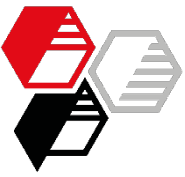


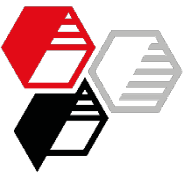
Water-based clear coat for wood, acrylics: Benefits of Neuburg Siliceous Earth

Author: Bodo Essen, Hubert Oggermueller



Content

- Introduction
- Experimental
- Results
 - Filler
 - Universal Multi Layer 1
 - Universal Multi Layer 2
- Summary



Status Quo

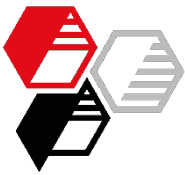
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- Need for alternatives to varnishes with very high VOC's i.e. Nitro cellulosics.
- Appropriate emulsion binders are suitable candidates.
- Quick drying and sandability, transparency and good wood warmth etc. are only some properties to match.
- The introduction of mineral filler should provide some additional improvements.



Objective

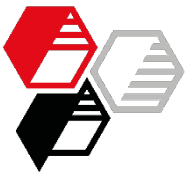
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- What are the benefits of introducing **Neuburg Siliceous Earth** into 1 C Acrylic emulsions for the use as clear coat onto wood?
- This investigation provides an approach based on
 - ✓ three different binders, non crosslinking and self-crosslinking.
 - ✓ formulations used as filler and for universal multi layer clear coat.
 - ✓ with different filler dosages and adaptations.



What is Neuburg Siliceous Earth?

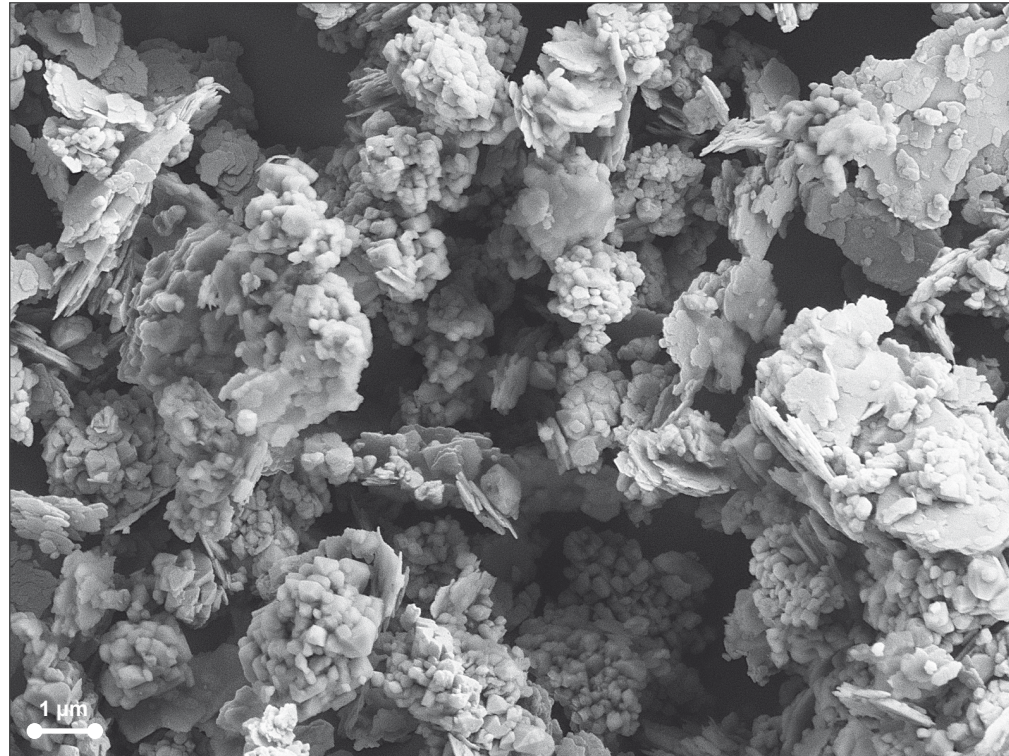
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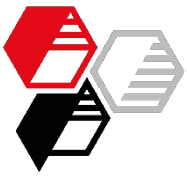
RESULTS

SUMMARY



A natural combination of corpuscular Neuburg silica and lamellar kaolinite: a loose mixture impossible to separate by physical methods.

The silica portion exhibits a round grain shape and consists of aggregated primary particles of about 200 nm diameter.



