Neuburg Siliceous Earth

in soft feel coatings

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1 Introduction

Neuburg Siliceous Earth (NSE) has been recommended for pigmented Hydro Soft Feel Coatings for many years. By using this NSE mineral, the haptics as well as the optical and mechanical properties of the coating can be maintained or even improved.

Since 2018, no more binders are produced with the co-solvent NMP (N-methyl-2-pyrrolidone) from Covestro. Therefore, the aim of this study is to consider whether the already known advantageous properties of Neuburg Siliceous Earth can also be found in the new, NMP-free binder generation.

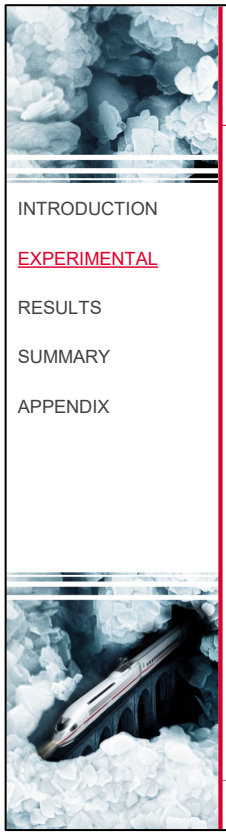
The commercially available matting agents, which are also used in transparent systems, are very cost-intensive. Therefore, the question arises whether the calcined Neuburg Siliceous Earth can also be used as a partial substitute for the matting agents in transparent Hydro Soft Feel coatings, thus achieving a positive effect on formulation costs with at least the same property profile.

2 Main study 2 K PU Hydro Clear Coat

2.1 Formulations and characteristics

The ingredients of the A-component are listed in *Fig. 1*. Bayhydrol U 2757 is an aliphatic, hydroxy-functional polyurethane dispersion and is responsible for crosslinking and hardness in the coating. Bayhydrol UH 340/1 is an aliphatic, anionic polyurethane dispersion and is used for the soft feel effect. The additives Tego-Wet KL 245 and BYK 348 are used for substrate wetting, Aquacer 513 for surface protection.

The focus in this study is on the matting agents, Decosoft transparent 7D, a PU polymer and Acematt 3300, a fumed silica treated with a special polymer. Both matting agents are supposed to be partially replaced by the filler Aktifit PF 115.



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Base Formulation, Component A

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	Description	[%]
Bayhydrol U 2757	Polyurethane dispersion	30.5
Bayhydrol UH 340/1	Polyurethane dispersion	39.7
Water, demineralized	Solvent	9.8
Lucrafoam DNE 01	Defoamer	0.2
Tego-Wet KL 245 (50 % in water)	Additive (substrate wetting)	0.4
BYK 348	Additive (substrate wetting)	0.6
Aquacer 513	Additive (surface protection)	1.6
Decosoft transparent 7 D	Matting agent PU polymer	7.4
Acematt 3300	Matting agent thermal silica	3.0
Total (Component A)		**93.2**

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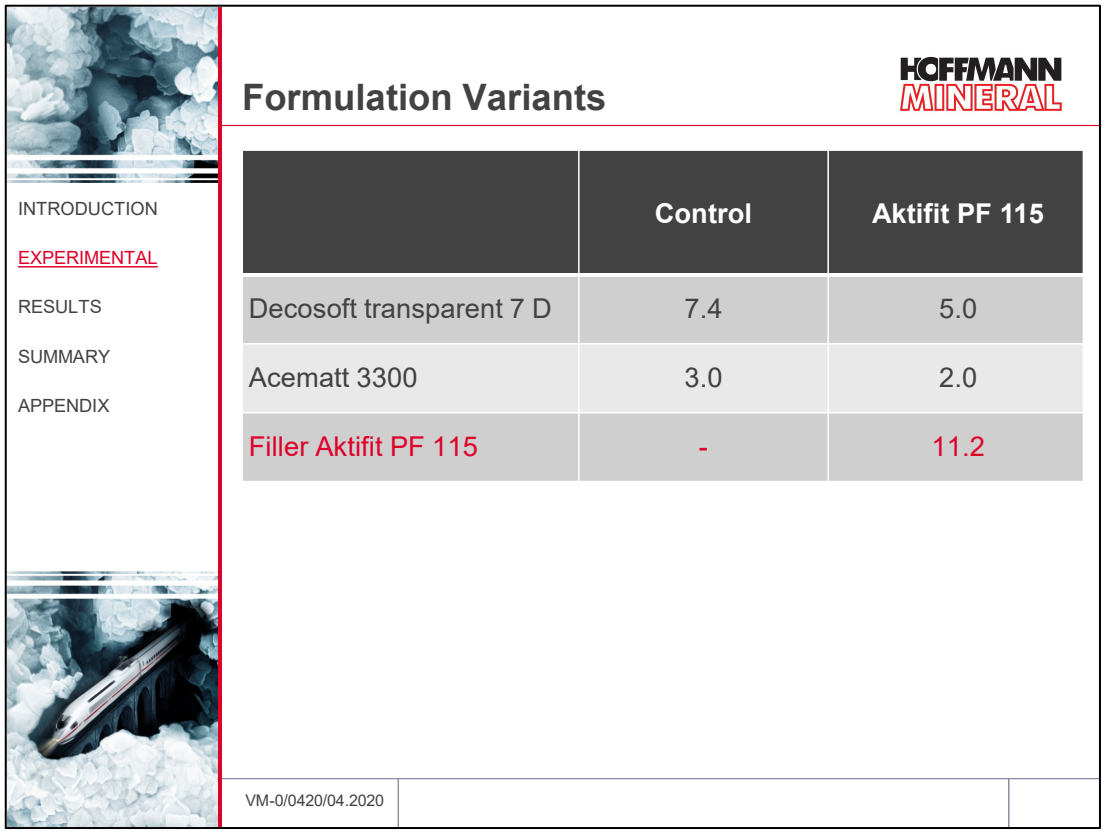
Fig. 1

