Neuburg Siliceous Earth in UV-curing wood Coatings: surfacer and top coat

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Epoxy Acrylate

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Introduction

The objective of this study was to show how different fillers affect important properties of a surfacer for parquet floorings. For this purpose a mineral filler should provide:

- high amounts in formulation
- viscosity increase, especially associated with an yield point (important for processing behaviour on a roller coater)
- good transparency
- high abrasion resistance
- cost reduction

As the most frequently used fillers for this product sector we tested:

- two grades of Talc products
- Blanc Fixe (precipitated Barium Sulfate)
- three grades of Neuburg Siliceous Earth:
  - Sillitin V 88
  - Sillitin Z 89
  - Aktisil MAM

Filler Characteristics

CONTENTS

	Talc 1	Talc 2	Blanc Fixe	Sillitin Z 89	Sillitin V 88	Aktisil MAM
Mineral Description	Talc + others	Talc + others	prec. Barium-sulfate	Silica/ Kaolinite	Silica/ Kaolinite	Silica/ Kaolinite
Chemical Composition	55 % SiO_2 32 % MgO 5 % Al_2O_3	32 % SiO_2 31 % MgO 22 % Al_2O_3	99 % $BaSO_4$	82 % SiO_2 12 % Al_2O_3	88 % SiO_2 8 % Al_2O_3	88 % SiO_2 8 % Al_2O_3
Particle Shape	lamellar	lamellar, more stacks	rhombo-hedral	corpuscular aggregates and lamellar	corpuscular aggregates and lamellar	corpuscular aggregates and lamellar
Particle Size d_{50} [µm]	7.8	3.2	4.4	2	4	4
Particle Size d_{97} [µm]	27	17	16	9	18	18
Oil Absorption [g/100 g]	47	42	17	55	45	45
Density [g/cm³]	2.8	2.8	4.4	2.6	2.6	2.6
Functionali-sation	none	none	none	none	none	Methacrylic

Base Formulation

CONTENTS

	Parts by weight
Ebecryl 6040	42.4
OTA 480	50.8
Benzophenone	3.4
Omnirad BDK	3.4
Filler	variable X
Total	100 + X

Testing

Viscosity:
Rotation viscometer MC 1 (Anton Paar), at 23 °C

Yield Point:
Rotation viscometer MC 1, stress controlled, at 23 °C

Curing:
Mercury UV lamp at 80 W/cm; speed 15 m/min; two passes

Color Shift of Film:
The color value b* (Cielab Color system) of the film was measured on a white substrate with a Luci 100 color meter; dry film thickness 40 µm.
The color shift Δb* is the difference between the measured value and the color value b* of the formulation without filler; the higher the number, the more yellowish tint.

Testing

CONTENTS

Transparency Loss:

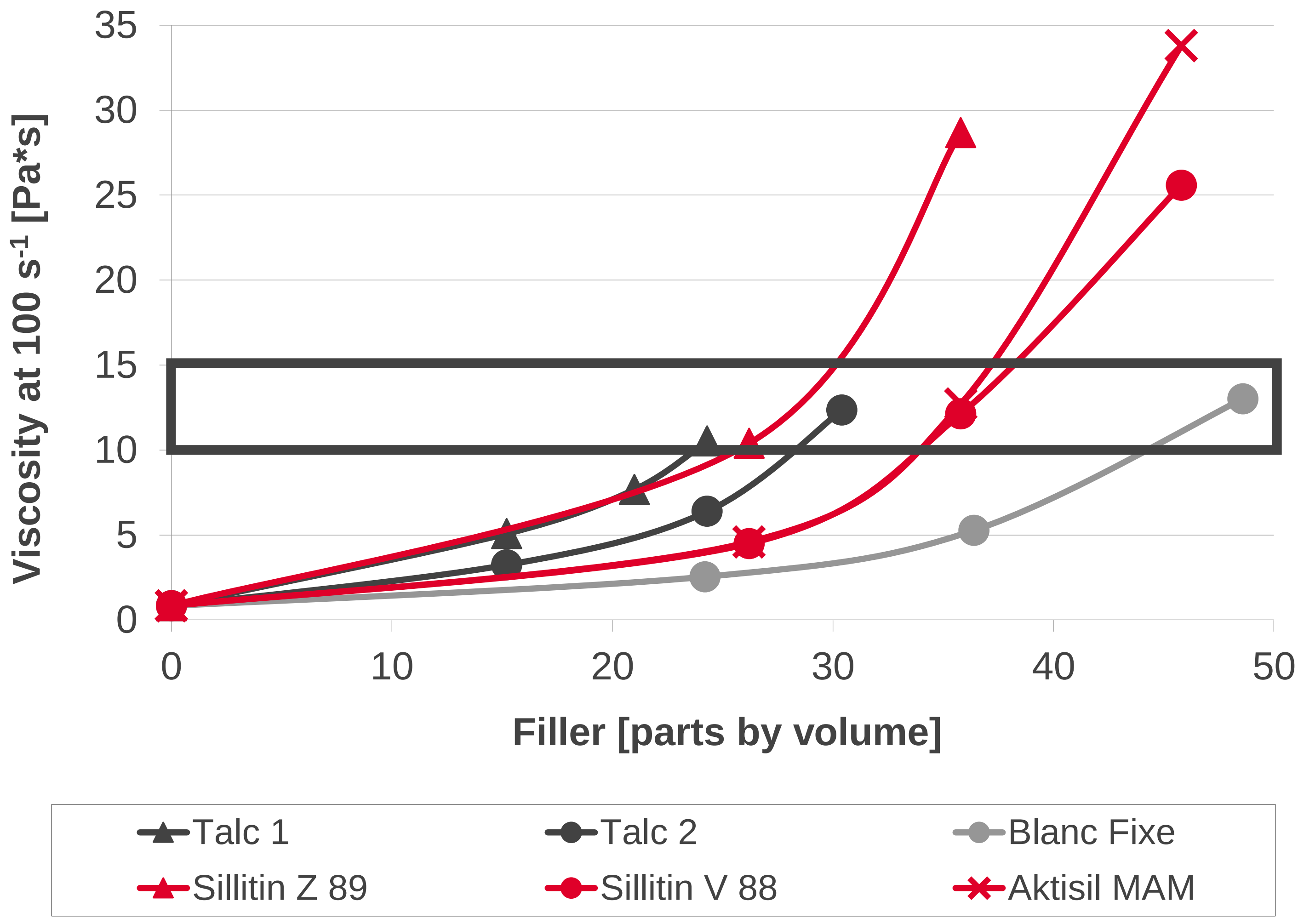
The color value Brightness L* (Cielab Color system) of the film was measured on a black substrate with a Luci 100 color meter; dry film thickness 40 µm.

The transparency loss ΔL* is the difference between the measurement of the black substrate without coating and the measurement with applied film; the lower the number, the better the transparency.