Morphology of Neuburg Siliceous Earth

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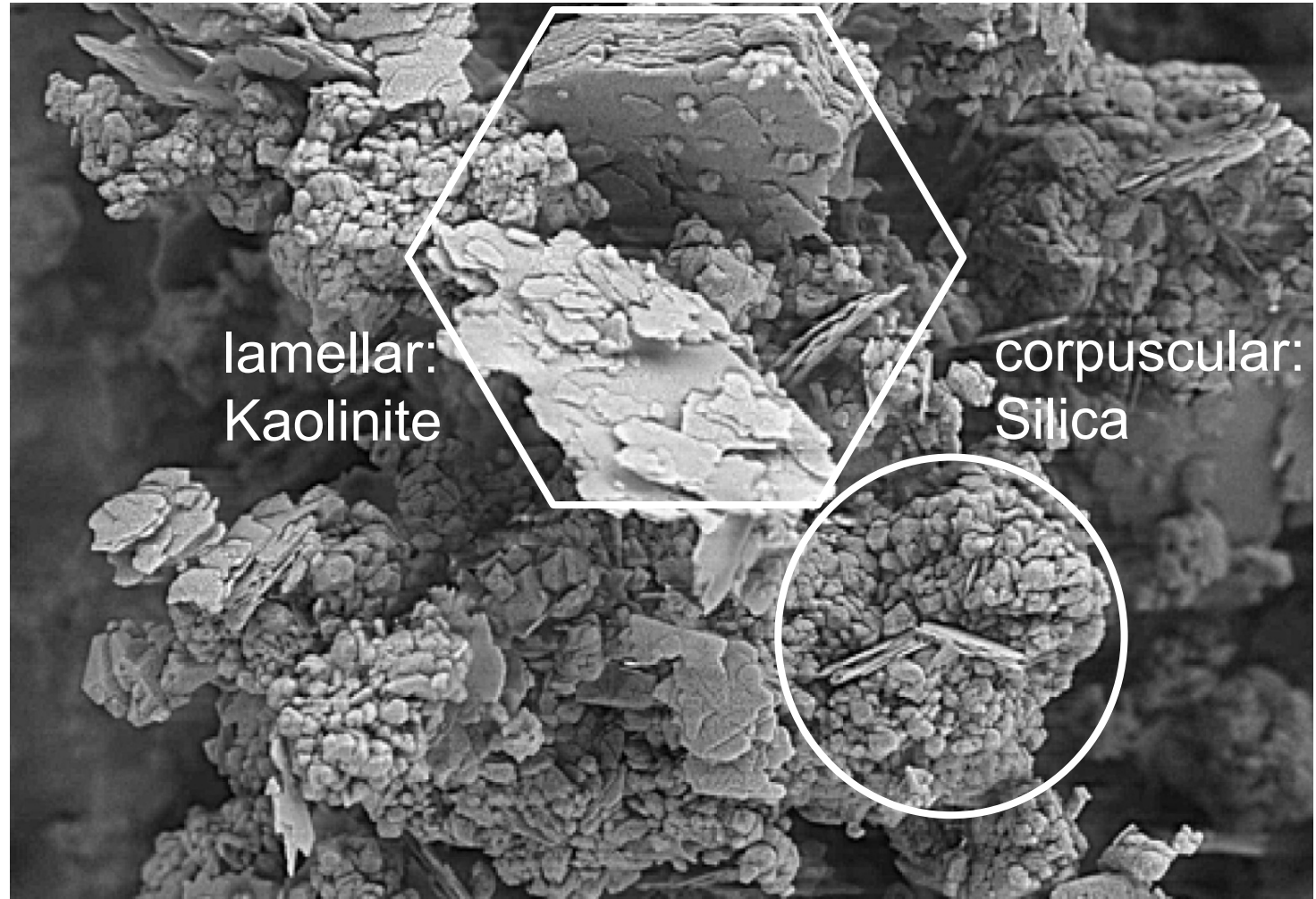
Magnification 10.000x

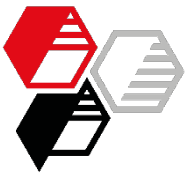
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Filler Characteristics

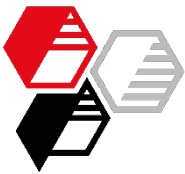
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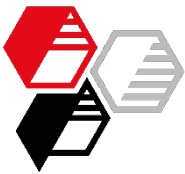
		Neuburg Siliceous Earth		
		Non surface treated		Surface treated
		Sillitin Z 89	Sillitin V 88	Aktisil MAM
Density	[g/cm ³]	2.6	2.6	2.6
Particle size d ₅₀	[μm]	1.8	4	4
Particle size d ₉₇	[μm]	8	18	18
Oil absorption	[g/100g]	55	45	45
Spezific surface area BET	[m ² /g]	11	8	7



Suitable Type of Filler?

Filler	PVC 25 %	DFT 60 µm	Black walnut	
Talc	Calcium carbonate natural	Barium sulfate natural	Kaolin	Neuburg Siliceous Earth





Acrylic Emulsions

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Wood Filler *

Alberdingk AC 31:
hydroxy-functional

MFFT 40°C, Tg 35°C
300 - 2000 mPas
relatively hard

Multi Layer 1*

Alberdingk AC 25381:
self-crosslinking
core-shell
MFFT 17°C, Tg 10/60°C
2000 - 8000 mPas
relatively soft

Multi Layer 2*

Alberdingk AC 2514:
self-crosslinking
MFFT 43°C, Tg 52°C
30 - 300 mPas
relatively hard

Process

- Drying
- Sanding
- Anti-Blocking

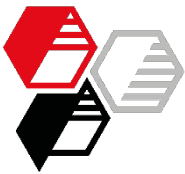
Appearance

- Transparency
- Gloss / Matting
- Wood warmth

Resistance

- Abrasion
- Water / Chemical
- Stains

* Base formulations by Alberdingk Boley



Filler Formulations

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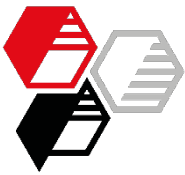
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	Control		Same solid volume	Neuburg Siliceous Earth
	%	pbw		pbw
Butyl glycol	7.7	5.0		5.0
Water demineralized	13.3	8.6	3. increased	
Tego Dispers 750 W	----	----	2. added	
Filler	----	----	1. added	20.0
Alberdingk AC 31	77.3	50.0		50.0
Byk 024	0.8	0.5		0.5
Rheovis PU 1214	0.9	0.6		0.6
Total	100.0	64.7		100.0
Solid content w/w	[%]	39.8		46.9
Solid content v/v	[%]	37.2	←————→	37.2
PVC	[%]	0		25.3



Sanding

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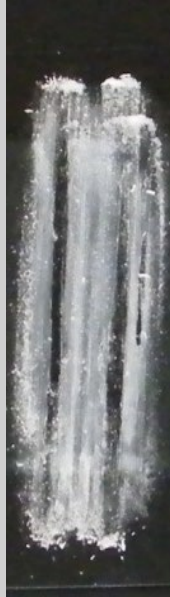
INTRODUCTION

