Kayalar AR-GE MERKEZİ

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Improved Scratch and Mar Resistance Acrylic Matt Varnish

Seher GENÇ TAŞDELEN

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OUTLINE

- Introduction
- Description of the problem
- Experiments & Results
- Conclusion

INTRODUCTION

PAINT & COATING

Protective

- UV resistance
- Chemical resistance
- Weathering resistance
- Corrosion resistance

Decoration

- Aesthetic appearance
- Visual effect (color, texture, and gloss)
- Haptic effect (soft-touch)

Functional

- Fire-resistance,
- Super hydrophobic (lotus effect)
- Self healing
- Self cleaning
- Special-purpose coatings such as anti-graffiti, anti-static, and anti-slip paints

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PAINT & COATING

WOOD COATING COMPOSITIONS

Binder

Pigments & Fillers

Additives

Solvents

Paint & Coating

Wood Coating types

- Acid curable coatings
- Synthetic coatings
- Cellulosic coatings
- Polyurathane coatings (1K & 2K)
- Acrylic coatings (1K & 2K)
- Polyester coatings
- Water based coatings
- UV curable coatings
- Epoxy coatings
- Powder coatings

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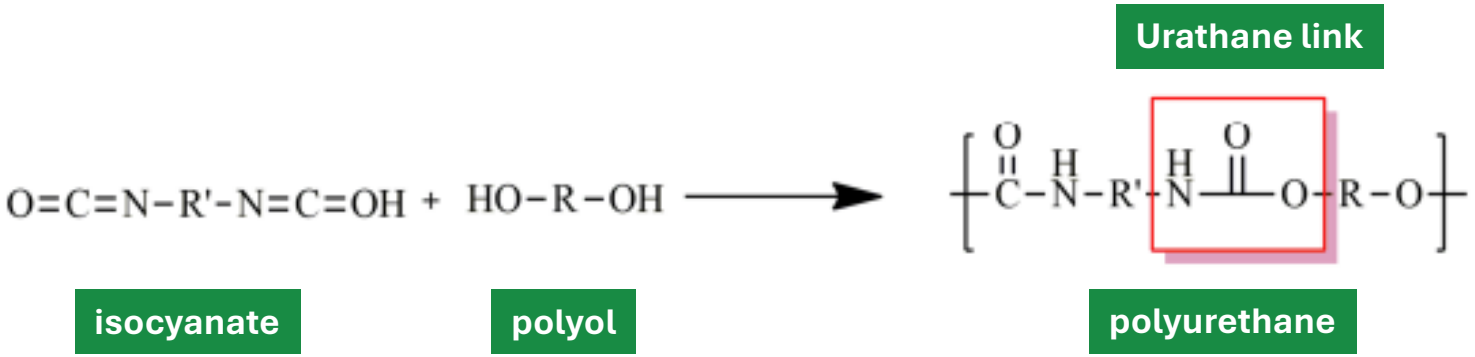
POLYURETHANE CHEMISTRY