Abrasion Resistance:

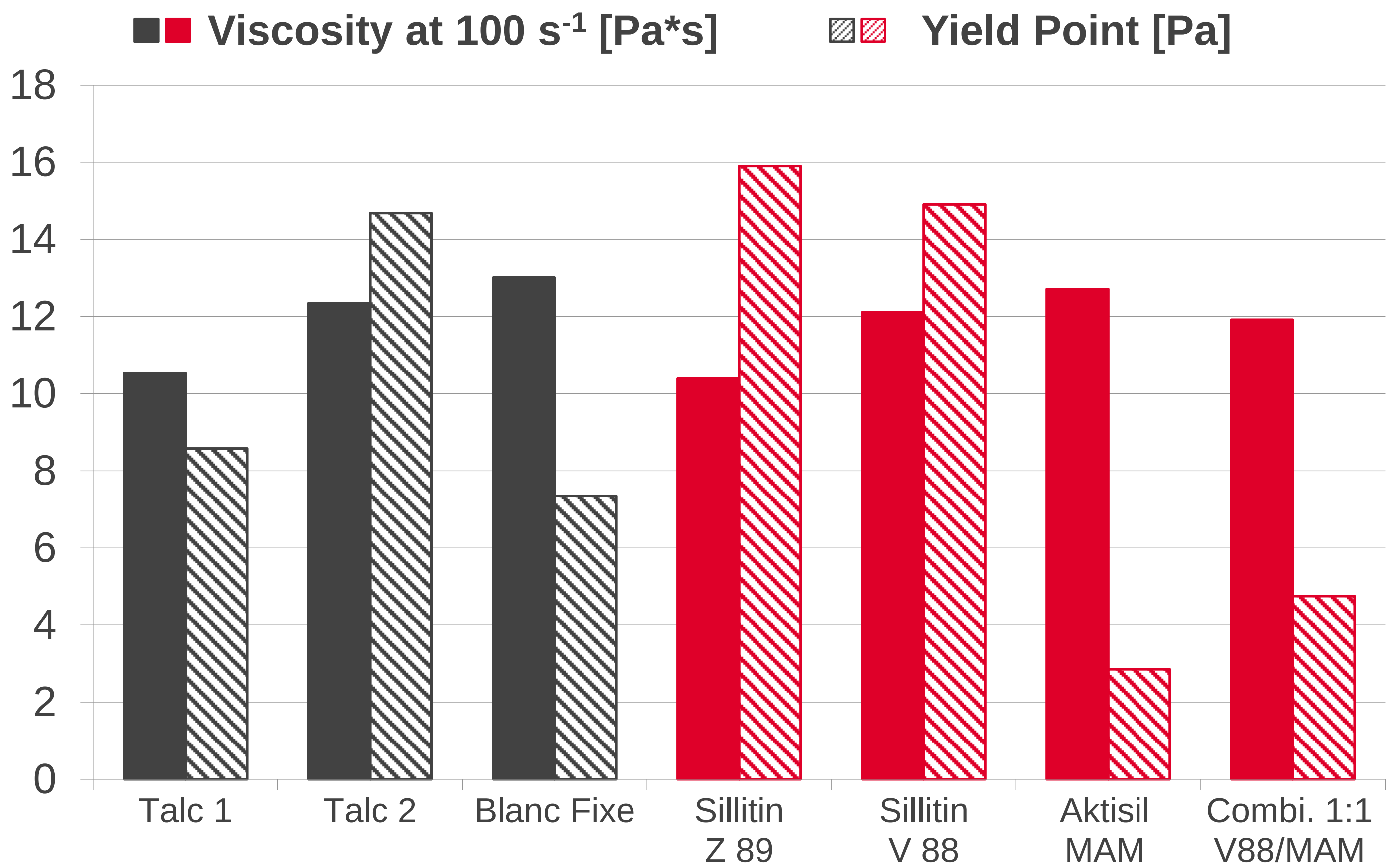
Tested with a Taber Abraser with S 42 sanding strips at a load of 0.5 kg. The abrasion loss was determined after 100 revolutions at a speed of 55 rpm by weighing the specimen and calculating the volume loss (considering the different densities).

Viscosity vs. Filler Dosage



Viscosity and Yield Point

in the targeted range



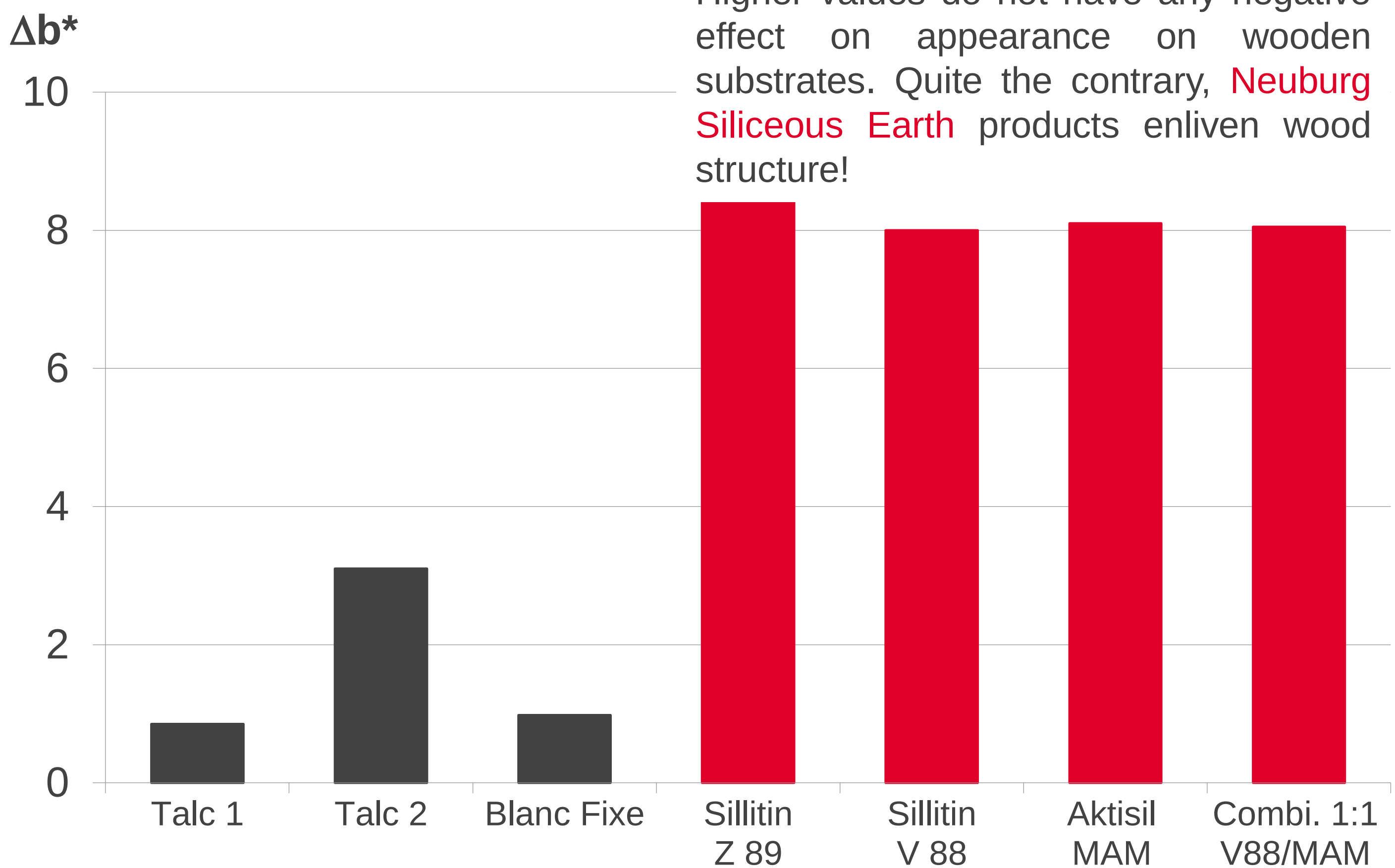
Vol.parts:	24.3	30.4	48.6	26.2	35.8	35.8	35.8
Weight p.:	68	85	214	68	93	93	93