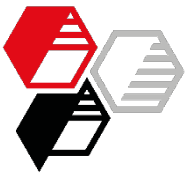
EXPERIMENTAL

RESULTS

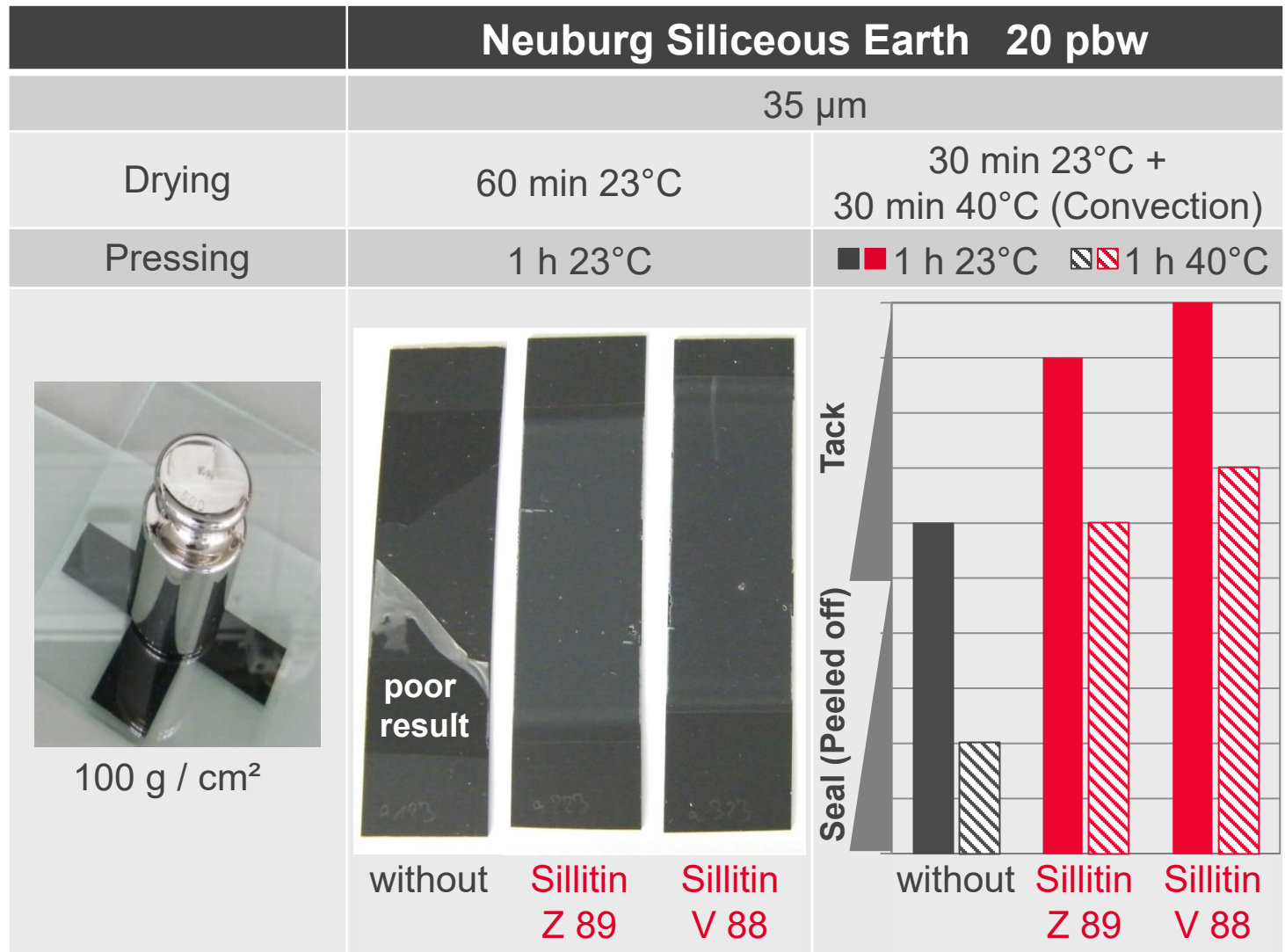
• Filler

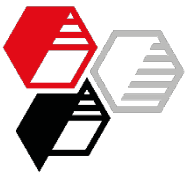
SUMMARY

		Neuburg Siliceous Earth 20 pbw					
		30 µm			60 µm		
		without	Sillitin Z 89	Sillitin V 88	without	Sillitin Z 89	Sillitin V 88
Drying		120 min	40 min	40 min	240 min	90 min	90 min
 50 double rubs							