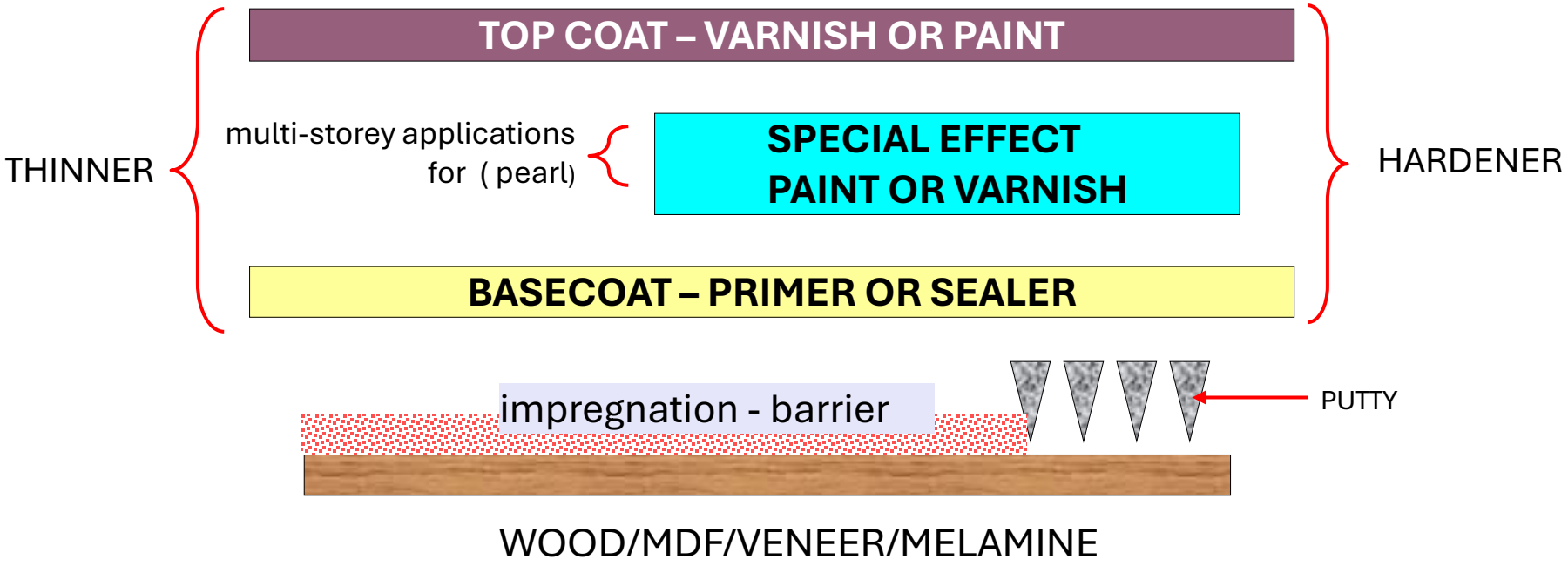
Polyurethanes are polymers containing urethane bonds formed by the reaction of hydroxyl and isocyanate functional groups. It can be either thermoset or thermoplastic in structure. It is used in the paint and coatings industry, as well as in the production of foams, insulation, and isolation materials.

Çalıkoğlu, Y. (2017). *Epoksitlenmiş soya yağından tioglikolik asit ve tioglikolik asit metil esteri ile halka açılarak oluşan poliollerden yeni poliüretan sentezi ve karakterizasyonu* (Yüksek lisans tezi, Sakarya Üniversitesi). Sakarya Üniversitesi Tez Merkezi.

POLYURETHANE CHEMISTRY

ADVANTAGES	DISADVANTAGES
Chemical and Physical Resistance	Pot-life
Solvent Resistance	Yellowing (with wrong hardener)
Good hardness	
Fast drying	
Good adhesion	
Wear resistance	
High Build	
Elasticity	
Suitable for polishing	

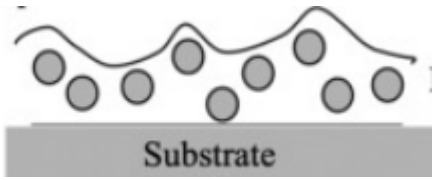
WOOD COATING APPLICATION



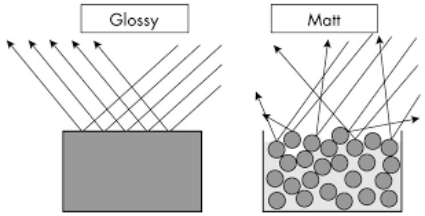
DESCRIPTION OF THE PROBLEM

INDUSTRIAL CHALLENGES

Silika matting agent orientation



Formulation Difficulty



Industrial Expectation

Mar & scratch resistance

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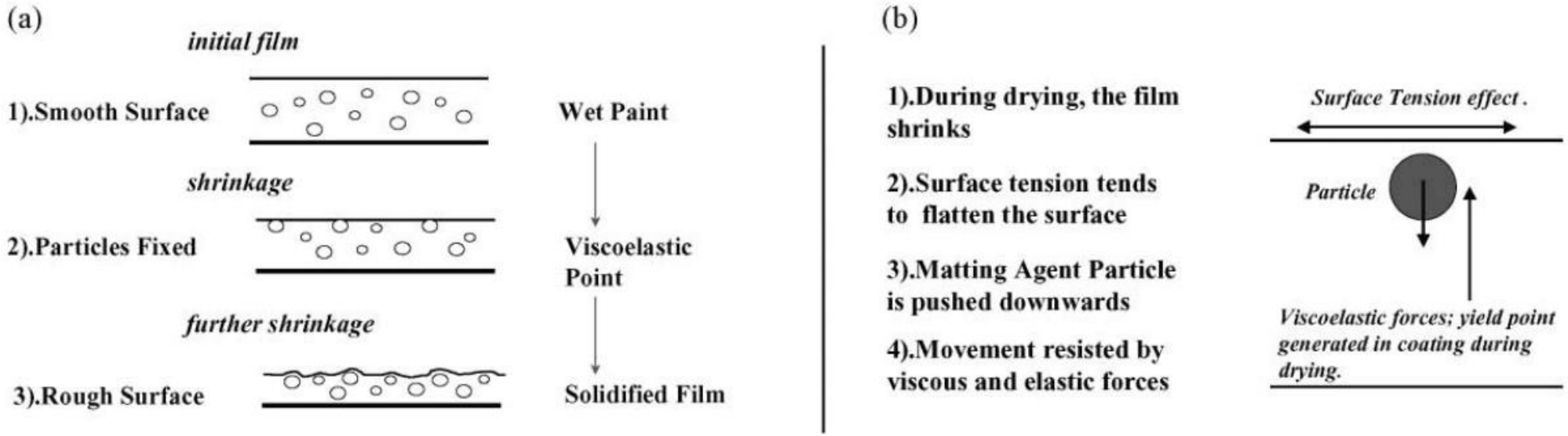
MATTING MECHANISM