CONTENTS

Color Shift

DFT 40 µm on white substrate

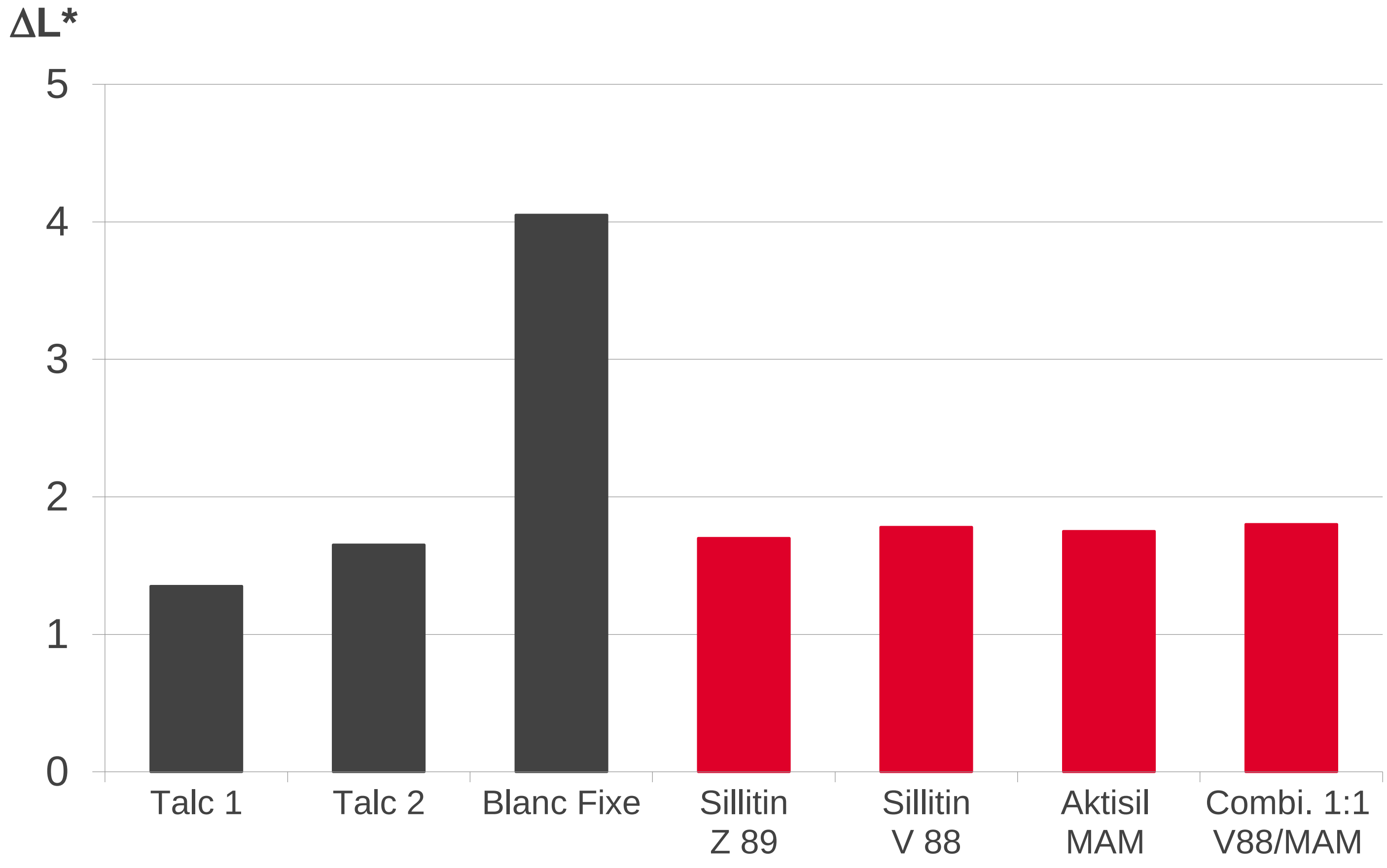
Higher values do not have any negative effect on appearance on wooden substrates. Quite the contrary, Neuburg Siliceous Earth products enliven wood structure!



Vol.parts:	24.3	30.4	48.6	26.2	35.8	35.8	35.8
Weight p.:	68	85	214	68	93	93	93

Transparency Loss

DFT 40 µm on black substrate

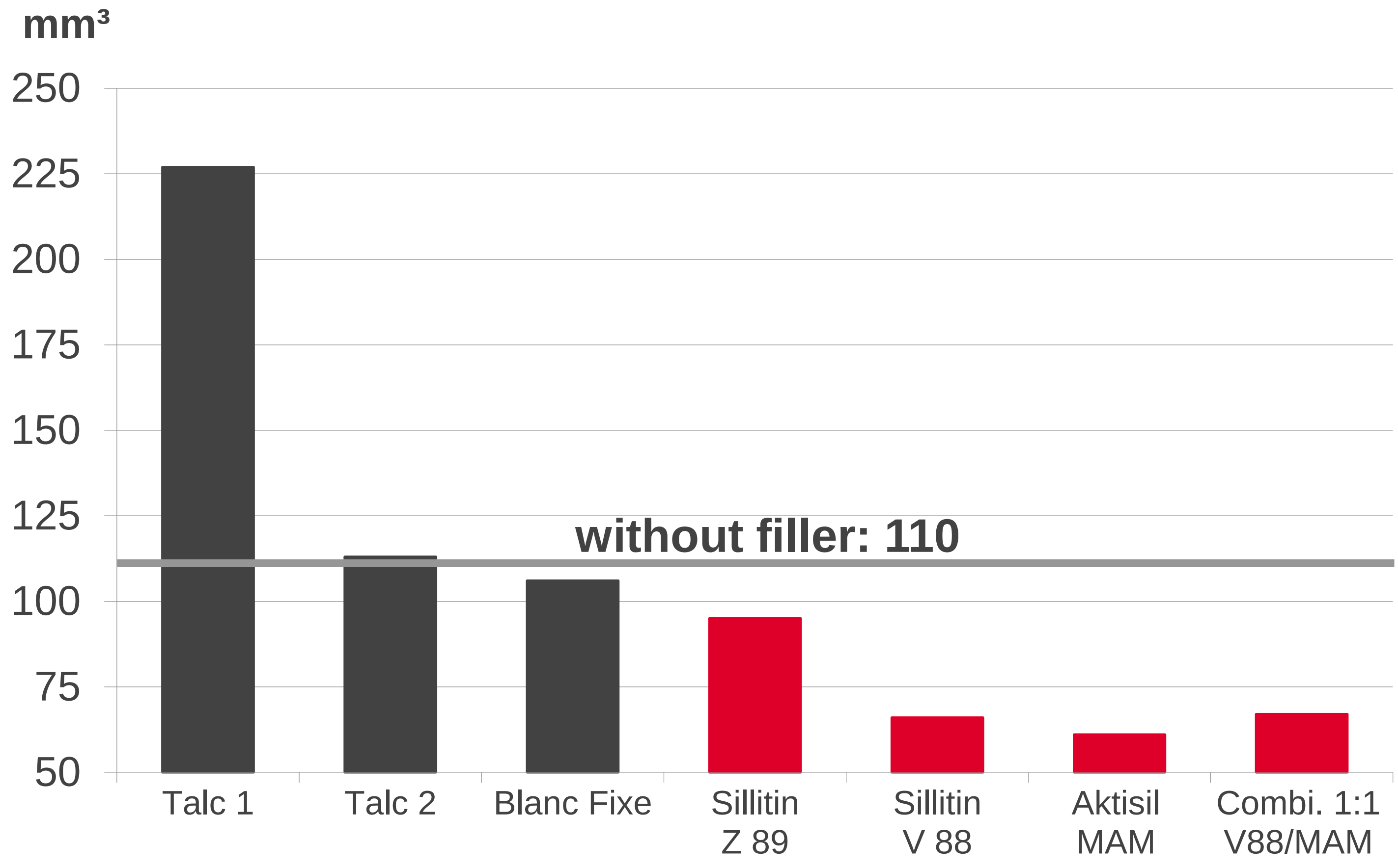


	Talc 1	Talc 2	Blanc Fixe	Sillitin Z 89	Sillitin V 88	Aktisil MAM	Combi. 1:1 V88/MAM
Vol.parts:	24.3	30.4	48.6	26.2	35.8	35.8	35.8
Weight p.:	68	85	214	68	93	93	93