Anti-Blocking

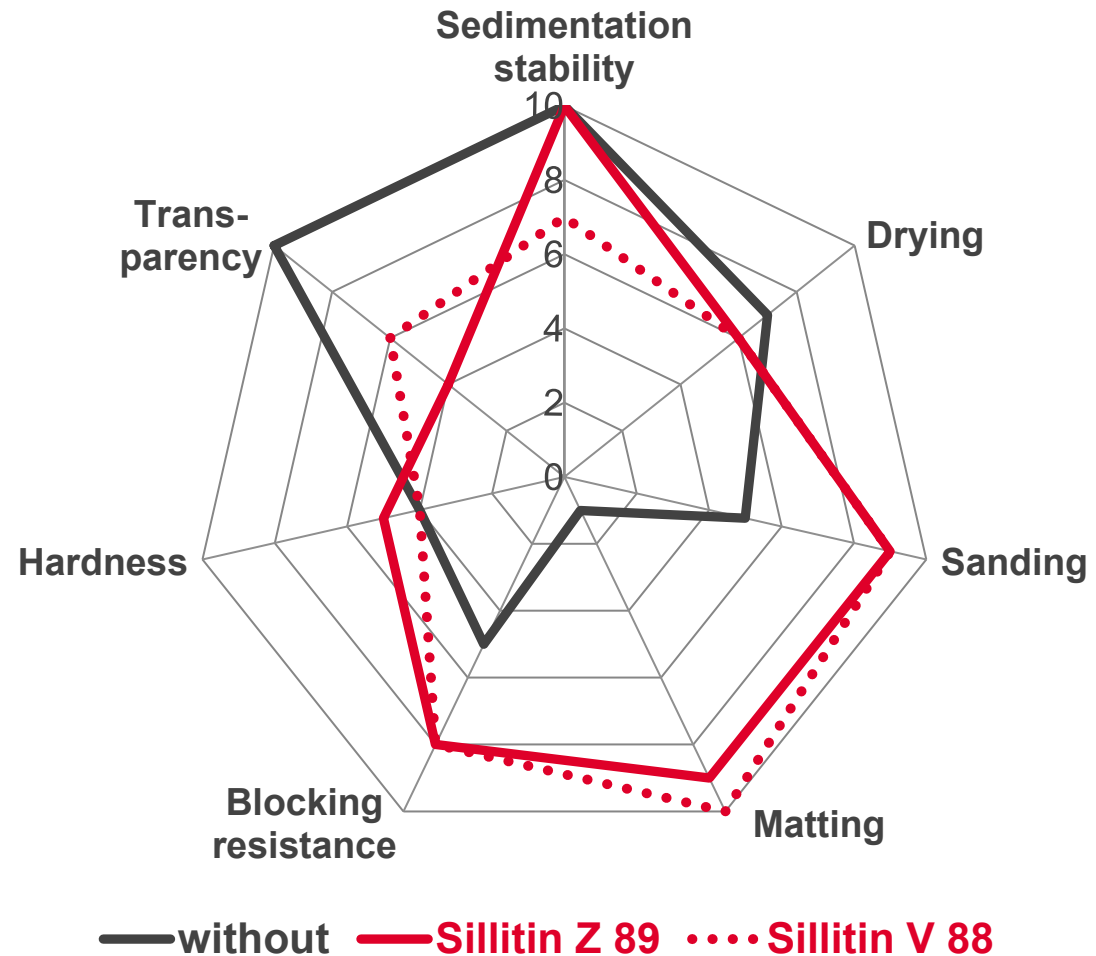


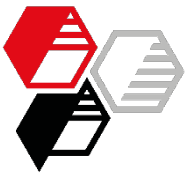


Overall Performance

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at high filler loading 20 pbw





Multi Layer 1 Formulations

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SUMMARY

	Control		Efflux time 75 s DIN-4 Cup	Neuburg Siliceous Earth	
	pbw			pbw	
Alberdingk AC 25381	74.5		4. reduced 2. replaced 1. added 3. reduced	74.5	74.5
Tego Foamex 822	0.6			0.6	0.6
DPM	5.0			5.0	5.0
DPnB	2.0			2.0	2.0
Water demineralized	13.8			6.0	7.5 – 8.0
Acematt TS 100	0.5			----	----
Filler	----			10.0	20.0
Aquacer 539	3.0			3.0	3.0
Byk 346	0.3			0.3	0.3
Rheovis PU 1214	0.3			0.15	0.15
Total	100.0			101.55	113.05 - 113.55
Solid content w/w	[%]	37.7		46.4	50.3 – 50.6
PVC	[%]	0.7		10.6	19.1

Drying / Sanding

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- Multi Layer 1

SUMMARY

Neuburg Siliceous Earth 20 pbw				
	without	Sillitin Z 89	Sillitin V 88	Aktisil MAM
Reduction Drying time DFT 35 µm	[%]	31	41	38
Drying Sanding  50 double rubs	6 h 	6 h 	6 h 	6 h 

Drying / Sanding

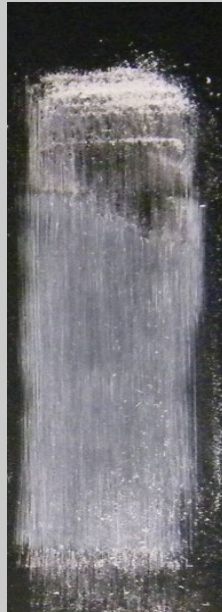
INTRODUCTION

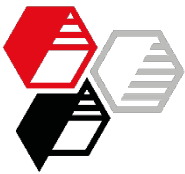
EXPERIMENTAL

RESULTS

- Multi Layer 1

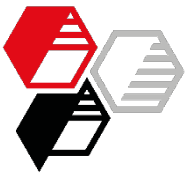
SUMMARY

		Neuburg Siliceous Earth 20 pbw			
		without	Sillitin Z 89	Sillitin V 88	Aktisil MAM
Reduction			31	41	38
Drying time					
DFT 35 µm					
Drying		24 h	6 h	6 h	6 h
Sanding		 “rolls”			
 50 double rubs					

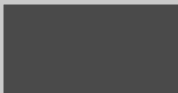


Appearance

	Neuburg Siliceous Earth 20 pbw			
	without	Sillitin Z 89	Sillitin V 88	Aktisil MAM
Gloss 60°	64			
DFT 35 µm		15 	8 	8 
Black walnut DFT 60 µm				



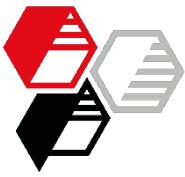
Appearance

	Neuburg Siliceous Earth reduced 10 pbw			
	without	Sillitin Z 89	Sillitin V 88	Aktisil MAM
Gloss 60°	64	42	23	23
DFT 35 µm				
Black walnut DFT 60 µm				

+ Clear top coat without filler

+ Clear top coat without filler

+ Clear top coat without filler



Water / Chemical / Stain Resistance

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INTRODUCTION

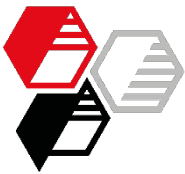
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- Multi Layer 1