For the control, the amount of the two matting agents were maintained as indicated in the base formulation. The Decosoft transparent 7 D was used with 7.4 parts and the Acematt 3300 with 3 parts.

The formulation variation with Aktifit PF 115 was carried out with a reduced content of the matting agent. The Decosoft transparent 7 D was used with a decreased proportion of 5 parts, the Acematt 3300 was minimized to 2 parts. Therefore, Aktifit PF 115 was implemented overproportionally with 11.2 parts (*Fig. 2*).



	Control	Aktifit PF 115
Decosoft transparent 7 D	7.4	5.0
Acematt 3300	3.0	2.0
Filler Aktifit PF 115	-	11.2

Fig. 2

The higher than average filler content in the Aktifit PF 115 filled formulation results in 101 parts for the A component in contrast to the control with only 93.2 parts.

The A component was mixed with the B component, consisting of a 70:30 mixture of the two aliphatic polyisocyanates Desmodur ultra N 3600 and Bayhydur XP 2655, 75 % in 1-methoxy-2-propylacetate.

Afterwards, the formulations were diluted with demineralized water to a flow time of about 30 seconds in the ISO 5 mm cup (*Fig. 3*).

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Formulation Variants
Component A+B

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	Description	Control	Aktifit PF 115
Component A		93.2	101
Component B Desmodur ultra N 3600/ Bayhydur XP 2655 70 : 30; 75 % in 1-methoxy-2-propylacetate	HDI-Polyisocyanates	6.8	6.8
Dilution with demineralized water to a flow time of approx. 30 s in ISO 5mm cup		2.1	3.6
Total (Component A+B)		**102.1**	**111.4**

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Fig. 3

The characteristic values of the two matting agents Decosoft transparent 7 D and Acematt 3300 can be found in *Fig. 4*.

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Matting Agent Characteristics

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	Decosoft transparent 7 D	Acematt 3300
Description	polyurethane polymer	thermal silica
Particle size d_{50} [µm]	6 - 9	8.5 – 11.5
Oil absorption [g/100g]	40 - 80	not specified
BET [m²/g]	n.a.	170 - 210
Density [g/cm³]	1.05	approx. 2
Surface treatment	none	polymer treated

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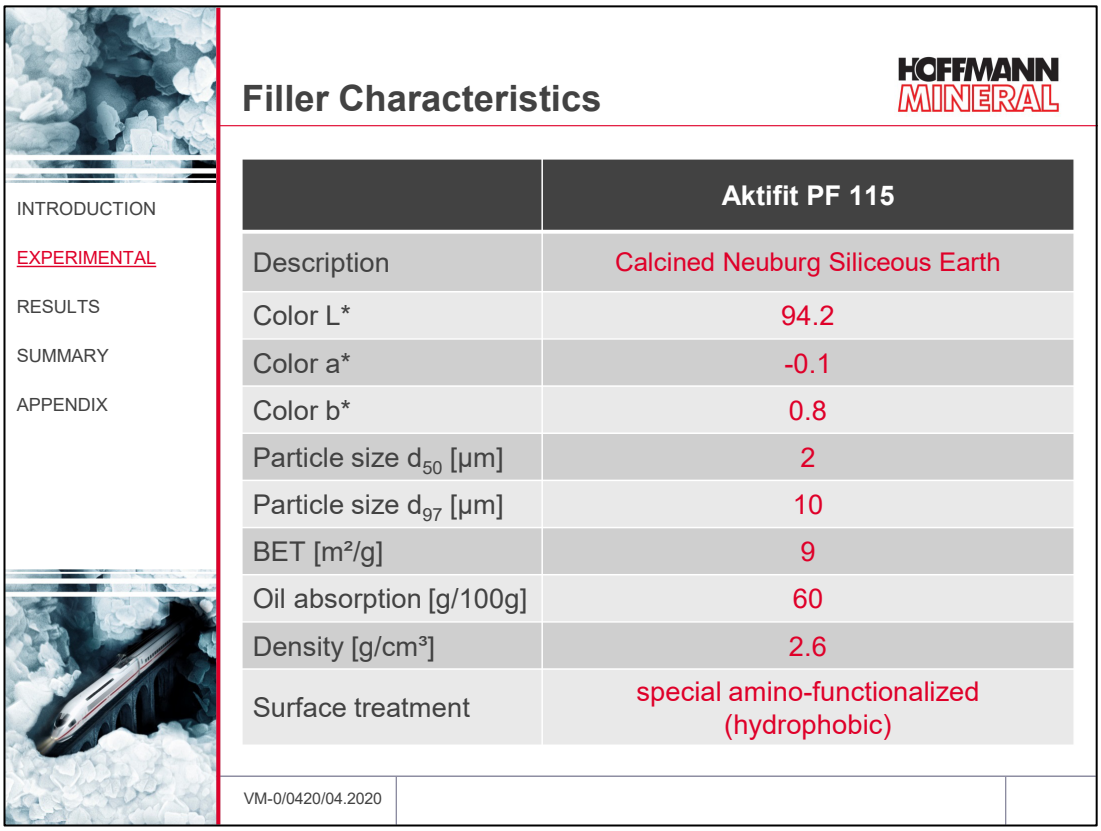
Fig. 4