Abrasion Loss

CONTENTS

Taber S 42 0.5 kg; 55 rpm; 100 revolutions

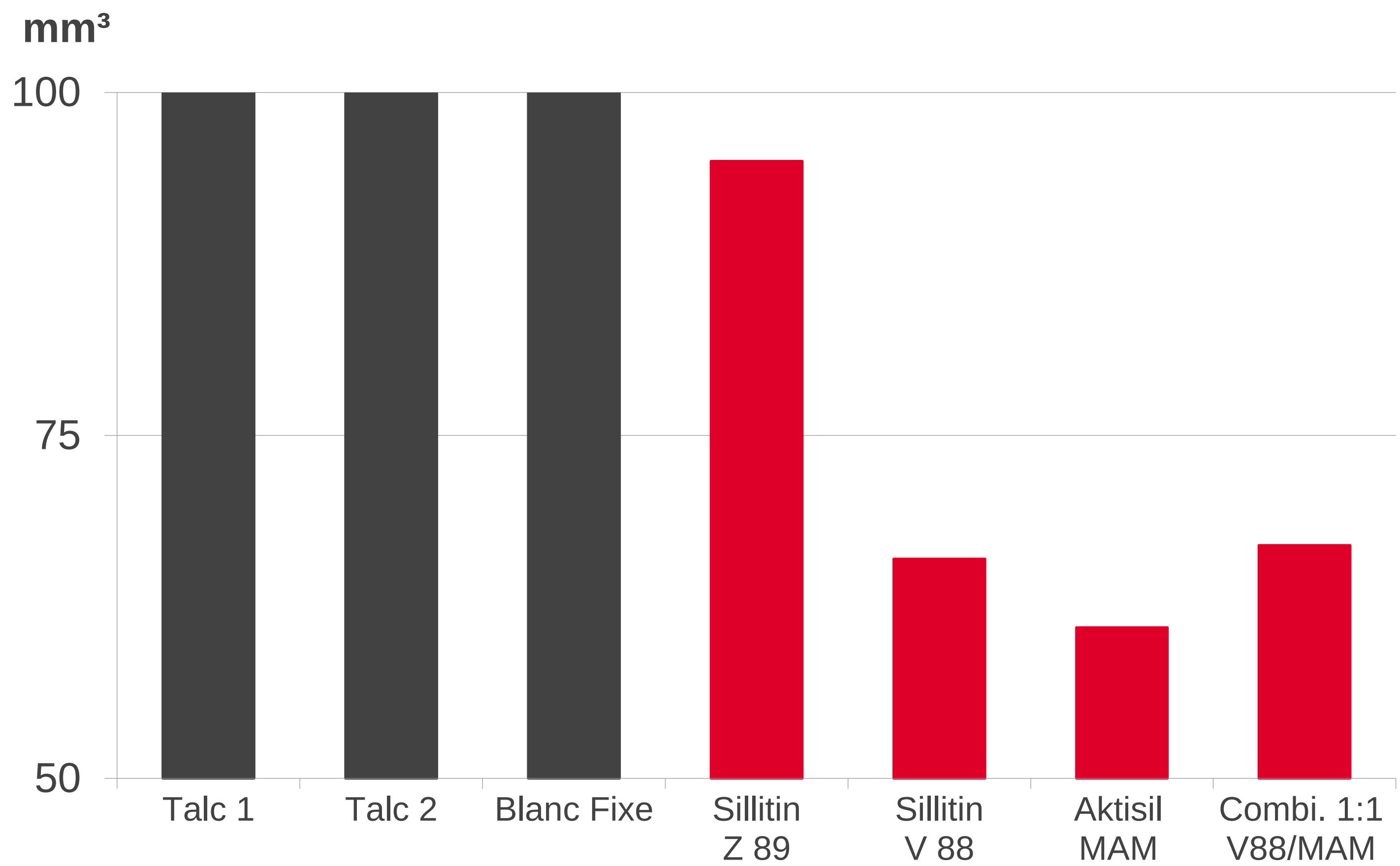


Vol.parts:	24.3	30.4	48.6	26.2	35.8	35.8	35.8
Weight p.:	68	85	214	68	93	93	93

Abrasion Loss

CONTENTS

focused on low loss range

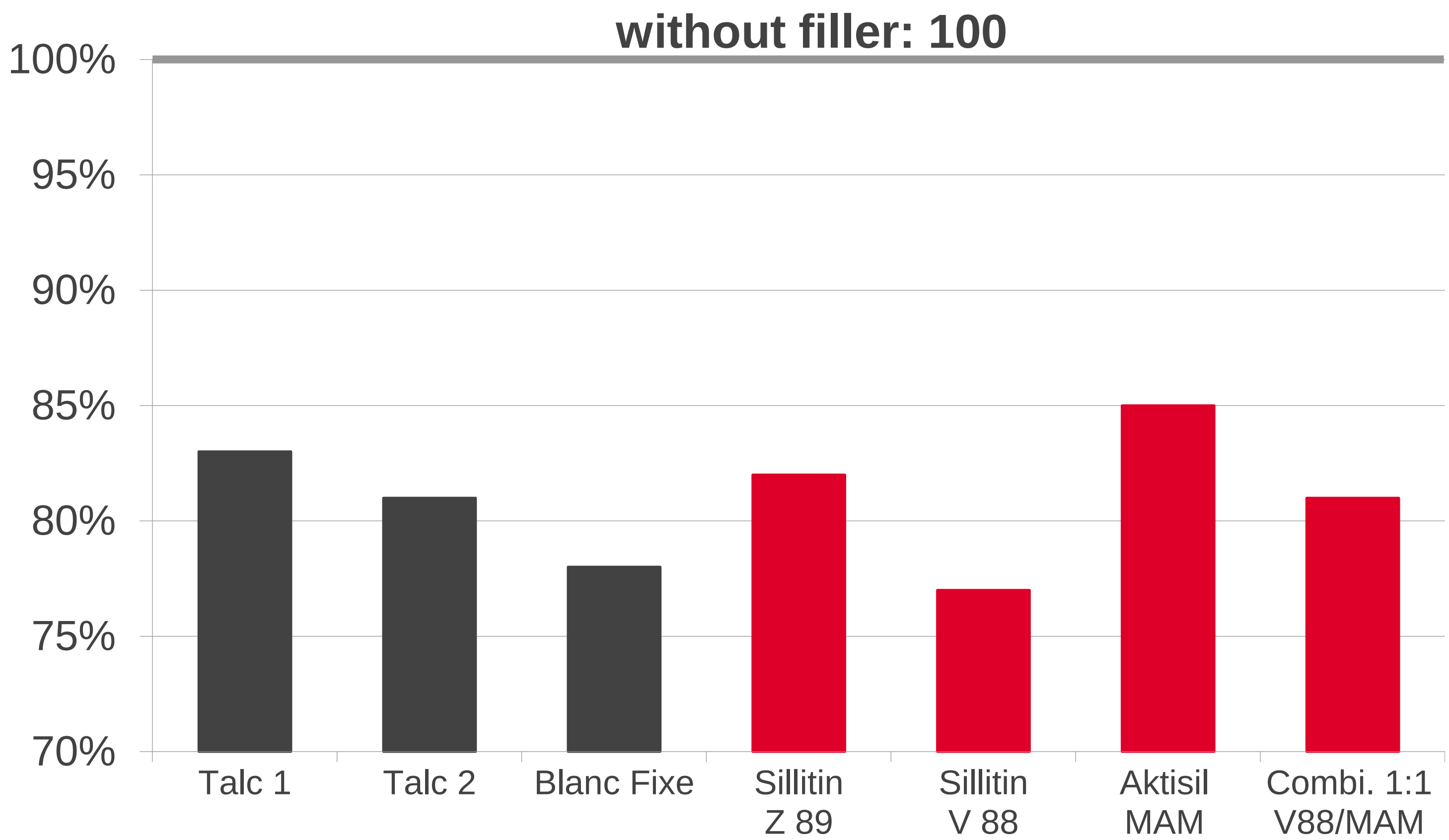


	Talc 1	Talc 2	Blanc Fixe	Sillitin Z 89	Sillitin V 88	Aktisil MAM	Combi. 1:1 V88/MAM
Vol.parts:	24.3	30.4	48.6	26.2	35.8	35.8	35.8
Weight p.:	68	85	214	68	93	93	93

Formulation Cost Index

CONTENTS

per liter (Germany)



Vol.parts:	24.3	30.4	48.6	26.2	35.8	35.8	35.8
Weight p.:	68	85	214	68	93	93	93

Part 2: Top Coat
Aliphatic Urethane Acrylate

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- Introduction
- Experimental
  - Filler Characteristics
  - Base Formulation
  - Test Design
  - Application, Tests and Parameters
- Results
  - Viscosity
  - Color Shift
  - Gloss 60°
  - Abrasion Resistance
  - Formulation Cost Index
  - Benchmarking

Introduction

UV-cured coatings, as 100 % systems without any volatile matter, are very difficult to mat. Even classical matting agents like silica gel based products achieve only moderate matting effect, whereas the viscosity increase is dramatic.