SUMMARY

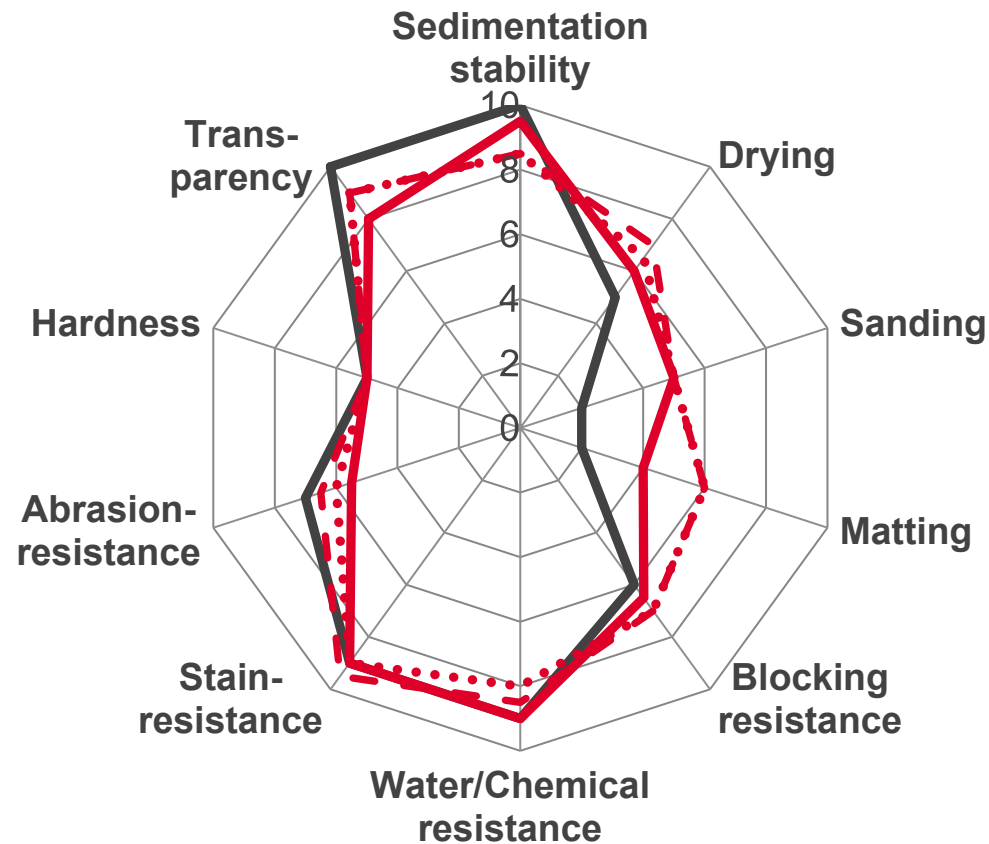
		Neuburg Siliceous Earth					
DFT 105 µm (3 x 35) Drying 10 d			10 pbw			20 pbw	
		without	Sillitin Z 89	Sillitin V 88	Aktisil MAM	Sillitin Z 89	Sillitin V 88 Aktisil MAM
Water	16h						
Acetic acid 10%	16h						
Ethanol 48%	1h						
Ammonia 10%	2 min						
Coffee	16h						
Cola	16h						
Red wine	6h						
Mustard	6h						
Ink	16h						
Hand cream	16h						
Butter	16h						



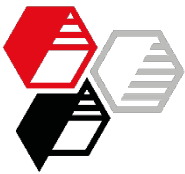
Overall Performance

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at filler loading 10 pbw



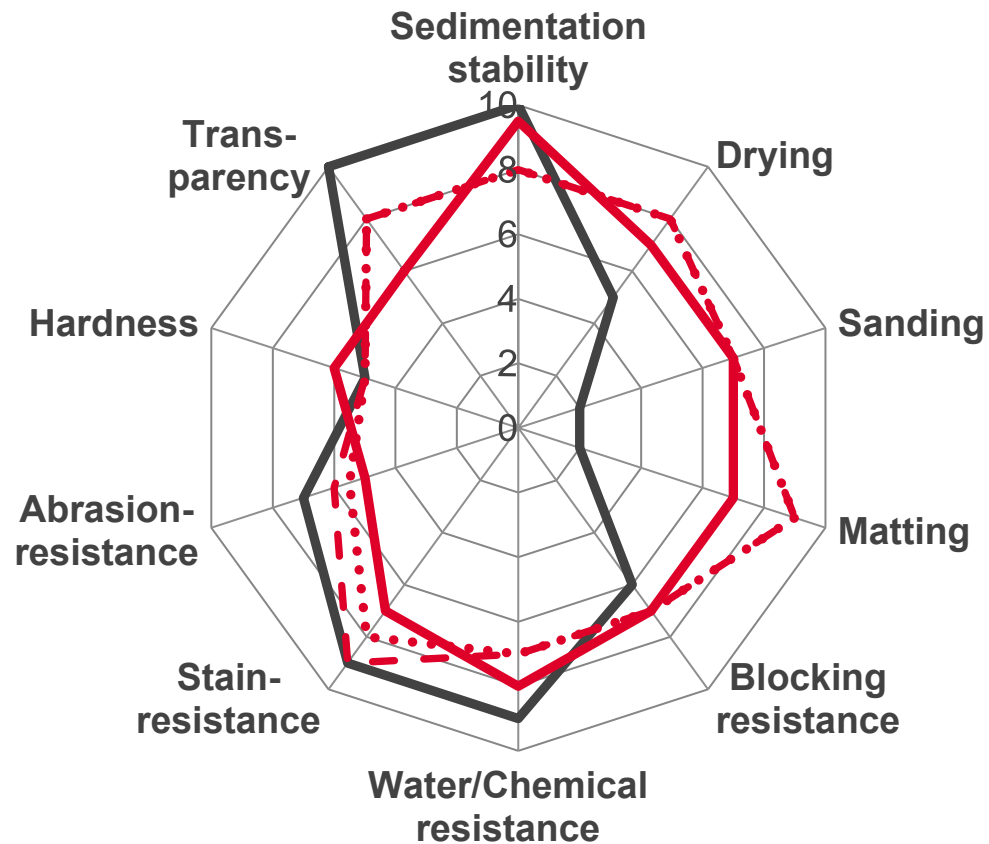
—without —Sillitin Z 89 Sillitin V 88 - -Aktisil MAM