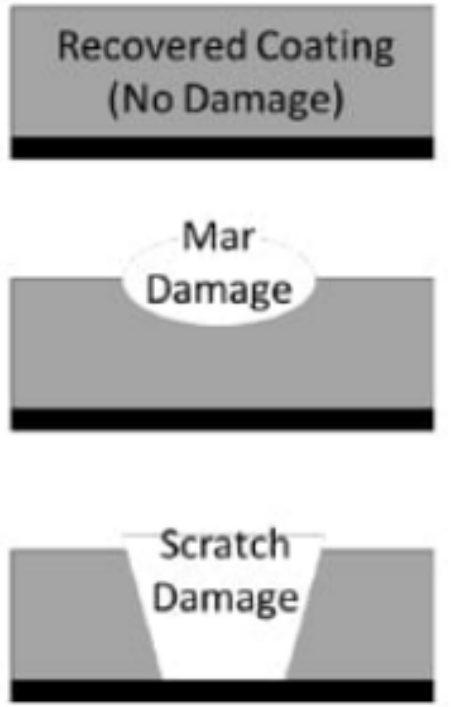
Schematic diagram to illustrate the mechanism of matting by particles in a shrinking paint film: (a) stages during film shrinkage, (b) forces at work.

Fletcher, T. E. (2001). A simple model to describe relationships between gloss behaviour, matting agent concentration and the rheology of matted paints and coatings. *Grace GmbH & Co. KG*. In der Hollerhecke 1, D-67547 Worms, Germany. *Received March 12, 2001; accepted July 16, 2001*.