The aim was to achieve a good matting with the lowest possible increase in viscosity and, in addition, to minimize abrasion loss as much as possible.

The influence of a commercially available matting agent based on silica gel or Aktisil MAM and combinations of both materials is examined below.

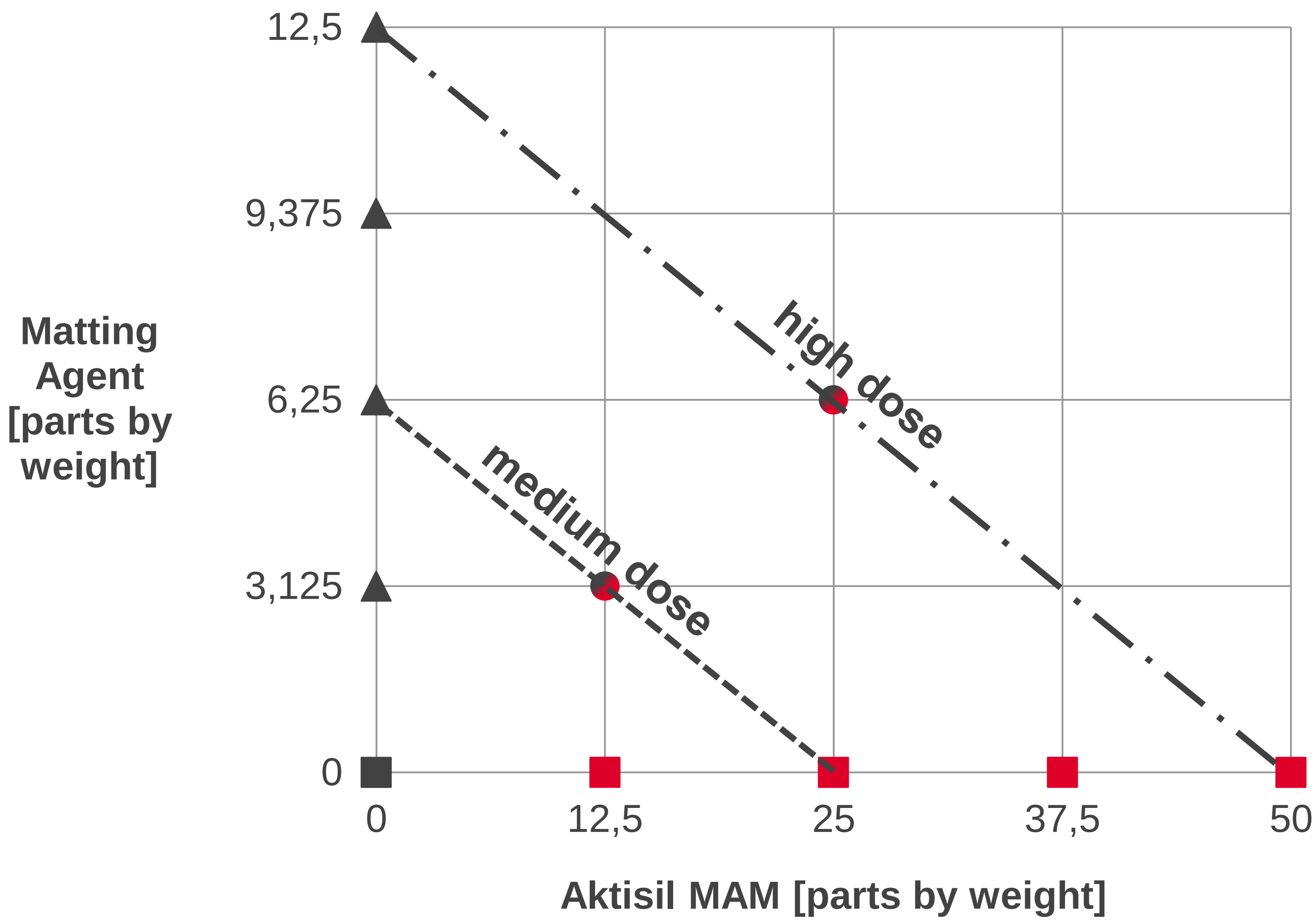
Filler Characteristics

	Matting Agent	Aktisil MAM
Mineral Description	Silica Gel	Neuburg Siliceous Earth
Composition (approx.)	SiO_2	88 % SiO_2 8 % Al_2O_3
Grain Shape	corpuscular aggregates, highly porous	corpuscular aggregates and lamellar
Particle Size d_{50} [µm]	4	4
Particle Size d_{97} [µm]	12	18
BET Surface [m²/g]	400	11
Functionalisation	none	Methacrylic

Base Formulation

	Parts by weight
Ebecryl 294	65.0
HDDA	30.0
Benzophenone	3.0
Omnirad 1173	2.0
Byk 088	0.3
Matting Agent	variable X
Aktisil MAM	variable Y
Total	100.3 + X + Y

Test Design



Matting Agent [parts by weight]
12,5
9,375
6,25
3,125
0
0
12,5
25
37,5
50
high dose
medium dose
Aktisil MAM [parts by weight]

Test Design Examples

Dosage			Parts by weight
„none“			0
„medium“	Matting Agent		6.25 or
	Aktisil MAM		25.0 or
	Combination:	Matting Agent and Aktisil MAM	3.125 and 12.5
„high“	Matting Agent		12.5 or
	Aktisil MAM		50.0 or
	Combination:	Matting Agent and Aktisil MAM	6.25 and 25.0

