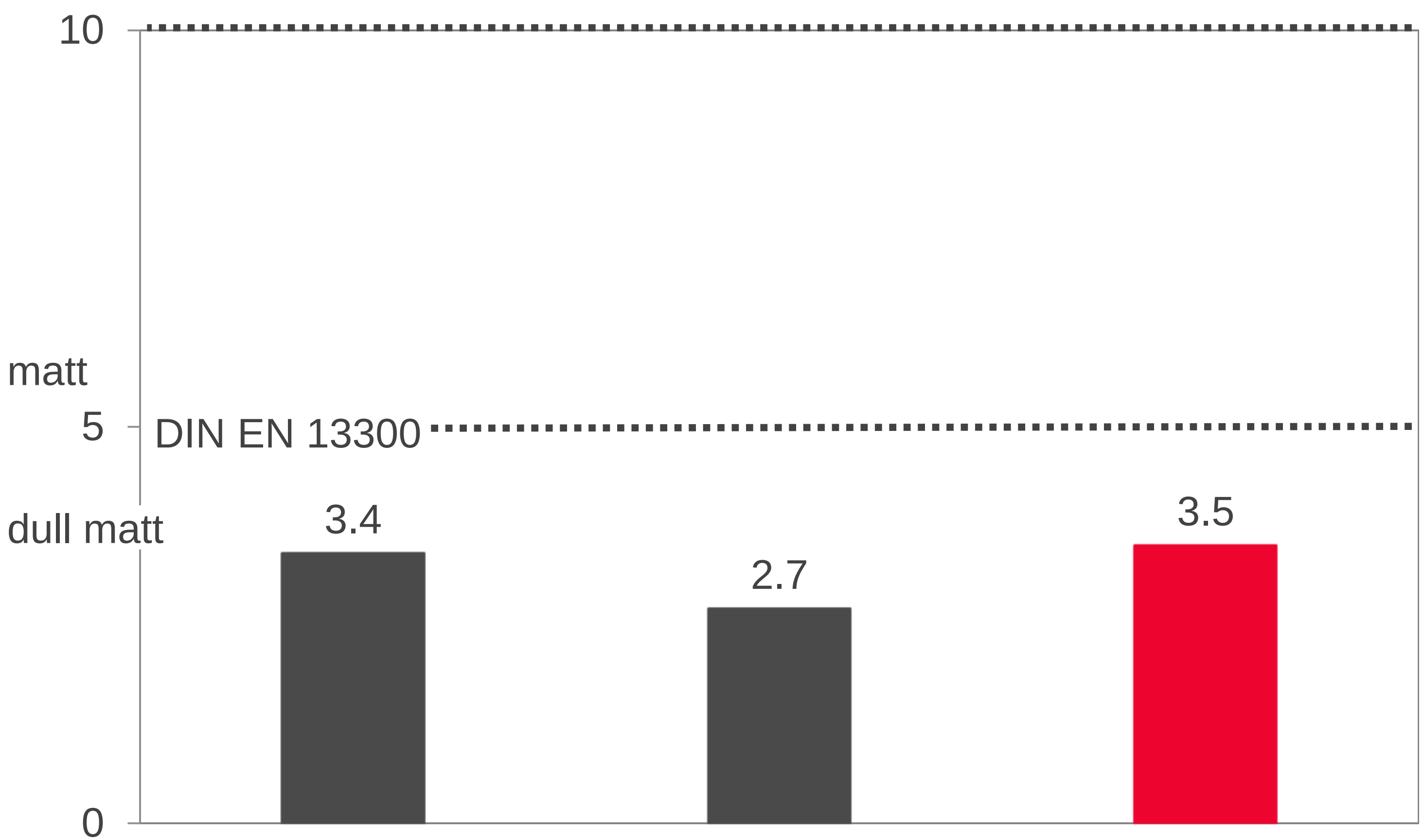


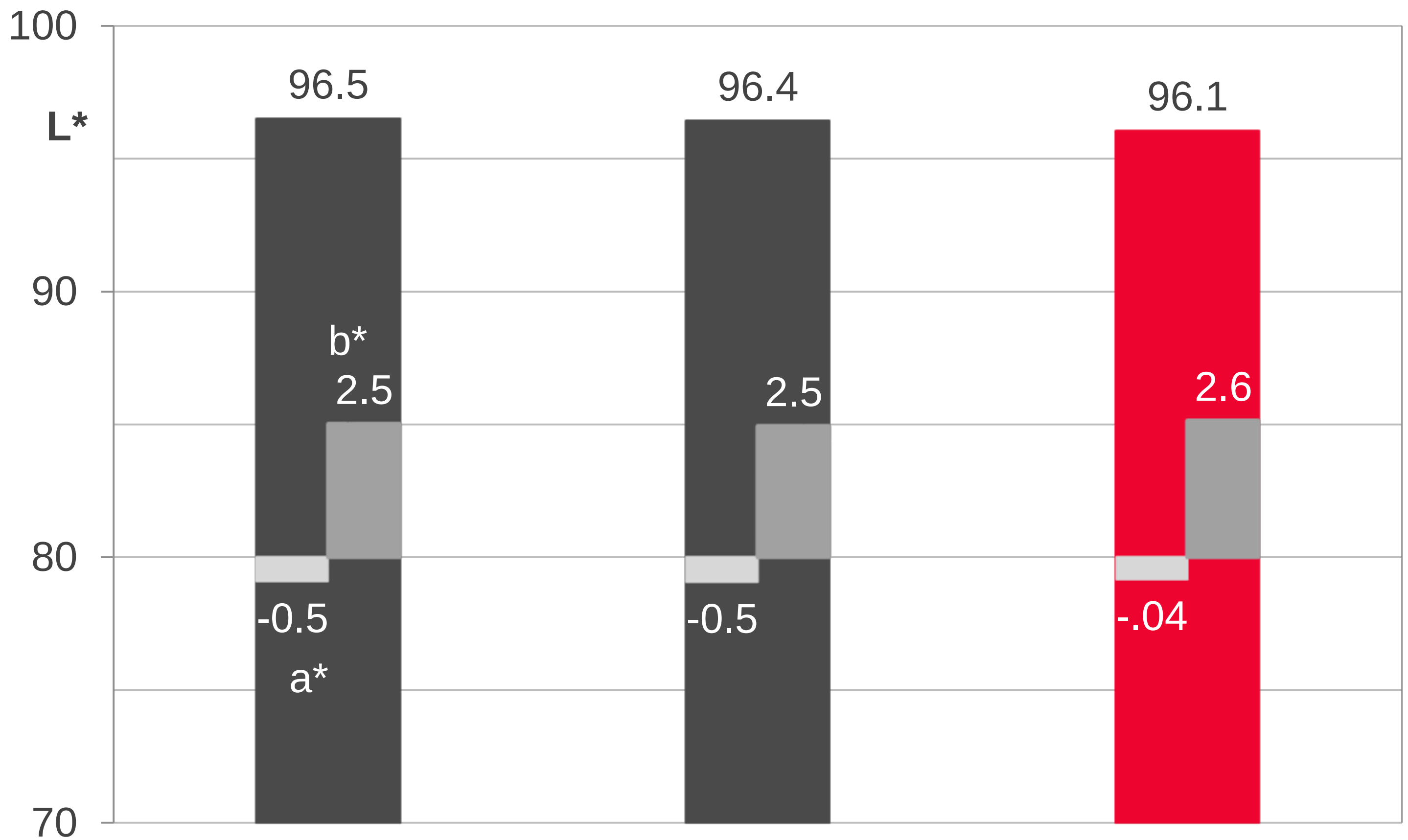
Gloss at 85° (Sheen)

	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91



Color

	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91



Hiding Power
EU Ecolabel

General:

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

Criterias relating to facade paints:

- Spreading rate
  ≥ **6 m² / liter** at contrast ratio 98 %
- Content of white pigments (refractive index ≥ 1.8)
  ≤ **38 g / m²** dried paint film at contrast ratio 98 %