The classic Neuburg Siliceous Earth is a natural combination of corpuscular Neuburg Silica and lamellar kaolinite; a loose mixture impossible to separate by physical methods. As a result of natural aging, the silica portion exhibits a round grain shape and consists of aggregated primary particles of about 200 nm diameter. This unique structure is responsible for a relatively high specific surface area and oil absorption.

Aktifit PF 115 is a calcined Neuburg Siliceous Earth, which offers highest brightness and color neutrality due to the calcination process. In addition, the surface has been treated with a special amino functional group, resulting in a strong hydrophobicity. The filler characteristics are shown in *Fig. 5*.



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Filler Characteristics

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	Aktifit PF 115
Description	Calcined Neuburg Siliceous Earth
Color L*	94.2
Color a*	-0.1
Color b*	0.8
Particle size d_{50} [µm]	2
Particle size d_{97} [µm]	10
BET [m²/g]	9
Oil absorption [g/100g]	60
Density [g/cm³]	2.6
Surface treatment	special amino-functionalized (hydrophobic)

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Fig. 5

2.2 Preparation / application / curing

The preparation of the A-component was on the Scandex shaker by the use of glass beads. Aktifit PF 115 and Decosoft were grinded until a grain fineness of < 10 µm was achieved. Afterwards the Acematt 3300 was only stirred in.

The application was carried out with a air spray gun with a nozzle diameter of 1.2 mm and a pressure of 2.1 bar.

The coatings were applied on black Bayblend T 65 XF sheets (polycarbonates/acrylonitrile butadiene styrene) and on Makrofol (polycarbonate-based transparent extrusion foil) with a dry film thickness of approx. 50 µm. The coated test specimens were first dried for 10 minutes, followed by forced drying for 30 minutes at 80 °C and 4 hours at 60 °C. They were then stored for 7 days at 23 °C and 50 % relative humidity before the tests were performed.

2.3 Color and gloss

For evaluating the transparency of the clearcoat, the black Bayblend plate with the Soft Feel Coating was measured.

Fig. 6 shows the color values L* and b* of the clearcoat over a black surface. The formulation filled with Aktifit PF 115 is somewhat less transparent and appears slightly milkier than the control, which is expressed by a marginally increased brightness value L*. This is due to the very high filler volume and can be adjusted, if necessary, via the concentration. In this report, the maximum possible filler content of 11.2 parts is depicted. This can be reduced to 5 to 8 parts if the highest demands on the optical level should be required.

Aktifit PF 115, on the other hand, results in a lower b* value, which means an increase of the blue components and thus giving the impression of a deeper black.