Testing

Viscosity:
Rotation viscometer MC 1 (Anton Paar), at 23 °C

Curing:
Mercury UV lamp at 80 W/cm; speed 15 m/min; two passes

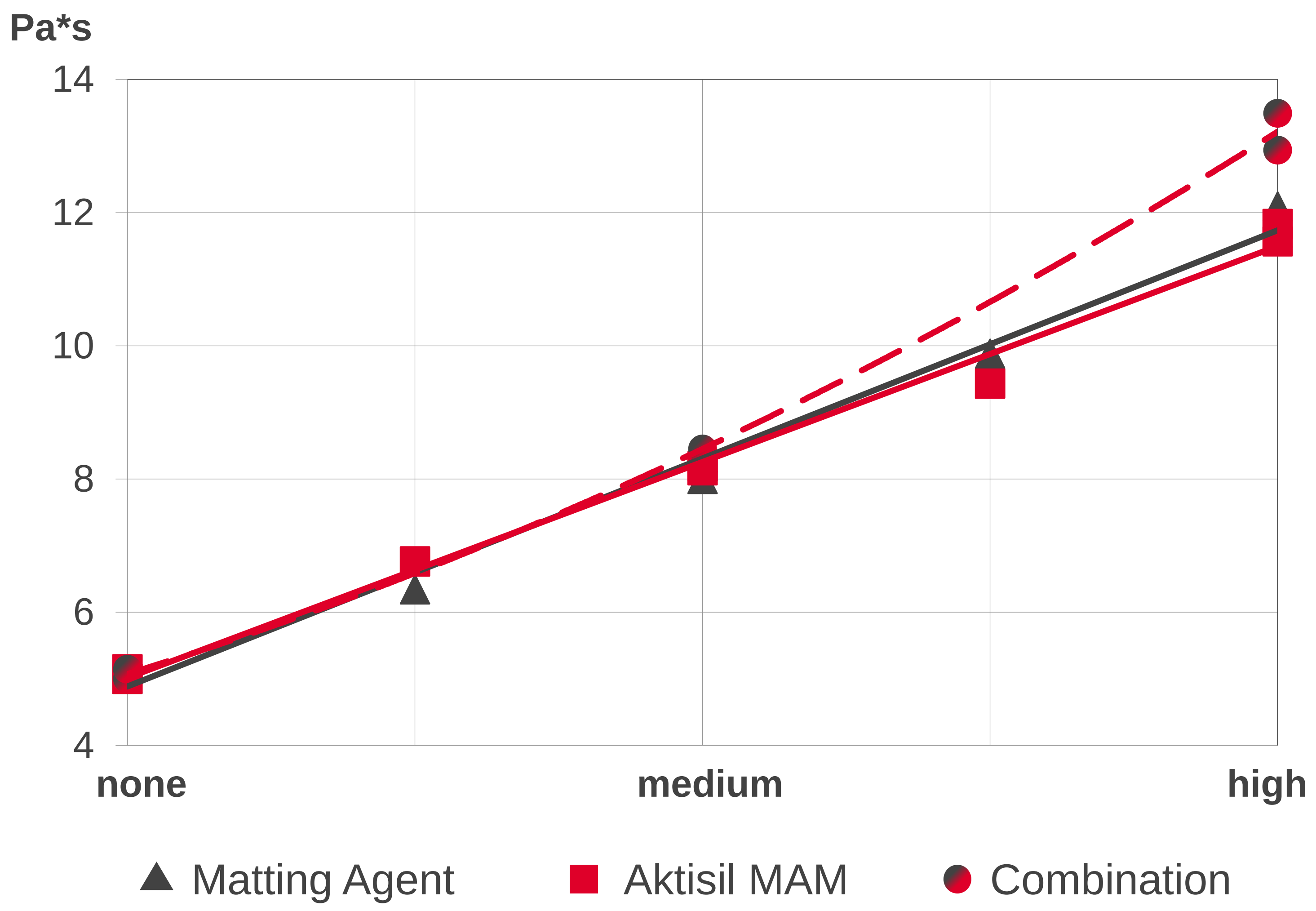
Gloss:
Erichsen Mini-Glossmaster (60° angle); 40 µm dry film thickness

Color Shift of Film:
The color value b* (Cielab Color system) of the film was measured on a white substrate with a Luci 100 color meter; dry film thickness 40 µm.
The color shift Δb* is the difference between the measured value and the color value b* of the formulation without filler; the higher the number, the more yellowish.

Abrasion Resistance:
Tested with a Taber Abraser with S 42 sanding strips at a load of 0.5 kg. The abrasion loss was determined after 100 revolutions at a speed of 55 rpm by weighing the specimen and calculating the volume loss (considering the different densities).

