Optimization of Extra-Matte Coatings with High Burnishing and Chemical Resistance

Vercher, Salvador; Pont, Rogelio

Valresa Coatings S.A.

Context and Motivation

- Extra-matte finishes are increasingly demanded in modern furniture design.
- Other technologies (e.g., UV, Excimer) offer performance but are expensive and limited to flat surfaces.
- A 2K spray-applied varnish offers a more flexible, cost-effective alternative.

Objectives

- Develop a **2K** extra-matte varnish with **high burnishing** and chemical **resistance**.
- Evaluate influence of raw materials and application conditions.
- Use **DOE** tools (Taguchi) to optimize formulation and process.

Key Raw Material Factors

Factor	Importance
Matting agents	Size, distribution, shape, chemistry
Base resin	Compatibility, elasticity/hardness, refraction index
Hardener	Type and ratio (crosslinking)
Additives	Surface, dispersants, rheological

DOE Approach

Selected: Taguchi L9 array with 4 factors, 3 levels each.

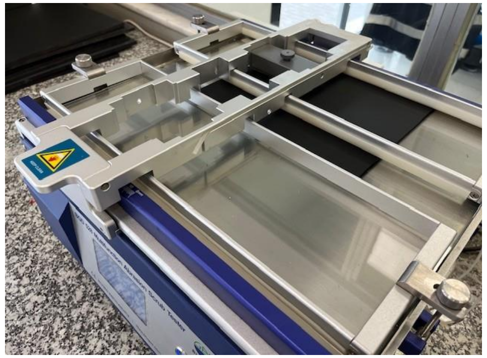
Factor	Level 1	Level 2	Level 3
Resin type	Standard acrylic	Elastic acrylic	Physically drying binder
Isocyanate type	Aliphatic	Aliphatic-MDI modified	Aliphatic-silane modified
Matting agents	Silica/Wax	PMMA	Polyamide
Crosslinking ratio	0.7	1.0	1.3

Component	%
Acrilic resin 50%	26-35
More elastic resin	0-5
Slow solvent	2
Drying binder	2,5-6
Defoamer	0,2
Wax	0-7
Silica	0-3
PMMA	0-8,4
Polyamide	0-7
Medium Solvent	20-30
Fast solvent	9
Accelerant	0,05
Surface additive	0,1

Base formula for DOE (burnishing resistance

Burnishing Test Method

- Based on ASTM D6376: 3000-grit sandpaper, 20 cycles.
- Gloss measured before and after friction.
- Lower gloss may lead to easier burnishing.



BOSAD
BOYA SANAYİCİLERİ DERNEĞİ
THE ASSOCIATION OF PAINT INDUSTRY

paintistanbul
TURKCOAT
CONGRESS

ChemMedia
PUBLISHER | CONGRESS | EVENTS | AGENCY

Influence of Raw Materials on Burnishing Resistance

Run	Matting	Resin combination	Hardener	Crosslinking	Delta °85
1	Wax Silica	Acrylic	Aliphatic MDI	1,3	24
2	PMMA	Drying binder increased	Aliphatic Silane modified	1,3	9
3	PMMA	Elastic resin addition	Aliphatic MDI	1	16
4	Wax Silica	Elastic resin addition	Aliphatic Silane modified	0,7	14
5	Polyamide	Elastic resin addition	Aliphatic	1,3	27
6	PMMA	Acrylic	Aliphatic	0,7	15
7	Polyamide	Acrylic	Aliphatic Silane modified	1	12
8	Polyamide	Drying binder increased	Aliphatic MDI	0,7	24
9	Wax Silica	Drying binder increased	Aliphatic	1	33

ANOVA for selected factorial model

Analysis of variance table [Classical sum of squares - Type II]

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F
Model	456.77	4	114.19	8.92	0.0285
A-Matting ager	*162.18*	*2*	*81.09*	*6.33*	*0.0576*
C-Hardener	*284.10*	*2*	*142.05*	*11.09*	*0.0233*
Residual	51.23	4	12.81		
Cor Total	508.00	8			

Hardener type showed statistically significant influence.
Particle type provided useful formulation insights

Impact of Application Parameters on Burnishing Resistance

Factor	Level 1	Level 2	Level 3
Hardener	Old	New	
Sealer	Standard	Higher crosslinking	Less solids
Wet film thickness	60 µ	100 µ	150 µ
Drying conditions	15ºC	25ºC	35ºC

Wet thickness found to impact burnishing resistance.