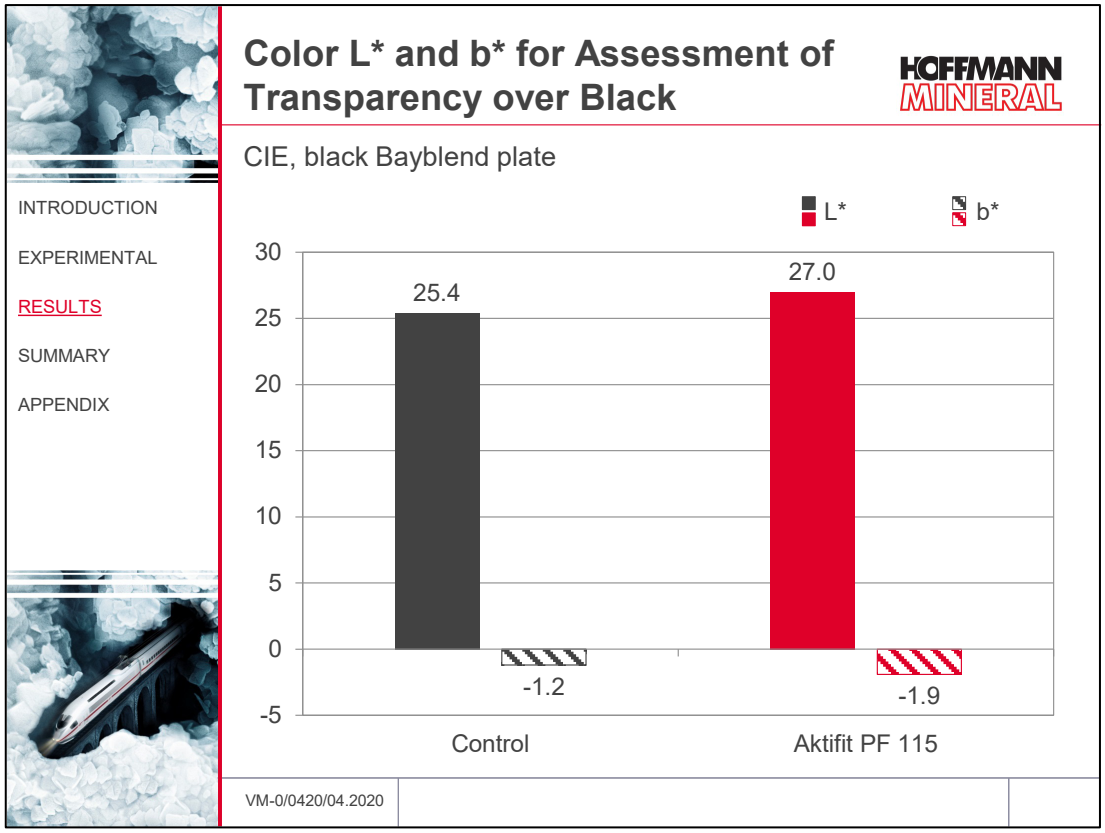


Fig. 6

For evaluating the color shift, the coated transparent Makrofol foil was placed on a contrast board and measured it over white (*Fig. 7*). Both color values L* and b* are in an absolutely comparable range, i.e. the control and the Aktifit PF 115 filled formulation show an identical color shift over white.

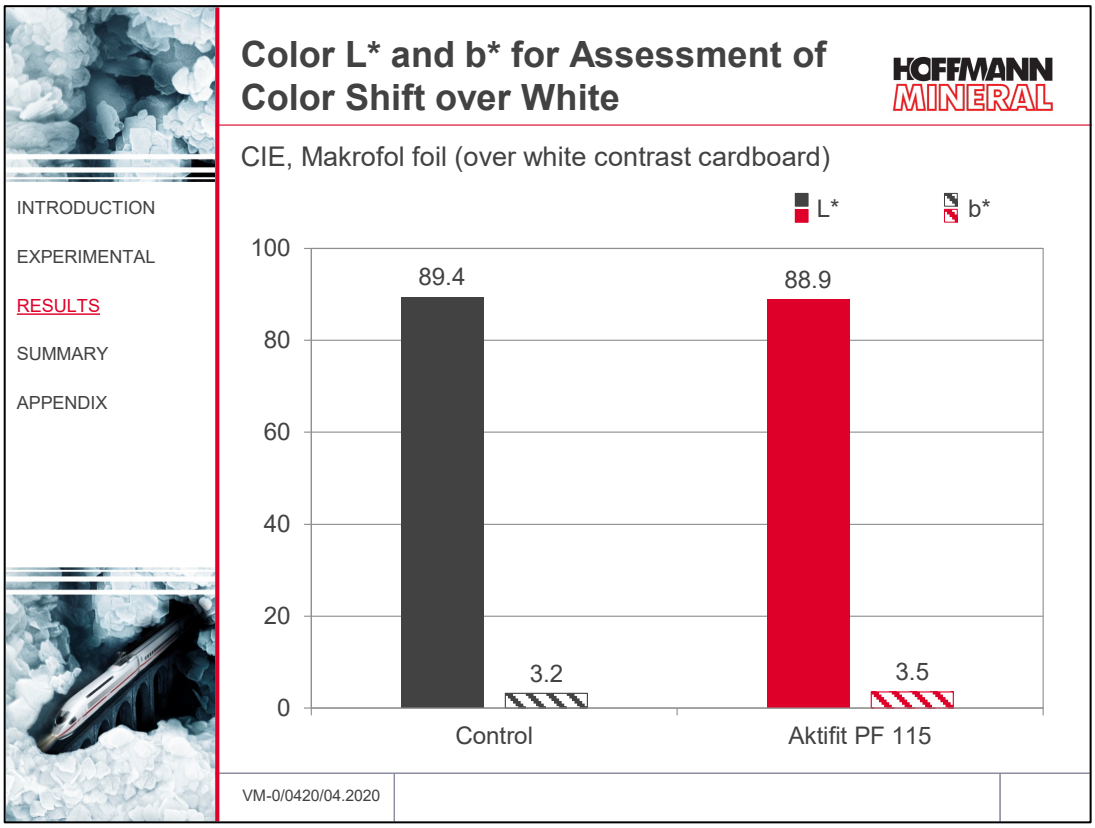


Fig. 7

For evaluation of the gloss, the 60° and 85° gloss according to DIN EN ISO 2813 was measured on the black Bayblend plates (*Fig. 8*). The gloss at the 60° angle is well comparable for the control and the Aktifit PF 115 with 1.5 to 1.6 GU, at the 85° angle the control has 5.0 GU and the Aktifit PF 115 7.4 GU. A gloss value of less than 10 GU corresponds according to the standard to a matt coating.