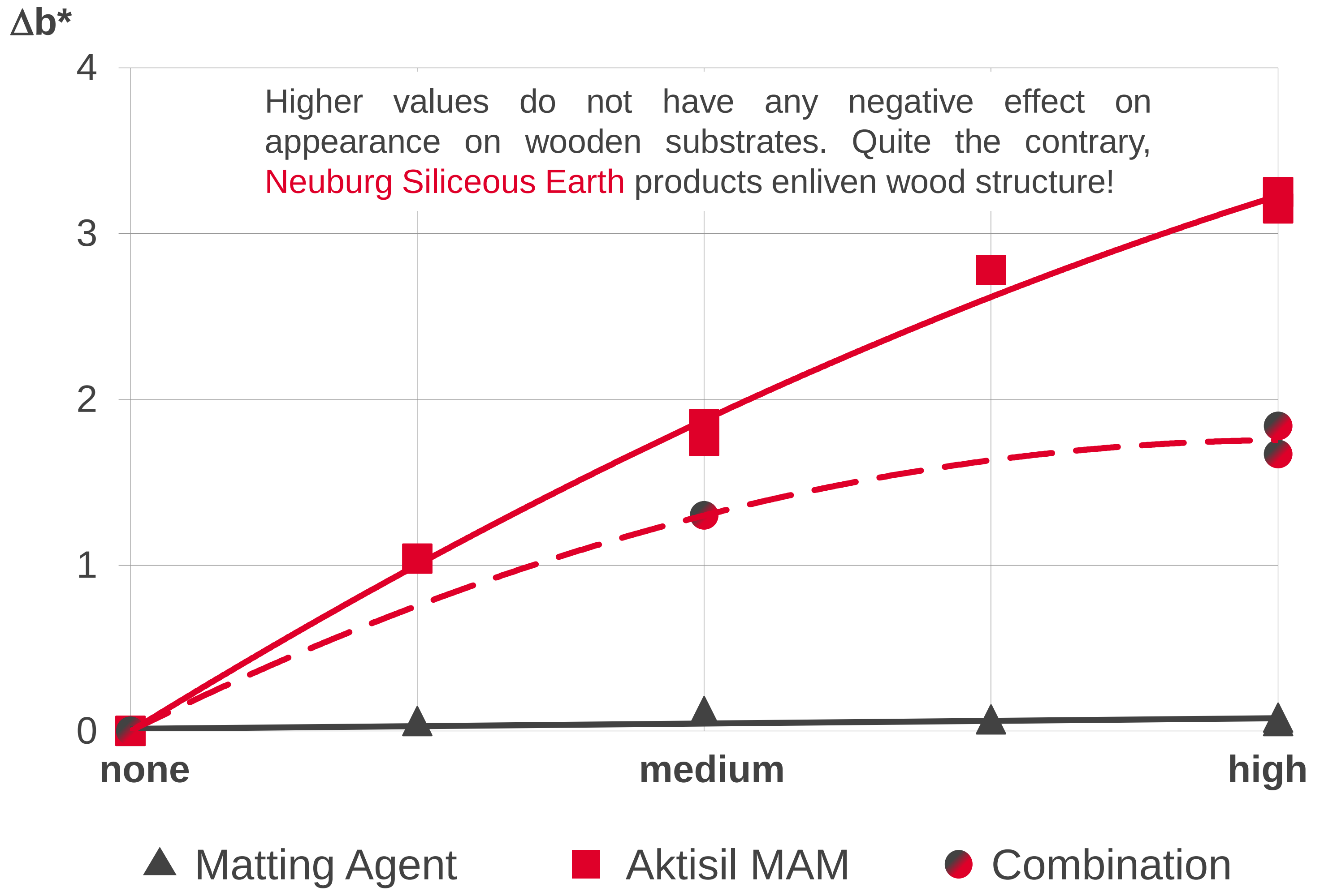
Viscosity

at 500 s^{-1}



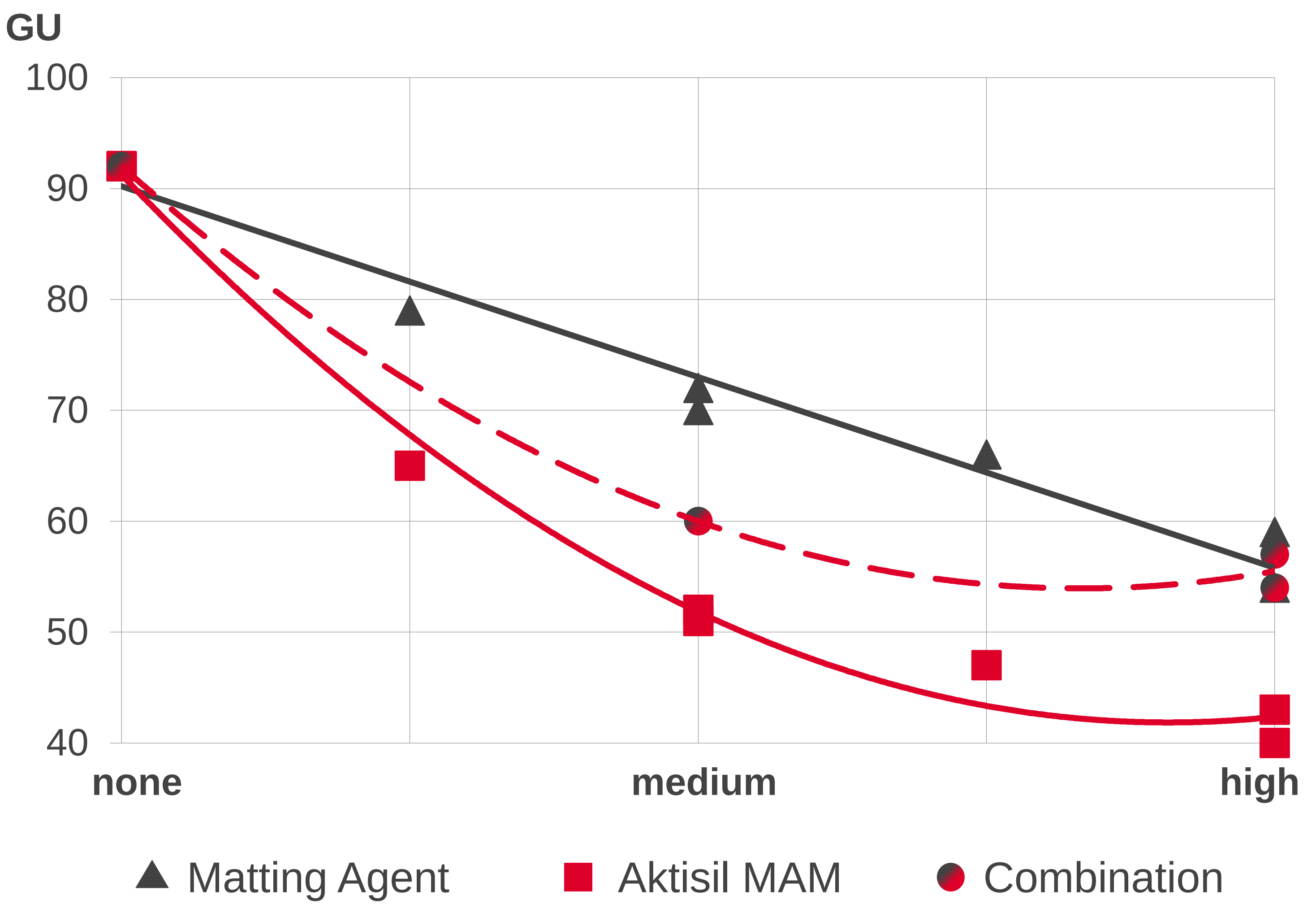
Color Shift

DFT 40 µm on white substrate



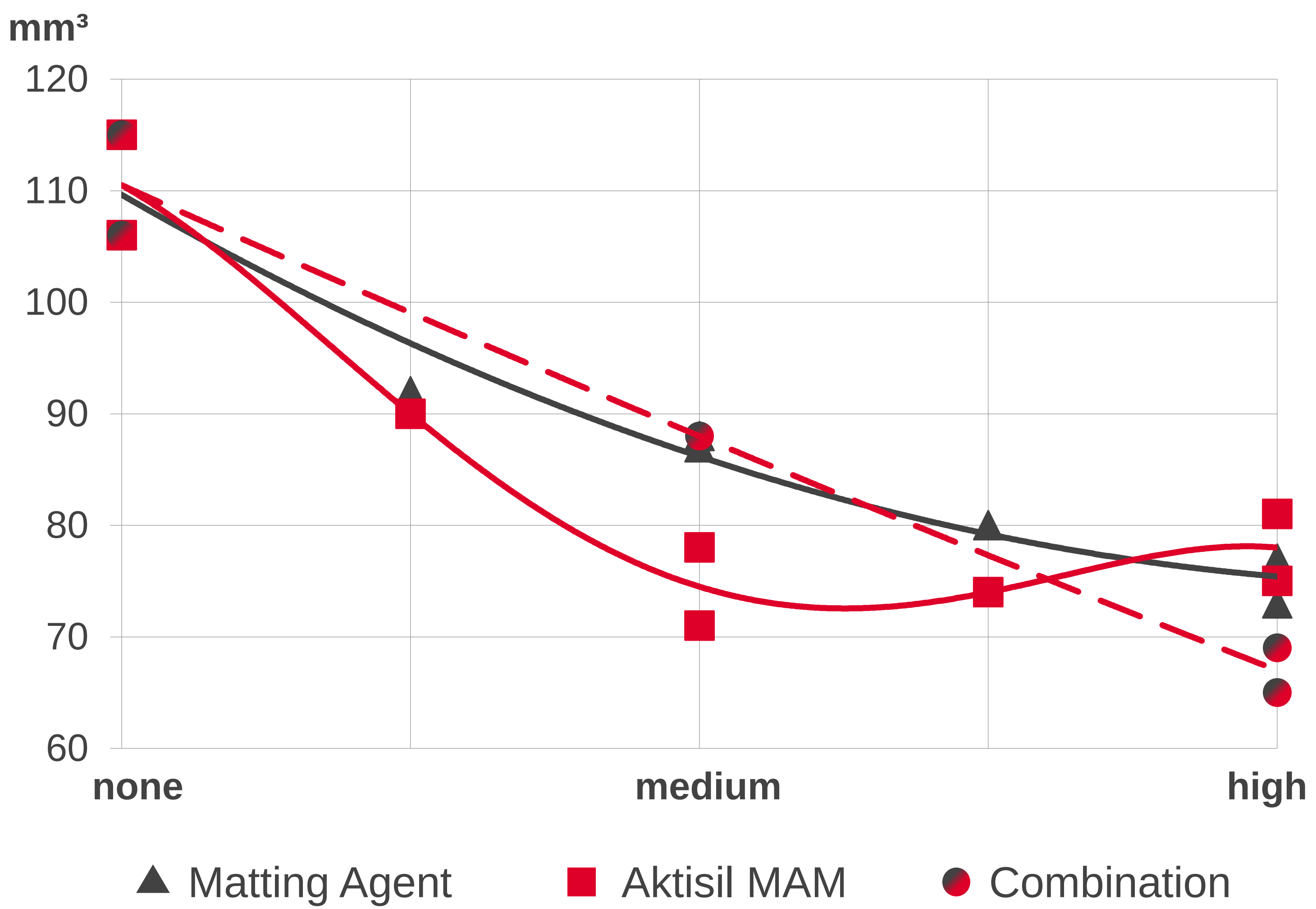
Gloss

60°, DFT 40 µm



Abrasion Loss

Taber S 42 0.5 kg; 55 rpm; 100 revolutions



Formulation Cost Index

per liter (Germany)