MAR & SCRATCH

Mechanical Input
Ex. Key, Finger Nail, Coin

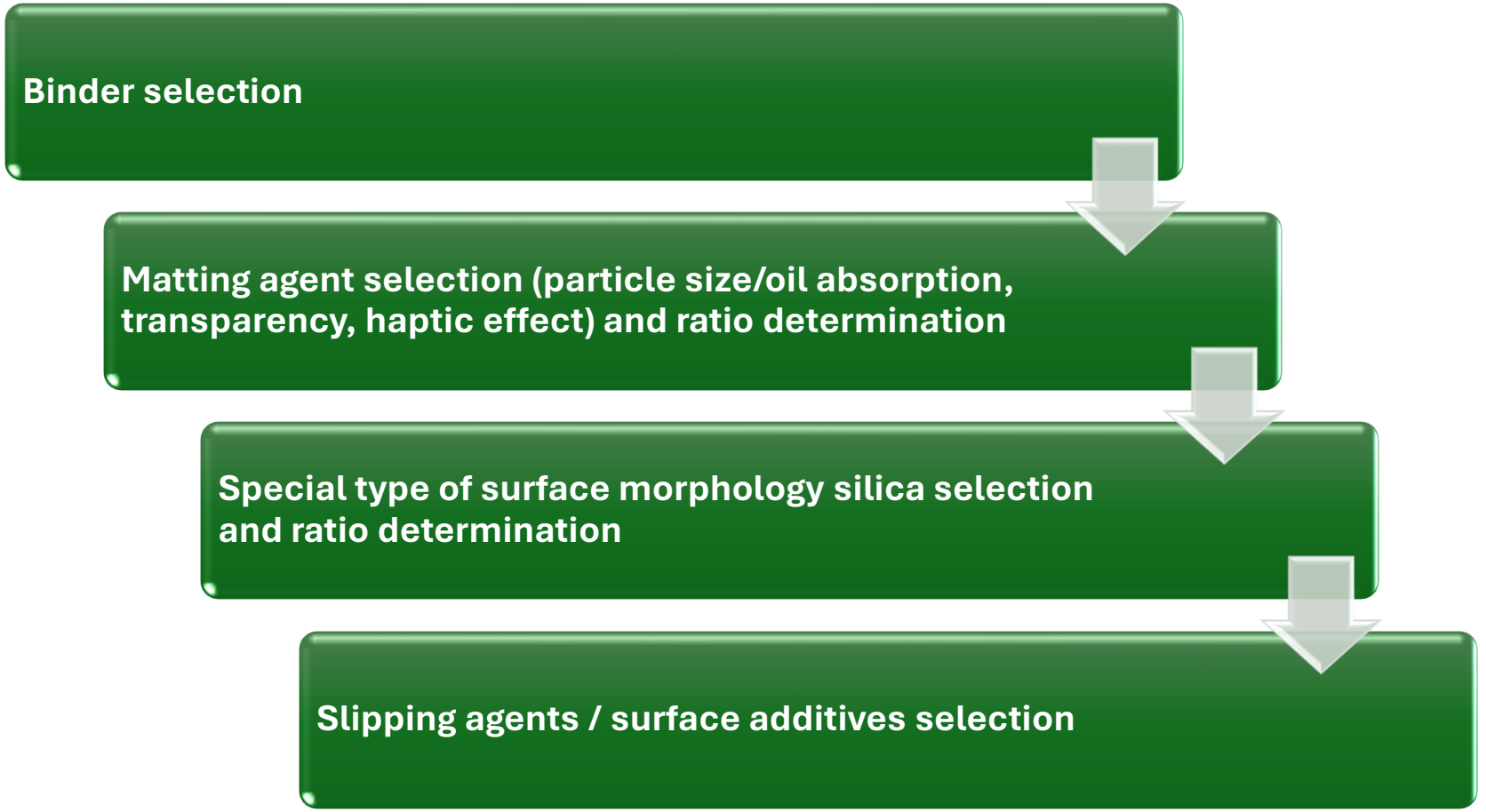
- Elastic Deformation (Recoverable / No Damage)
- Viscoplastic Damage (Visible Mar)
- Fracture Damage (Visible Scratch)



American Coatings Association. (n.d.). *Balancing performance of slip and mar additives using a high-throughput approach*. Retrieved from https://www.paint.org/coatingstech-magazine/articles/balancing-performance-slip-mar-additives-using-high-throughput-approach/

EXPERIMENTAL

STEPWISE APPROACH TO PRODUCT DESIGN



STEPWISE APPROACH TO PRODUCT DESIGN

POLYOL PART

- Acrylic polyol
- Matting agent
- Special silika
- Surface additives
- Catalyst
- Solvent

ISOCYANATE HARDENER

- HDI – trimer
- Solvent

TEST & RESULTS

- Wood panel preparation
- Application (spray)
- Test

Oak veneer panel was coloured with dark wood colorant → Acrylic sanding sealer (90-100 g/m^2) → Sanding with 220 grid sandpaper → Wet on wet polyester sanding sealer (300 g/m^2 each layer) → Left to dry for 24 h → 1 layer polyester sanding sealer (300g/m^2) → 2K acrylic mat varnish

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TARGETED VALUES

(Wet formulation and coated panels)

Wet formulation	
Solid Content (%) - TS 6035 EN ISO 3251	27-29
Grinding – TS 2620 EN ISO 1524, ASTM D-1210)	≤ 25µm
Density (g/cm^3) - ASTM D 1475-98	0,92-0,94
Viscosity (DIN4, 20 ° C, sec) – TS EN ISO 2431, DIN 53211	40 – 50
Storage stability - TS 4324	Stable
Coated Panels	
Gloss - 60° (Glossmeter, ASTM D 523)	7-13
Mar resistance (3M scrotch brite 7448 / 50 cycles) (% gloss difference at 85°)	%15-30
Scratch Resistance (Erichsen Scratch Tester 413, N)	Min 2
Haptic* (tactile sensation)	Good

*Determined through the input of six individuals.

