Novel Light Stabilizers for Waterborne and Functional Coatings

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B.A. Special Chem & Color S.r.l.

Everlight Chemical

Outline

(1) Everlight Group in Brief

(2) Why Coatings need light stabilizer

(3) Principles of UVA and HALS

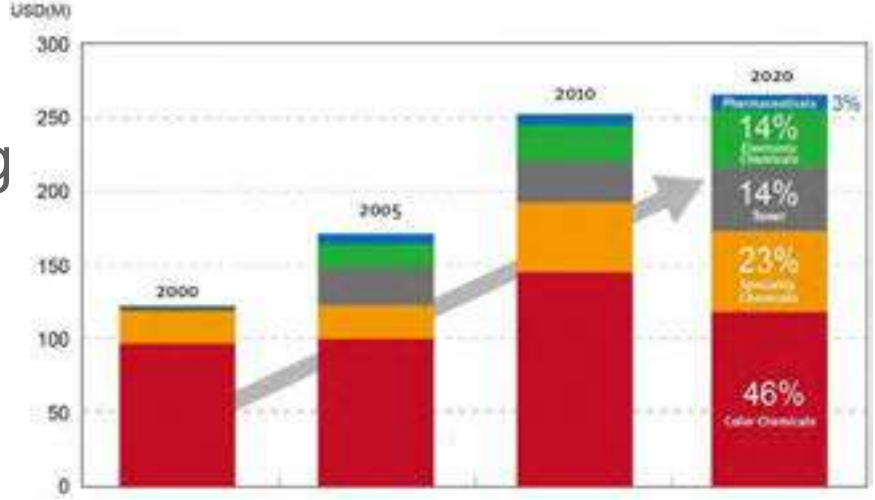
(4) Recommendations for **Waterborne** Coatings

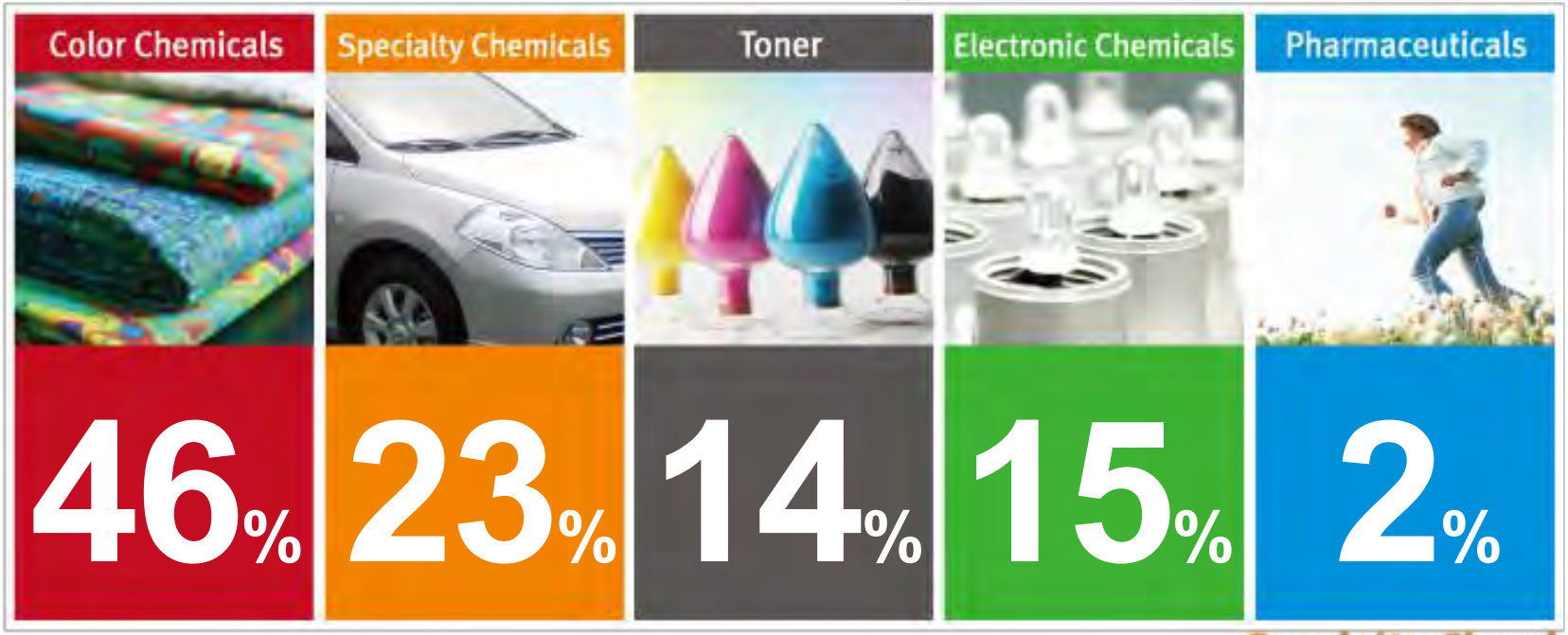
(5) Recommendations for **Functional** Coatings