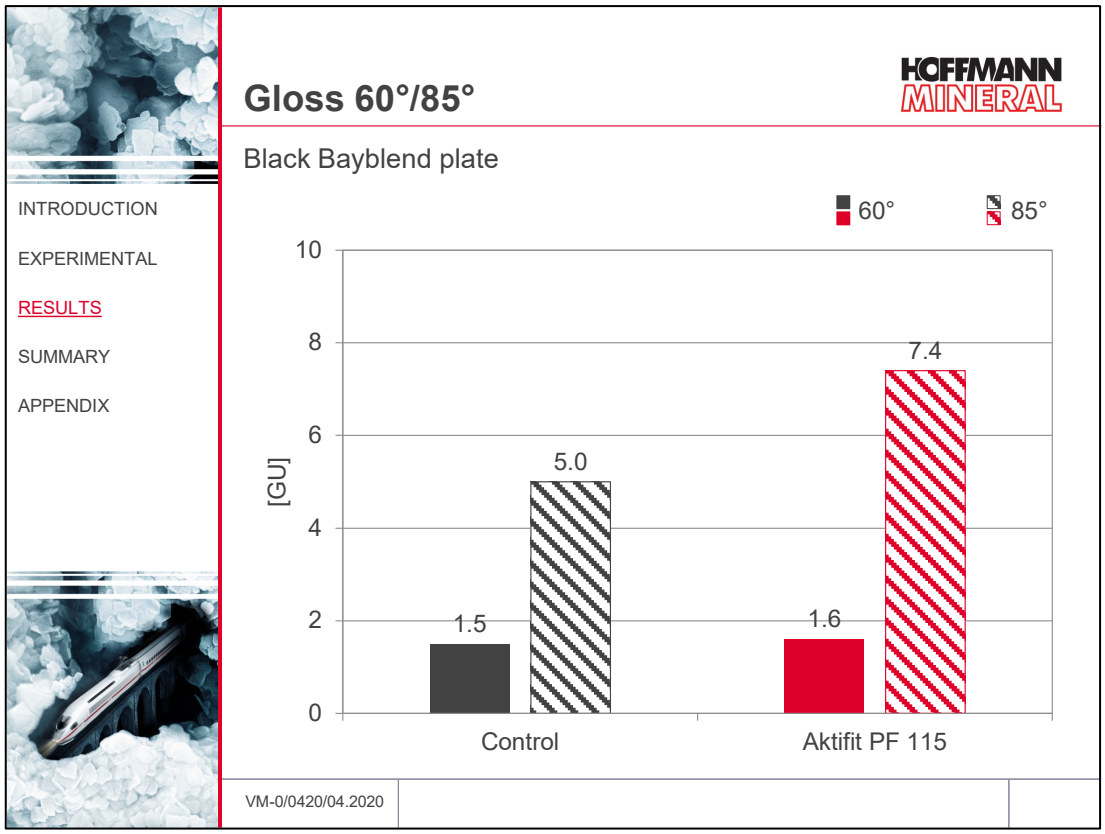


Fig. 8

2.4 Adhesion

Adhesion was determined by cross cut test (2 mm) according to DIN EN ISO 2409 (*Fig. 9*). The coating with Aktifit PF 115 has a better adhesion than the control. After the cross cut test, significantly less coating peels off at the edges with the Aktifit PF 115 than with the control. The cross cut characteristic value of the Aktifit PF 115 is therefore GT 1-2, the control achieves only GT 3.