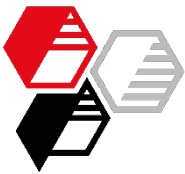
Overall Performance

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at filler loading 20 pbw



—without — Sillitin Z 89 Sillitin V 88 - -Aktisil MAM

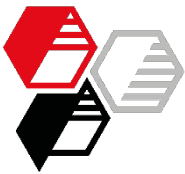


Multi Layer 2 Formulations

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		Control	Efflux time 20 s DIN-4 Cup	Neuburg Siliceous Earth	
		pbw		pbw	
Alberdingk AC 2514		79.4		79.4	79.4
Byk 024		0.8		0.8	0.8
Butyl diglycol		6.0		6.0	6.0
Butyl glycol		2.0		2.0	2.0
Water demineralized		7.5	4. replaced / reduced	----	4.0
Acematt TS 100		0.5	2. replaced	----	----
Filler		----	1. added	10.0	20.0
Ultralube D 816		3.0		3.0	3.0
Byk 346		0.4		0.4	0.4
Rheovis PU 1214		0.4	3. replaced	----	----
Total		100.0		101.6	115.6
Solid content w/w	[%]	37.7		46.3	49.1
PVC	[%]	0.7		10.6	19.4



Drying / Sanding

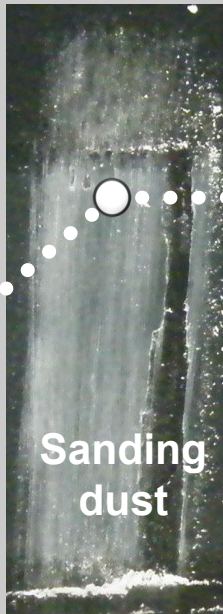
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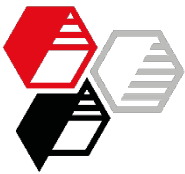
EXPERIMENTAL

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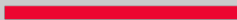
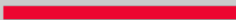
- Multi Layer 2

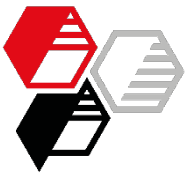
SUMMARY

	Neuburg Siliceous Earth 20 pbw		
	without	Sillitin Z 89	Sillitin V 88
Reduction Drying time DFT 35 µm		35	31
Drying	1.5 h	1.5 h	1.5 h
Sanding			
			
50 double rubs			



Appearance

	Neuburg Siliceous Earth 20 pbw		
	without	Sillitin Z 89	Sillitin V 88
Gloss 60°	43	9	9
DFT 35 µm			
Black walnut DFT 60 µm		 + Clear top coat without filler	 + Clear top coat without filler



Appearance

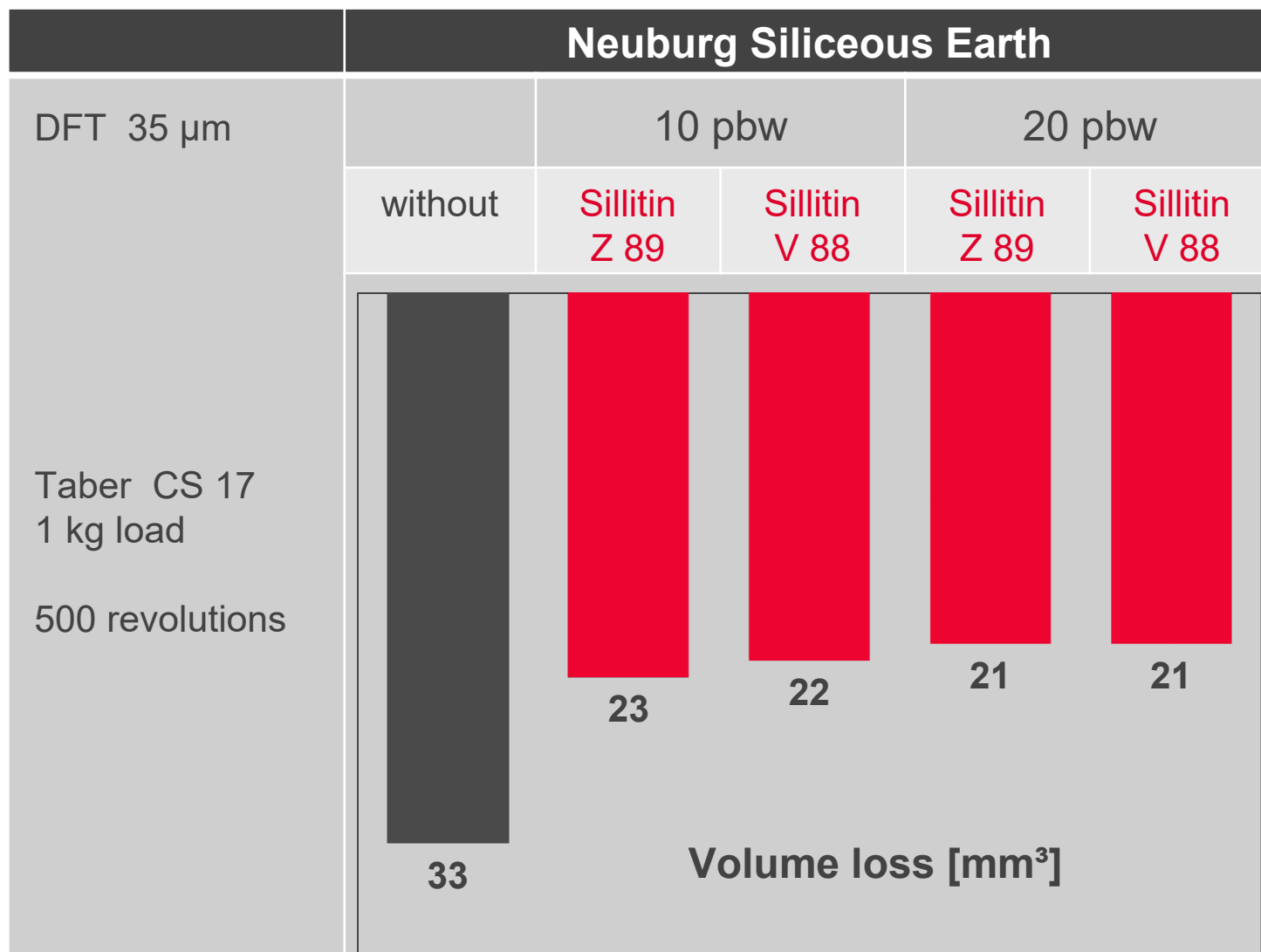
	Neuburg Siliceous Earth reduced 10 pbw		
	without	Sillitin Z 89	Sillitin V 88
Gloss 60°	43	23	21
DFT 35 µm			
Black walnut DFT 60 µm			