(6) Conclusions

Everlight Chemical Profile

- Founded in 1972 in Taiwan
- Listed in Taiwan Stock Exchang since 1988
- Revenue: USD $263M
- 1,750 Employees world-wide





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Production Sites

1976 Plant I

1987 Plant II

1992 Plant III

2015 Plant IV

1997 Toner Plant

2006 Suzhou, China

1996 API Plant

1997 EC Plant

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Global Marketing, Sales, & Technical Services

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UV Absorbers Manufacturing Factory

- Founded in 1995
- Production Capacity : 5,000 metric tons
- Employees : 204
- Revenue : USD $60M (2020)
- Management Systems :
- ISO 9001 : 1996
- ISO 14001 : 1996
- OHSAS 18001 : 2001
- QC080000 :2007
- ISO22301 (BCMS) (2012)
- **IATF16949 :2016**

IATF16949 *For OEM Automotive*

Our Commitment as Part of OEM Supply Chain

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Eversorb ® in Everyday Life!

- Professional UV Absorber & Light Stabilizers

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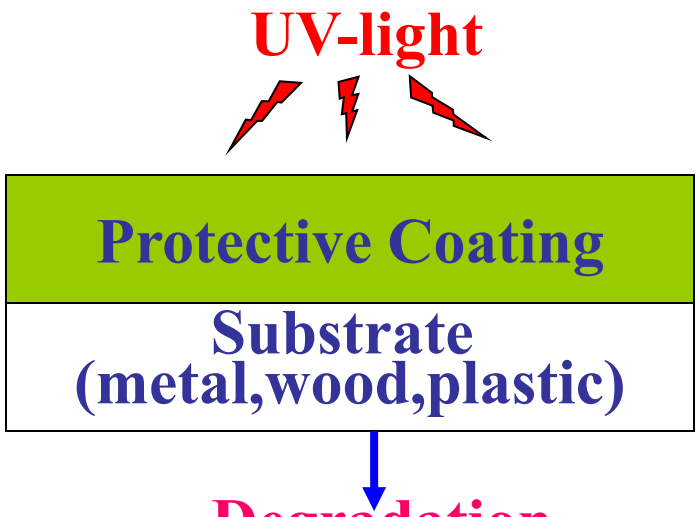
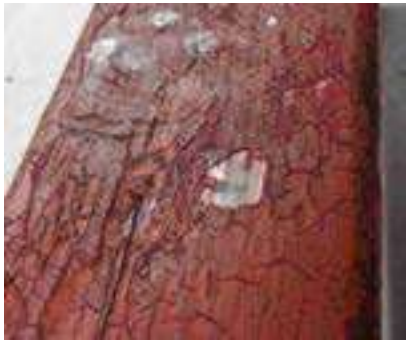
Why Coatings need light stabilizer