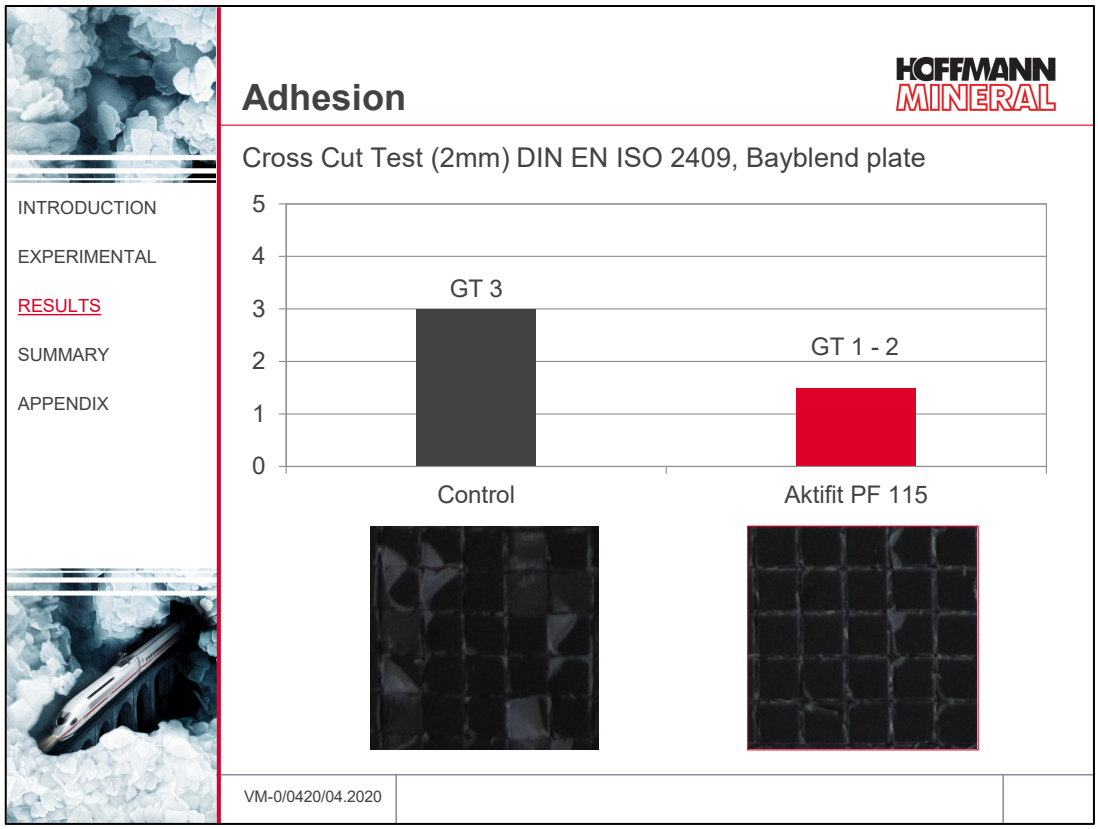


Fig. 9

2.5 Resistance tests

The following resistance tests relevant in the field of soft feel coatings were carried out on the Bayblend panels:

Solvent resistance:
The test substances listed below were dripped onto the coating and left there to affect for 1 minute. After this exposure time, the chemicals were wiped off and the surface was immediately assessed visually.
Test substances: Super petrol, methoxypropyl acetate, xylene, ethyl acetate, ethanol, water
→ no differences between control and Aktifit PF 115.

Suntan resistance:
The test substances listed below were applied onto the coating for 4 hours at 70 °C and for 4 hours at room temperature. After the entire exposure time, the cream was removed again and the adhesion was determined immediately by cross cut test and the Erichsen hardness test pencil type 319 (0.75 mm tip, loading of 10 and 20 N).
Test substances: Kamill classic Hand&Nail Cream, VW Hand Cream, VW Suntan lotion
→ hardly any differences between control and Aktifit PF 115 for the first two test substances.

When exposed to suntan lotion, however, Aktifit PF 115 tends to show better adhesion.

GM test:
0.05 g of a mixture of hand cream, sun cream, lotion and insect repellent is dripped onto the coating and then placed in the oven for 1 hour at 80 °C. After cooling down, the mixture is washed off with a soap solution and the surface is visually assessed and a scratch hardness test is carried out with a 1 mm needle and a loading of 8 N.
→ no tearing of the coating with the control and Aktifit PF 115.

Resistance to hydrolysis:
The coated sheets are stored for 72 hours at 90 °C and 90 % relative humidity. After conditioning for 1 hour at room temperature, pencil hardness and adhesion by cross cut test are determined.
→ no differences between control and Aktifit PF 115.

2.6 Costs

By partially replacing the cost-intensive matting agents Decosoft transparent 7 D and Acematt 3300 with the filler Aktifit PF 115, the formulation costs can be significantly reduced. Compared to the control with the full matting agent content, the modification with Aktifit PF 115 can save 20 % of the costs (*Fig. 10*).