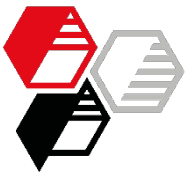


EXPERIMENTAL

- Multi Layer 2

SUMMARY





Water / Chemical / Stain Resistance

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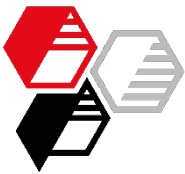
EXPERIMENTAL

RESULTS

- Multi Layer 2

SUMMARY

		Neuburg Siliceous Earth				
DFT 105 µm (3 x 35) Drying 10 d			10 pbw		20 pbw	
		without	Sillitin Z 89	Sillitin V 88	Sillitin Z 89	Sillitin V 88
Water	16h					
Acetic acid 10%	16h					
Ethanol 48%	1h					
Ammonia 10%	2 min					
Coffee	16h					
Cola	16h					
Red wine	6h					
Mustard	6h					
Ink	16h					
Hand cream	16h					
Butter	16h					



Water / Stain

Resistance optimized

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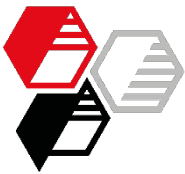
EXPERIMENTAL

RESULTS

- Multi Layer 2

SUMMARY

	Neuburg Siliceous Earth	
DFT 105 µm (3 x 35)	20 pbw	15 pbw
Drying 28 d DIN 68861-1,1B	Sillitin Z 89	Gloxil matt SL
Water 16 h		
Ink 16 h		



Appearance optimized

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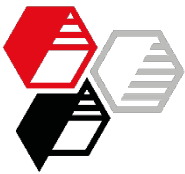
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- Multi Layer 2

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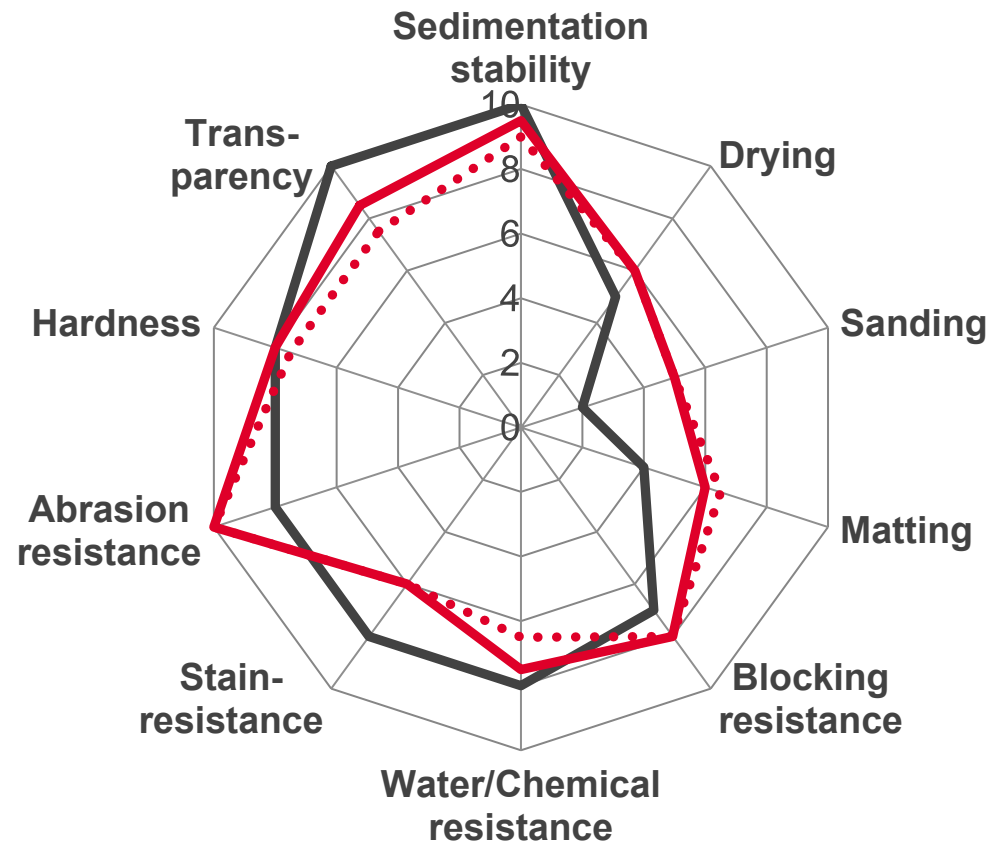
	Neuburg Siliceous Earth		
Black walnut DFT 60 µm + Clear top coat without filler →	10 pbw	20 pbw	15 pbw
	Sillitin Z 89		Gloxil matt SL
			 Further information in technical report Gloxil matt SL - Functional Matting Agent for Waterbased Clear Coats



Overall Performance

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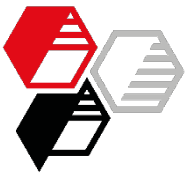
at filler loading 10 pbw