Hardener	Sealer	Secado	Thickness µm	Rating
Old	1	35	60	2
Old	1	25	150	1
New	2	15	150	1,3
New	3	15	60	1,3
New	3	25	100	2
Old	2	15	100	1,3
New	1	25	100	2,3
Old	3	35	100	1,7
New	1	35	150	1
New	3	35	150	1
New	2	25	60	2,3
Old	2	25	150	1
Old	3	15	150	1
New	1	15	60	3,7
Old	2	35	60	3,7
Old	3	25	60	3
New	2	35	100	3,7
Old	1	15	100	1,7

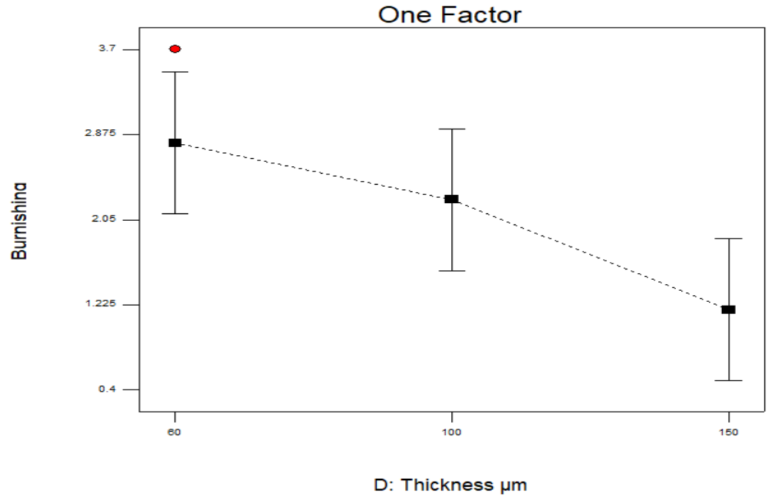
Second DOE design (burnishing according to application).

Impact of Application Parameters on Burnishing Resistance

Analysis of variance table [Classical sum of squares - Type II]

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F
Model	9.28	5	1.86	3.11	0.0497
A-Hardener	*0.27*	*1*	*0.27*	*0.45*	*0.5147*
B-Sealer	*0.91*	*2*	*0.45*	*0.76*	*0.4886*
D-Thickness g	*8.11*	*2*	*4.05*	*6.79*	*0.0106*
Residual	7.16	12	0.60		
Cor Total	16.44	17			

ANOVA for the second DOE (burnishing according to application).



Model graph for significant factor

Wet film thickness found to impact burnishing resistance.

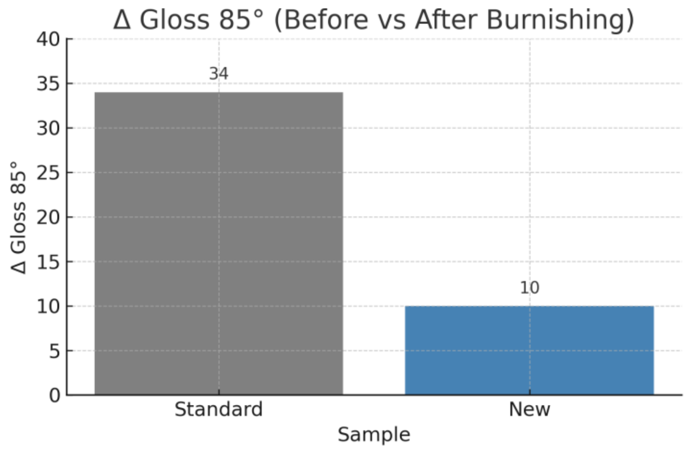
BOSAD
BOYA SANAYİCİLERİ DERNEĞİ
THE ASSOCIATION OF PAINT INDUSTRY

paintistanbul TURKCOAT CONGRESS

ChemMedia
PUBLISHER | CONGRESS | EVENTS | AGENCY

Validation – Internal and External

- Tests confirmed improvement in:
  - Burnishing resistance (ASTM D6376)
  - Scratch resistance (UNE EN 15186)
  - Chemical resistance (UNE EN 12720)



Validation – Internal and External

5 - 4 - 3 -2,5 – 2 – 1,5 – 1 N 5 - 4 - 3 -2,5 – 2 – 1,5 – 1 N

Comparison between new varnish and standard product (UNE EN 15186)

Cold liquid resistance (UNE EN 12720)		
	Standard	New
Test Substance	Result (1–5)	Result (1–5)
Acetic acid	5	5
Ammonia (10%)	5	4
Citric acid (10%)	5	5
Cleaning solution	5	5
Coffee	5	5
Ethanol (48%)	5	5
Mustard	4	5
Paraffin oil	5	5
Red wine	5	5
Water	5	5
COMPLIANT (for work surfaces and other surfaces)		

Chemical resistance evaluation according to UNE EN 12720 – standard and new product

Conclusions

- ✅ Taguchi DOE enabled effective optimization without the need for advanced statistical tools.
- 🧪 Developed varnish offers high performance (burnishing and chemical resistance).
- 🌱 Opens paths for further innovation (e.g., other particles, renewable materials)

Thank you

Teşekkür ederim

Gracias

BOSAD
BOYA SANAYİCİLERİ DERNEĞİ
THE ASSOCIATION OF PAINT INDUSTRY

paintistanbul
TURKCOAT
CONGRESS

ChemMedia
PUBLISHER | CONGRESS | EVENTS | AGENCY