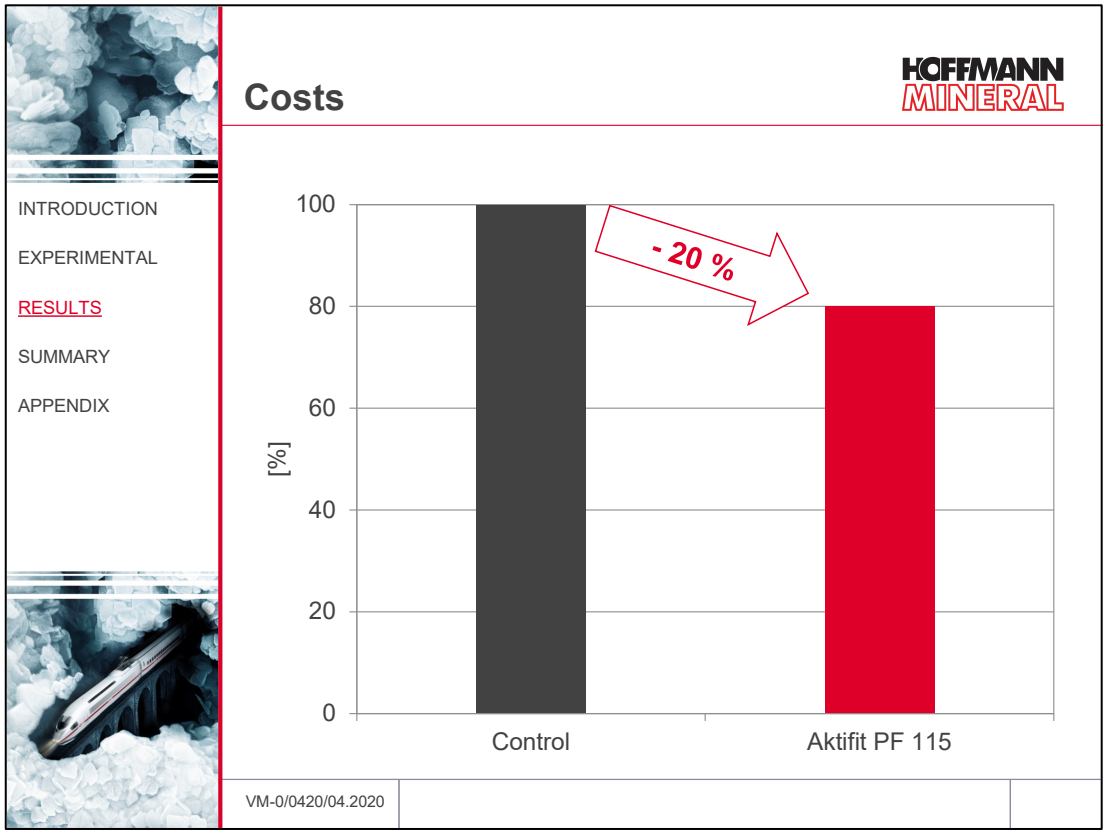


Fig. 10

3 Summary

Aktifit PF 115 can be used in transparent Hydro Soft Feel coatings as a partial replacement of the commercially available matting agents, it is ideally suited for the new, NMP-free binder generation.

- The optical properties as well as the resistance to various substances are largely retained

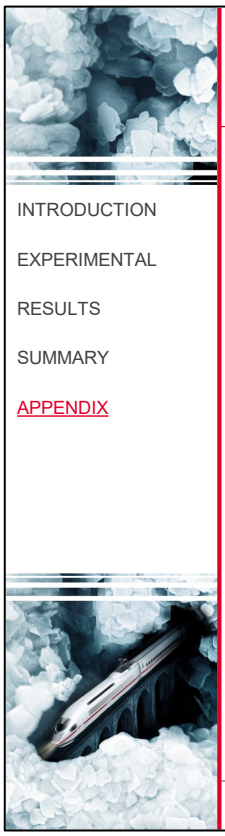
+ The adhesion is slightly improved by the use of Aktifit PF 115, even after testing the suntan lotion resistance

+ This results in a cost reduction potential of up to 20%

Our technical service suggestions and the information contained in this report are based on experience and are made to the best of our knowledge and belief, but must nevertheless be regarded as non-binding advice subject to no guarantee. Working and employment conditions over which we have no control exclude any damage claims arising from the use of our data and recommendations. Furthermore, we cannot assume any responsibility for any patent infringements which might result from the use of our information.

4 Appendix guide formulations

The appendix contains soft feel guide formulations with Neuburg Siliceous Earth for aqueous 1K (*Fig. 11*) and 2K systems (*Fig. 12 and 13*) as well as solvent-based 2K systems (*Fig. 14 and 15*) and one transparent, UV-curing formulation for wood (*Fig. 16*).



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1K Soft Feel lacquer, water-based, black

HOFFMANN MINERAL

Covestro PCO-0059SF	Description	[%]
Bayhydrol UH 340/1	Polyurethane dispersion	34.2
Bayhydrol UH 650	Polyurethane dispersion	27.9
Water, demineralized	Solvent	15.4
Lucrafoam DNE 01	Defoamer	0.2
Tego-Wet KL 245 (50 % in water)	Additive (substrate wetting)	0.3
BYK 348	Additive (substrate wetting)	0.4
Aquacer 535	Additive (surface protection)	1.1
SILLITIN Z 86	Filler	4.1
Talkum IT extra	Filler	3.2
Bayferrox 318 M	Pigment	11.0
Acematt OK 412	Matting agent	2.2
Total		**100**

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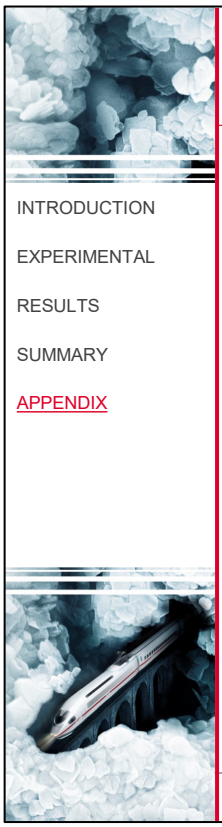
Fig. 11



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2K Soft Feel lacquer, water-based, black, Component A