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RESULTS & DISCUSSIONS

BINDER SELECTION

	2K Acrylic resin A	2K Acrylic resin B	2K Acrylic resin C
Solid Content (%) - TS 6035 EN ISO 3251	27	27,5	28
Grinding – TS 2620 EN ISO 1524, ASTM D-1210)	~10 µm	~10 µm	~10 µm
Density (g/cm^3) - ASTM D 1475-98	0,935	0,934	0,936
Viscosity (DIN4, 20 ° C, sec) – TS EN ISO 2431, DIN 53211	50	48	49,5
Storage stability - TS 4324	Stable, no sedimentation	Stable, no sedimentation	Stable, no sedimentation
Gloss (20°/60° /85°) (Glossmeter, ASTM D 523)	1.3/9.7/33.6	1.4/10.9/32.8	1.4/8.9/30.1
Mar resistance (% gloss difference at 85°)	%52	%48	**%32**
Scratch Resistance (Erichsen Scratch Tester 413, N)	2N	2N	**2N-3N**
Haptic	Good	Good	Good

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MATTING AGENT SELECTION

	1,5% Silica Matting Agent A Special slipping powders	1% Silica Matting Agent A 2% Special morphology silica Special slipping powders	1,5% Silica Matting Agent B Special slipping powders	0,5%Silica Matting Agent B 2% Special morphology silica Special slipping powder
Solid Content (%) TS 6035 EN ISO 3251	27,5	27,6	27,8	27,7
Grinding TS 2620 EN ISO 1524, ASTM D-1210)	~10µm	~10µm	~10µm	~10µm
Density (g/cm^3) ASTM D 1475-98	0,935	0,933	0,934	0,935
Viscosity (DIN4, 20 ° C, sec) TS EN ISO 2431, DIN 53211	45	47	48	50
Storage stability TS 4324	Stable, no sedimentation	Stable, no sedimentation	Stable, no sedimentation	Stable, no sedimentation
Gloss (20°/60° /85°) (Glossmeter, ASTM D 523)	1.4/10.9/32.8	1.5/11,2/32.8	0,5/5/10,5	1.4/10,5/30,2
Mar resistance (% gloss difference at 85°)	%32	%28	%25	**%20**
Scratch Resistance (Erichsen Scratch Tester 413, N)	2N-3N	3N-4N	2N-3N	**3N-4N**
Haptic	Good	Good	Good	Good

SELECTION OF SURFACE ADDITIVES

	Surface Additives Mixture A	Surface Additives Mixture B	Surface Additives Mixture C
Solid Content (%) - TS 6035 EN ISO 3251	27	26,5	27,2
Grinding – TS 2620 EN ISO 1524, ASTM D-1210)	~10µm	~10µm	~10µm
Density (g/cm^3) - ASTM D 1475-98	0,935	0,935	0,935
Viscosity (DIN4, 20 ° C, sec) – TS EN ISO 2431, DIN 53211	50	50	50
Storage stability - TS 4324	Stable, no sedimentation	Stable, no sedimentation	Stable, no sedimentation
Gloss (20°/60° /85°) (Glossmeter, ASTM D 523)	1.4/10,5/30,2	1.4/10,5/30,2	1.4/10,5/30,2
Mar resistance (% gloss difference at 85°)	%18,2	**%15**	%18
Scratch Resistance (Erichsen Scratch Tester 413, N)	3N	**4N**	3N
Haptic	Good	Good	Good

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CONCLUSION

COMPARISON WITH MARKET STANDARD

	Market Standard	Formulated Mat Varnish
Solid Content (%) TS 6035 EN ISO 3251	27	26,5
Grinding – TS 2620 EN ISO 1524, ASTM D-1210)	~10µm	~10µm
Density (g/cm^3) ASTM D 1475-98	0,932	0,935
Viscosity (DIN4, 20 ° C, sec) TS EN ISO 2431, DIN 53211	55	50
Storage stability TS 4324	Stable, no sedimentation	Stable, no sedimentation
Gloss (20°/60° /85°) (Glossmeter, ASTM D 523)	1,2/8,5/31,4	1.4/10,5/30,2
Mar resistance (% gloss difference at 85°)	%50	**%15**
Scratch Resistance (Erichsen Scratch Tester 413, N)	3N	**4N**
Haptic	Good	Good

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COMPARISON WITH MARKET STANDARD

Market standard

Formulated
Mat Varnish

CONCLUSION

- Trials were conducted to select suitable acrylic binders, focusing on achieving an optimal cost-performance balance.
- A combination of a narrow particle size distribution matting agent, special morphology silica, and selected slip additives was used to enhance mar and scratch resistance.
- To achieve a more uniform orientation of the matting agent, various surface additive chemistries and their combinations were evaluated.

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THANK YOU

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