Spreading Rate at Contrast Ratio 98 %

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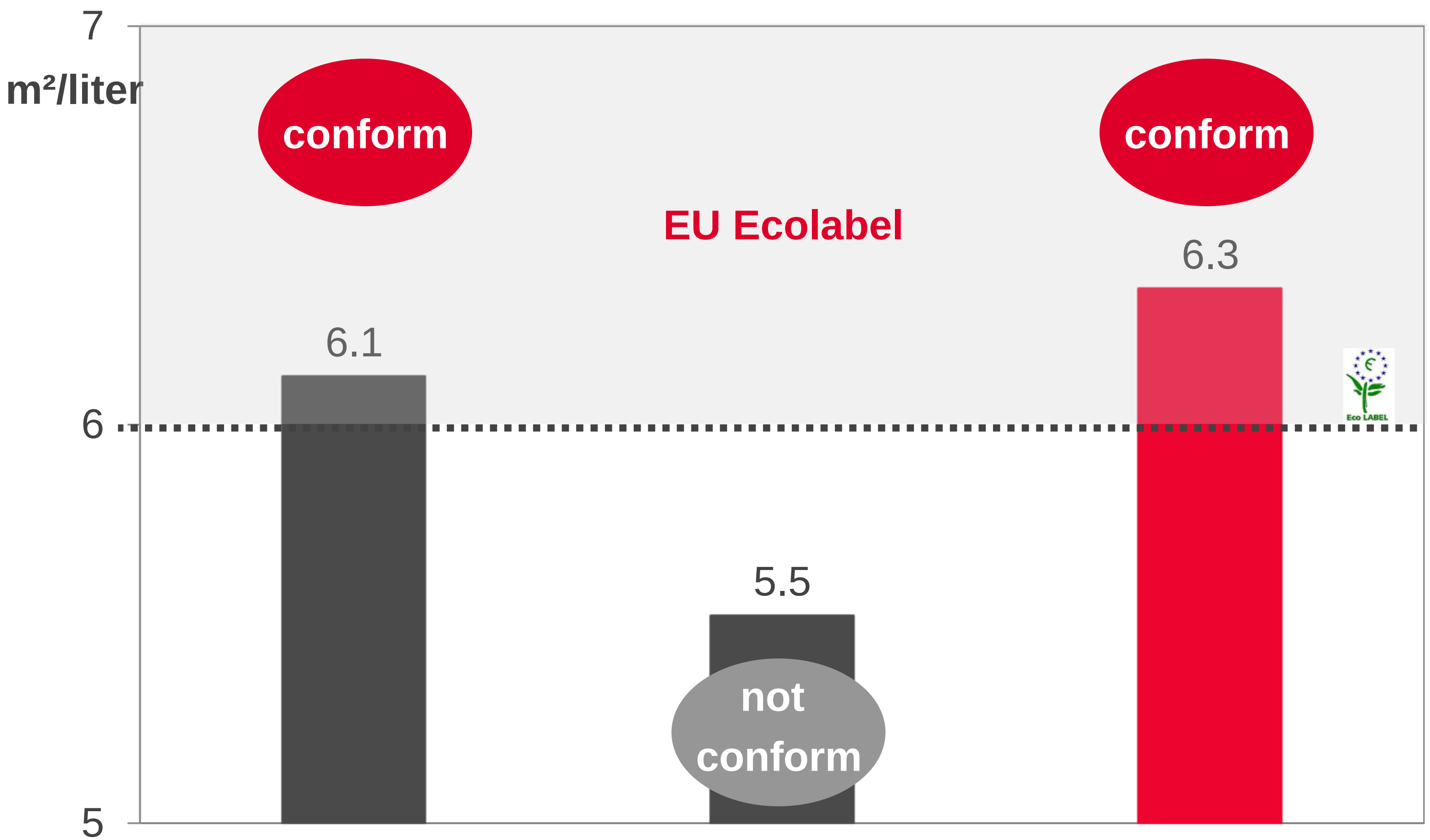
	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91