HOFFMANN MINERAL

Covestro PCO SF 0042-TC	Description	[%]
Bayhydrol U 2698	Polyurethane dispersion	26.2
Bayhydrol UH 340/1	Polyurethane dispersion	34.0
Water, demineralized	Solvent	18.2
Lucrafoam DNE 01	Defoamer	0.2
Tego-Wet KL 245 (50 % in water)	Additive (substrate wetting)	0.3
BYK 348	Additive (substrate wetting)	0.5
Aquacer 513	Additive (surface protection)	1.3
SILLITIN Z 86	Filler	4.6
Talkum IT extra	Filler	3.7
Kremer Color Paste-Black	Pigment	3.9
Acematt 3300	Matting Agent	2.5
Total (Component A)		**95.4**

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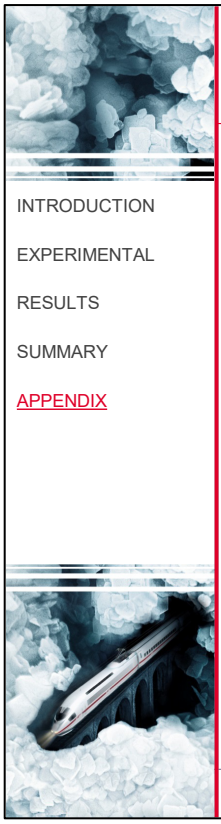
Fig. 12



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2K Soft Feel lacquer, water-based, black, Component A+B

HOFFMANN MINERAL

Covestro PCO SF 0042-TC	Description	[%]
Component A		95.4
Component B Desmodur ultra N 3600 / Bayhydur XP 2655 (70 : 30) 75 % in 1-methoxy-2-propylacetate	Polyisocyanate	4.6
Total (Component A+B)		**100**

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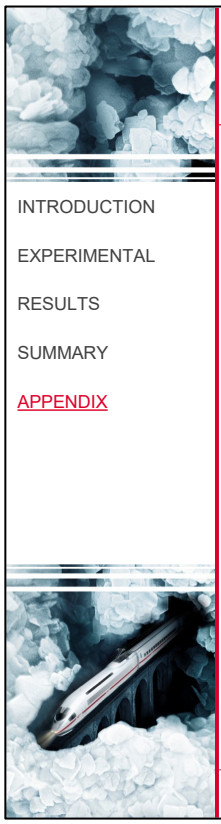
Fig. 13



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2K Soft Feel lacquer, water-based, pigmented, Component A

HOFFMANN MINERAL

Covestro PCO 0017e-SF B	Description	[%]
Desmophen 670, 75% in butyl acetate:xylene 1:1	Polyester	20.6
Desmophen 1652, 75% in butyl acetate:xylene 1:1	Polyester	20.6
Inorganic pigment	Pigment	13.5
SILLITIN Z 86 PURISS	Filler	6.2
Acematt OK 412 or Acematt TS 100	Matting agent	3.3
Bentone 38, 10% swelling	Rheological additive	3.4
Dibutyl-tin-dilaurate, 1% in butyl acetate	Catalyst	1.7
Butyl acetate:xylene 1:1	Solvents	30.7
Total (Component A)		**100**

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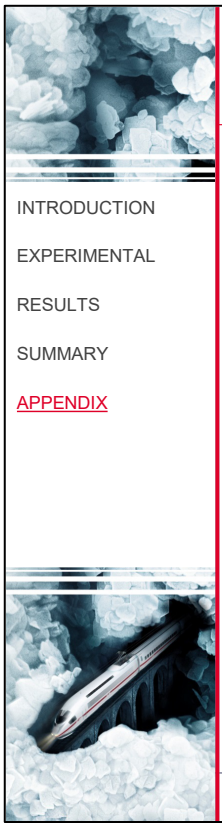
Fig. 14



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2K Soft Feel lacquer, water-based, pigmented, Component A+B

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Covestro PCO-0017e-SF B	Description	[%]
Component A		100
Component B Desmodur N 75 BA	Polyisocyanat	14
Total (Component A+B)		**114**

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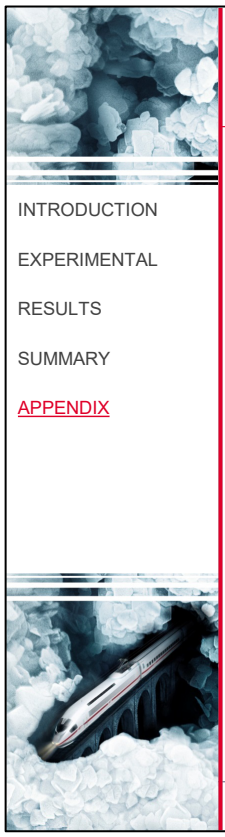
Fig. 15



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Soft Feel lacquer for wood, transparent, UV-curing

HOFFMANN MINERAL

Bayer Polymers FWO 4460-30	Description	[%]
Ebecryl 4491	Urethane acrylate	20.0
Ebecryl 4101	Urethane acrylate	20.0
Syloid ED 30	Matting agent amorphous silica	8.0
SILLITIN V 88	Filler	8.0
TPGDA	Reactive diluent	40.0
Omnirad 1173	Photoinitiator	4.0
Total		**100**

Fig. 16