—without

—Sillitin Z 89

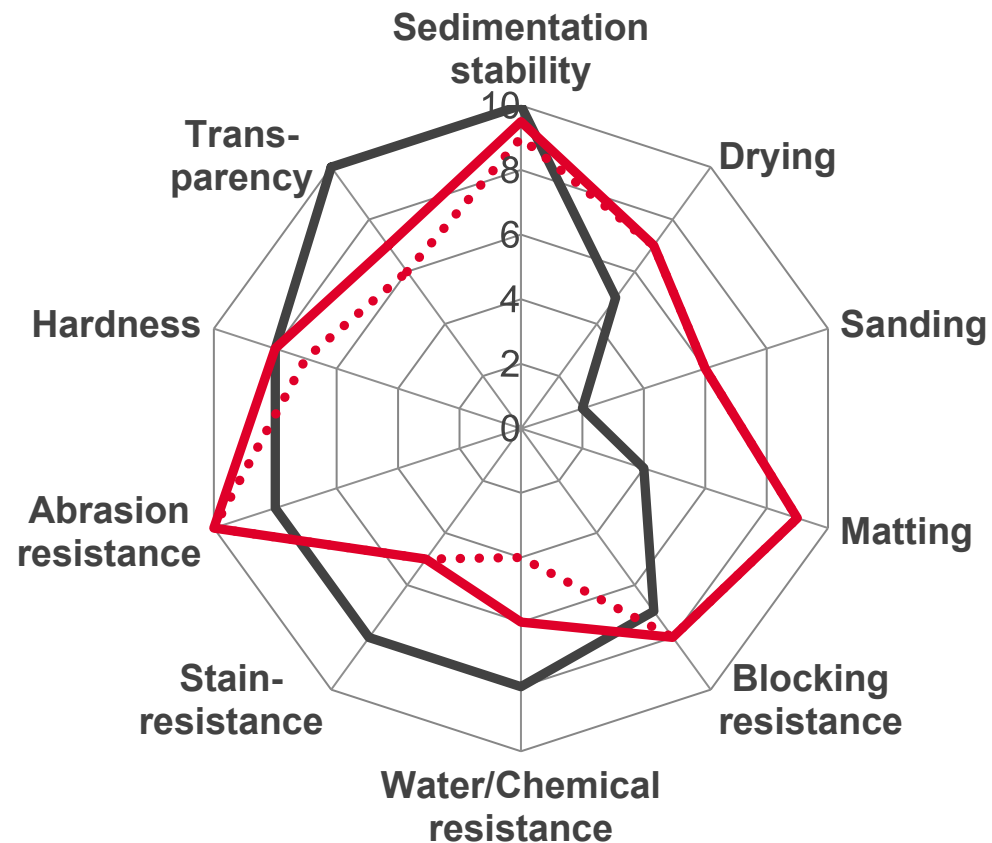
.... Sillitin V 88



Overall Performance

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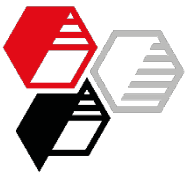
at filler loading 20 pbw



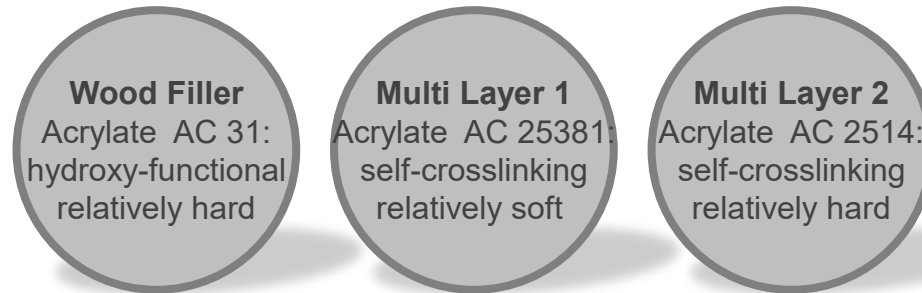
— without

— Sillitin Z 89

.... Sillitin V 88



Summary



Generally

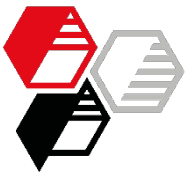
Neuburg Siliceous Earth offers benefits in formulating coatings with higher solid content, reduced drying time, markedly improved sanding while providing excellent matting effect.

Particularly

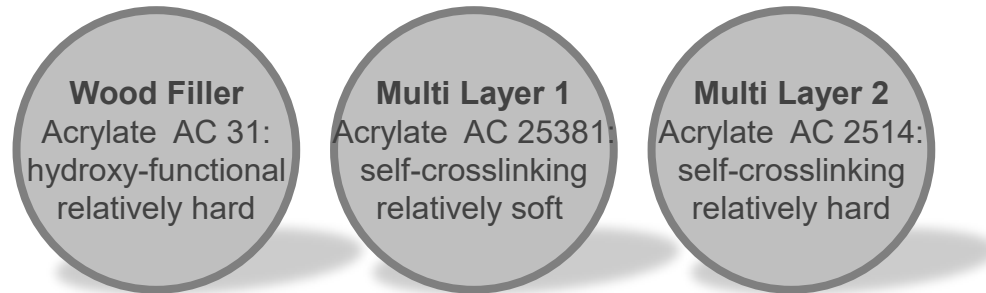
- Sillitin Z 89** → Universal use with good overall properties at lower filler loading, no sedimentation tendency
- Sillitin V 88** → High transparency and blocking resistance
- Aktisil MAM** → High abrasion- and stain resistance

Additionally

- Gloxil matt SL** → Very high water-/stain resistance combined with best transparency even at high loading

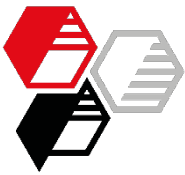


Summary



Conclusion

Base formulation and especially binder properties determine extend of filler effect. Suitable adjustment of **Neuburg Siliceous Earth** or **Gloxil matt SL** as well as filler loading contributes to further improve performance of clear wood coatings.



We supply material for good ideas!

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