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PART 1: SURFACER

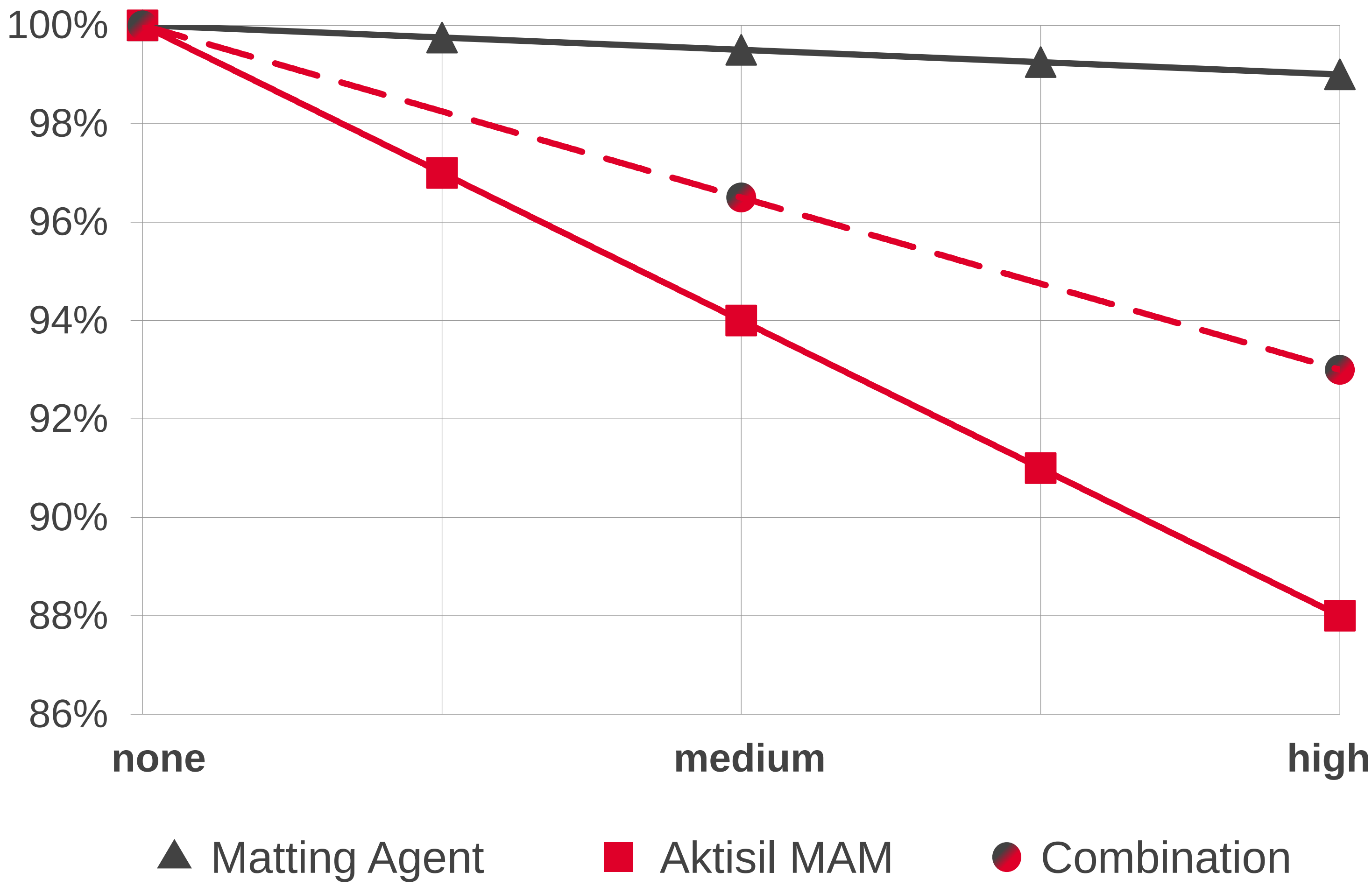
PART 2: TOP COAT

INTRODUCTION

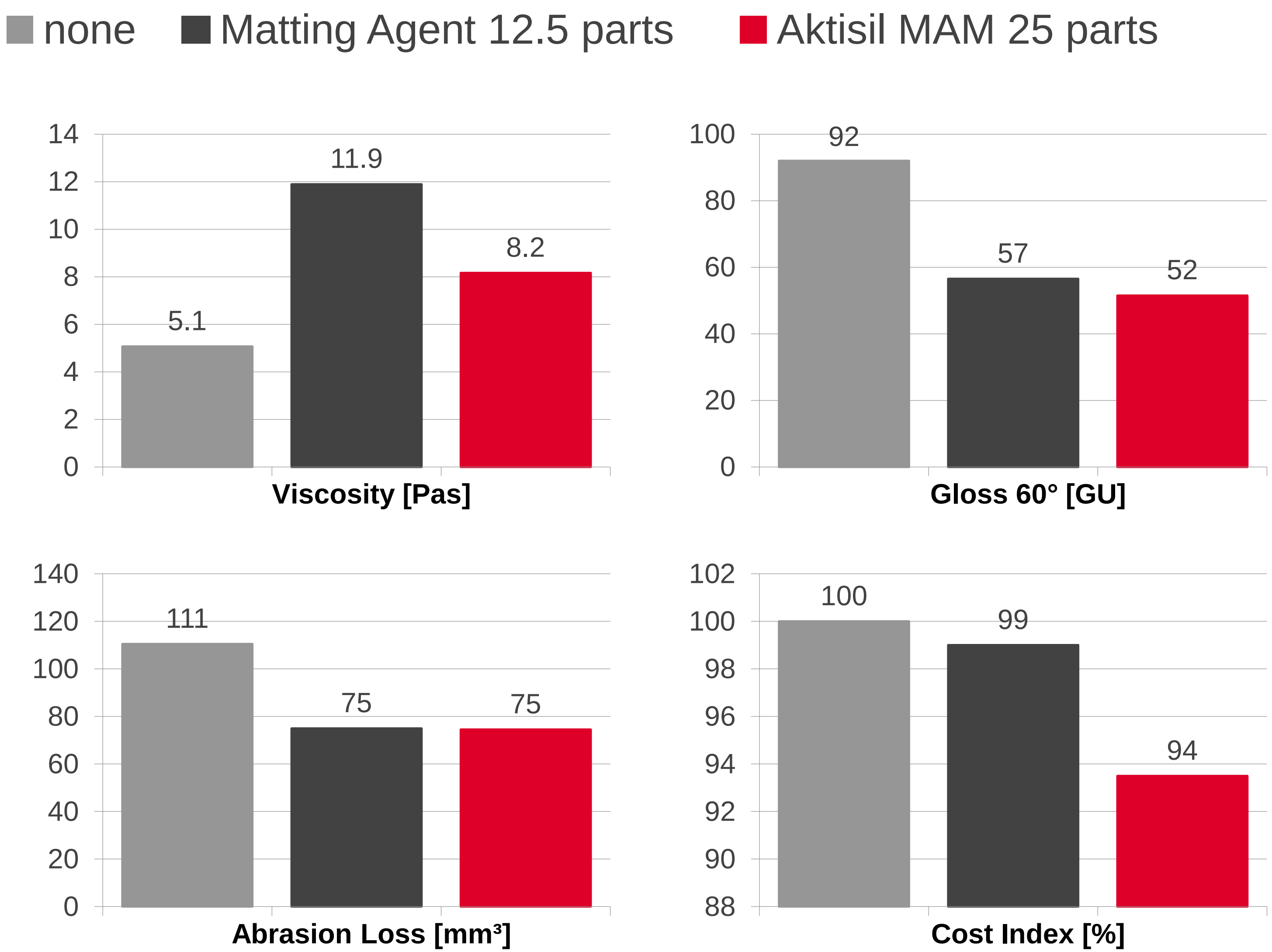
EXPERIMENTAL

RESULTS

SUMMARY



Benchmarking
Aktisil MAM vs. Matting Agent



Summary

The Neuburg Siliceous Earth grades Sillitin V 88, Sillitin Z 89 and the surface treated Aktisil MAM show excellent optical and mechanical properties in UV-curing wood coating systems.

Surfacer:

Neuburg Siliceous Earth fillers result in very low abrasion loss and do not impair mechanical sanding characteristics.

Rheological behaviour (yield point) can be controlled precisely by combining Sillitin V 88 with Aktisil MAM.

Top Coat:

Aktisil MAM achieves good matting with only a moderate increase in viscosity and low abrasion loss.

The excellent cost-performance ratio complements the overall result.

We supply material for good ideas!

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