TiO_2 Content per m²
at Contrast Ratio 98 %

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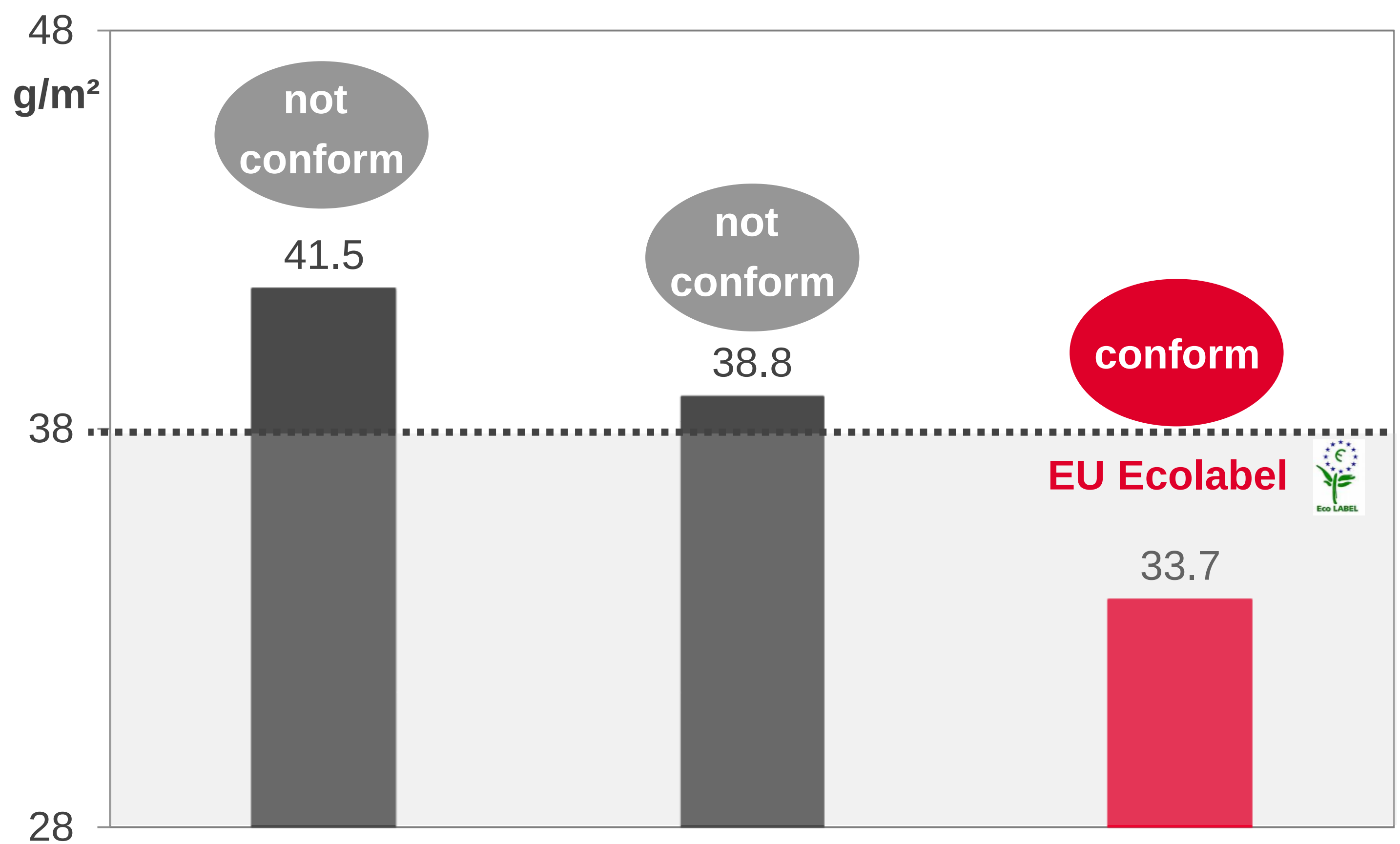
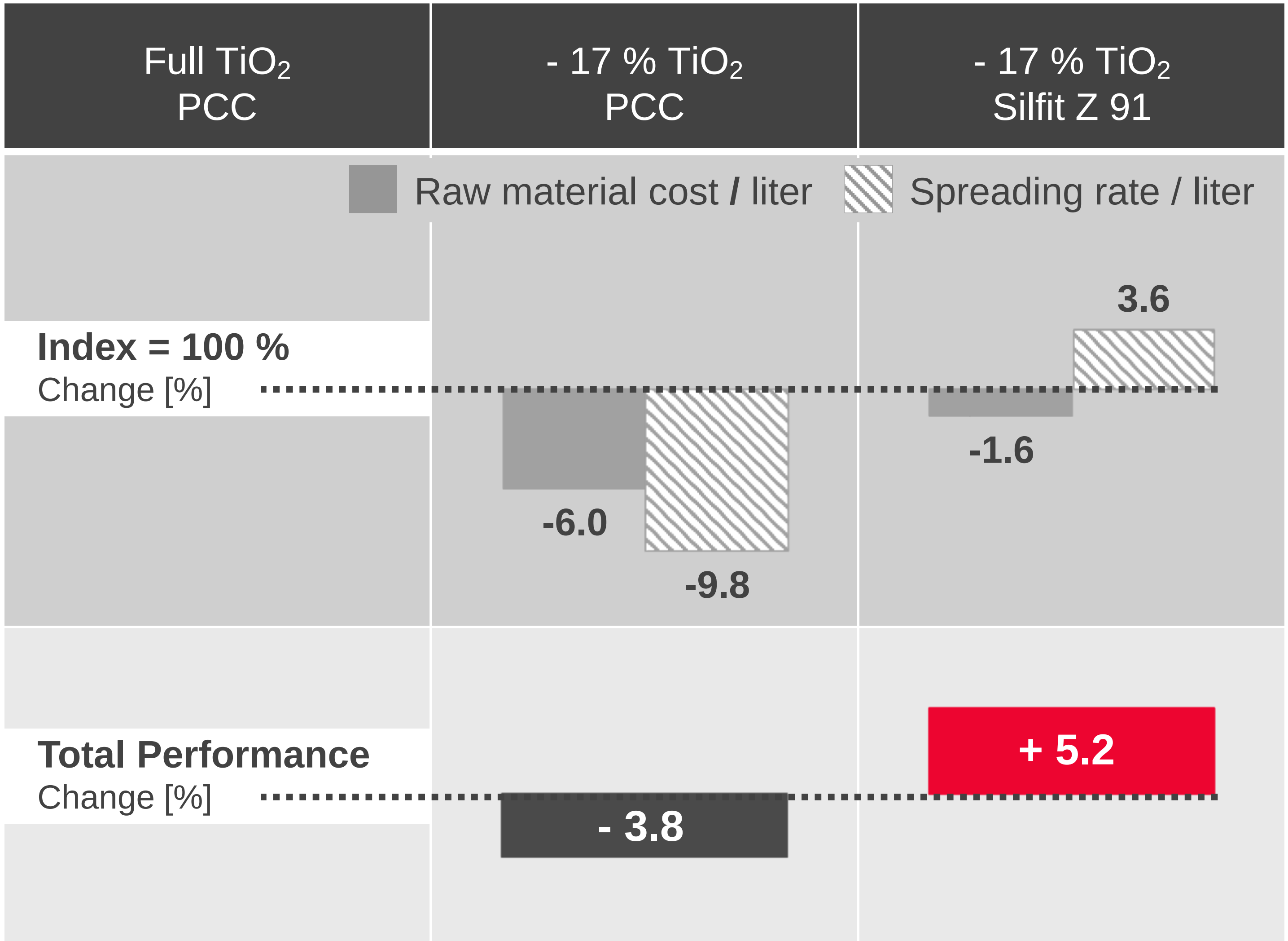
	Full TiO_2 PCC	- 17 % TiO_2 PCC	- 17 % TiO_2 Silfit Z 91



Cost / Performance

Germany 2019 / Contrast Ratio 98 %



Summary

If the Silfit Z 91 is dosed 1 by 1 compared to PCC it offers:

- Approximately equal: Processing properties, Storage stability, Color, Gloss, Liquid water permeability
- Slightly optimized: Wet-scrub Resistance
- Substantially optimized: Breathability, Hiding power

✓ Better mechanical resistance and durability

✓ Improved facade moisture balance

✓ Higher Spreading rates

✓ Cost saving potential with reduced TiO_2 content

✓ Despite of raw material cost savings

✓ Markedly improved performance even better than control with full TiO_2 level

✓ Paint clearly exceeding requirements of EU Ecolabel

Starting Formulation

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Water deionized		250
Natrosol 250 HR		2
Ammonia, conc. 25 %		2
Dispex AA 4030		2
Calgon N New, 10 % in water		3
Parmetol MBX		2
Foamaster MO 2134		2
Propylene glycol : Butyl diglycol : Texanol = 1 : 1 : 1		30
Kronos 2190		150
Omyacarb 5 GU		220
Finntalc M 15		50
Silfit Z 91		100
Acronal S 790		220
Foamaster MO 2134		3
Acticide MKB 3		10
Rheovis PE 1330		12
Water deionized		12
Solids content w/w	[%]	58.7
PVC	[%]	61.1

We supply material for good ideas!

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Preparation

Mixing and dispersing	Mixing with dissolver, in sequence of mentioning in the formulation Maximum peripheral speed of toothed disc (cowles blade) 15 m/s for 20 min Water cooling with T max. = 50°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 or as indicated

Testing

Paint Preparation	
Filler incorporation Foam formation	Subjective assessment during preparation
Wet Paint	
Fineness of grind	Grindometer 0 – 50 µm
Viscosity	1d after preparation, 23°C Rheometer, Searle system
Storage stability	Undiluted in 1l-metal can, 6 months 23°C
Application with doctor blade gap 300 µm on Leneta film, DFT ~ 70 µm	
Wet-scrub resistance	200 Cycles on automated wet-scrub resistance tester according to ISO 11998. Classification along with DIN EN 13300

Testing

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Application 400 ml in total (equal to 2 coats with 5 m²/l each), DFT ~ 160 µm	
Liquid Water Permeability W	Priming + 2 coats brush-applied on sand lime bricks Testing according to DIN EN 1062-3 Classification along with DIN EN 1062-1
Water-vapour Transmission Rate V	2 coats brush-applied on filter paper grade 1575 Testing according DIN EN ISO 7783, wet-cup method; classification along with DIN EN 1062-1
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, Spreading Rate	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 respectively contrast ratio at given spreading rate

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