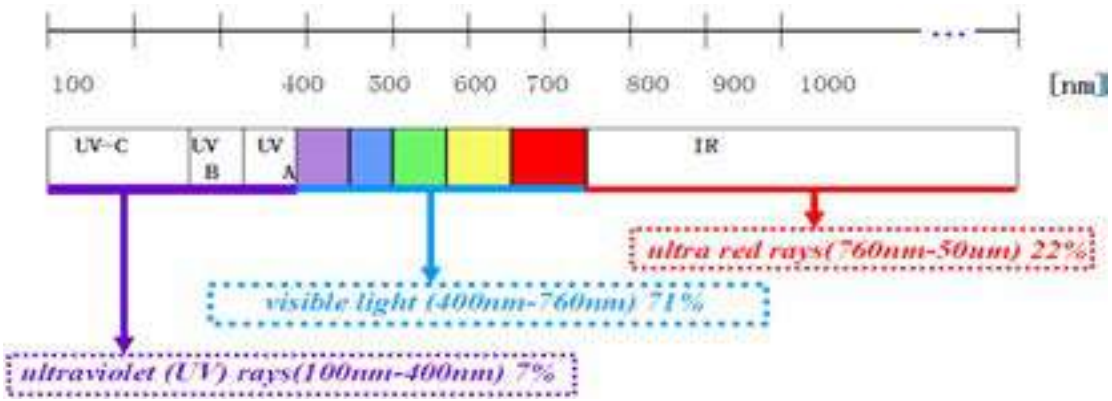
Examples of coating degradation.. ?

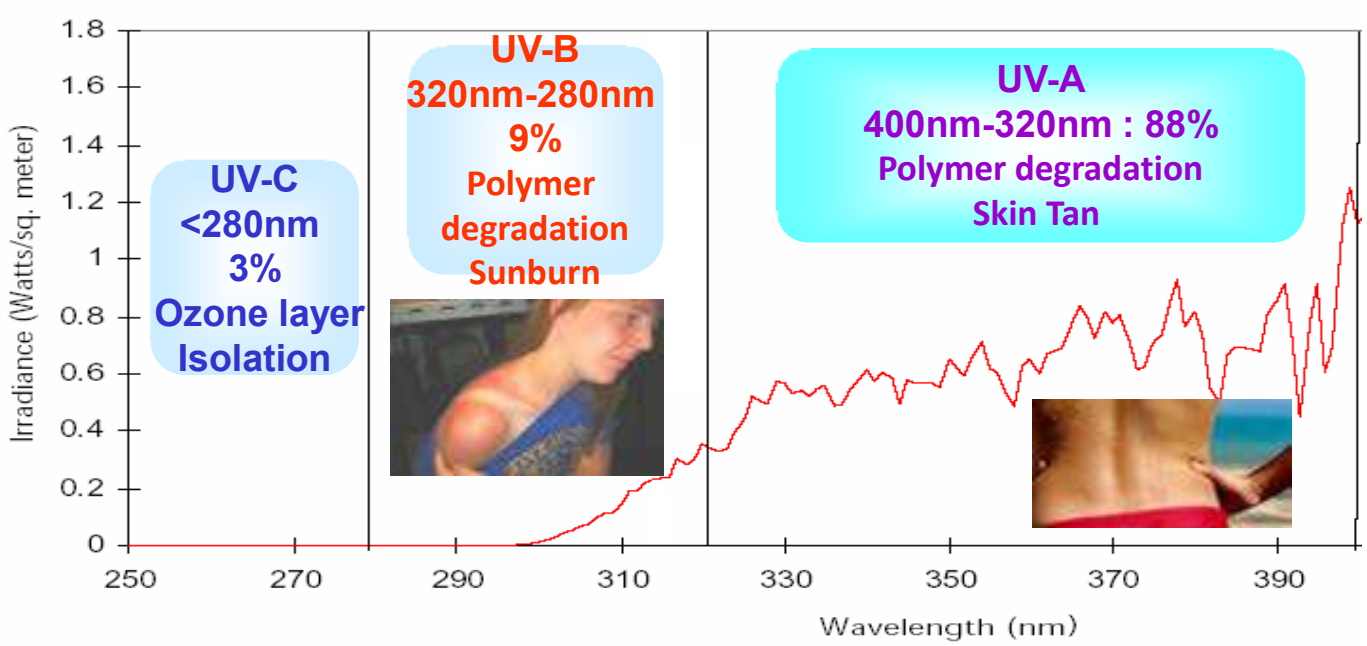


Without Light Stabilizers

- cracking
- chalking
- gloss loss
- delamination
- color change

Sunlight / UV Spectrum





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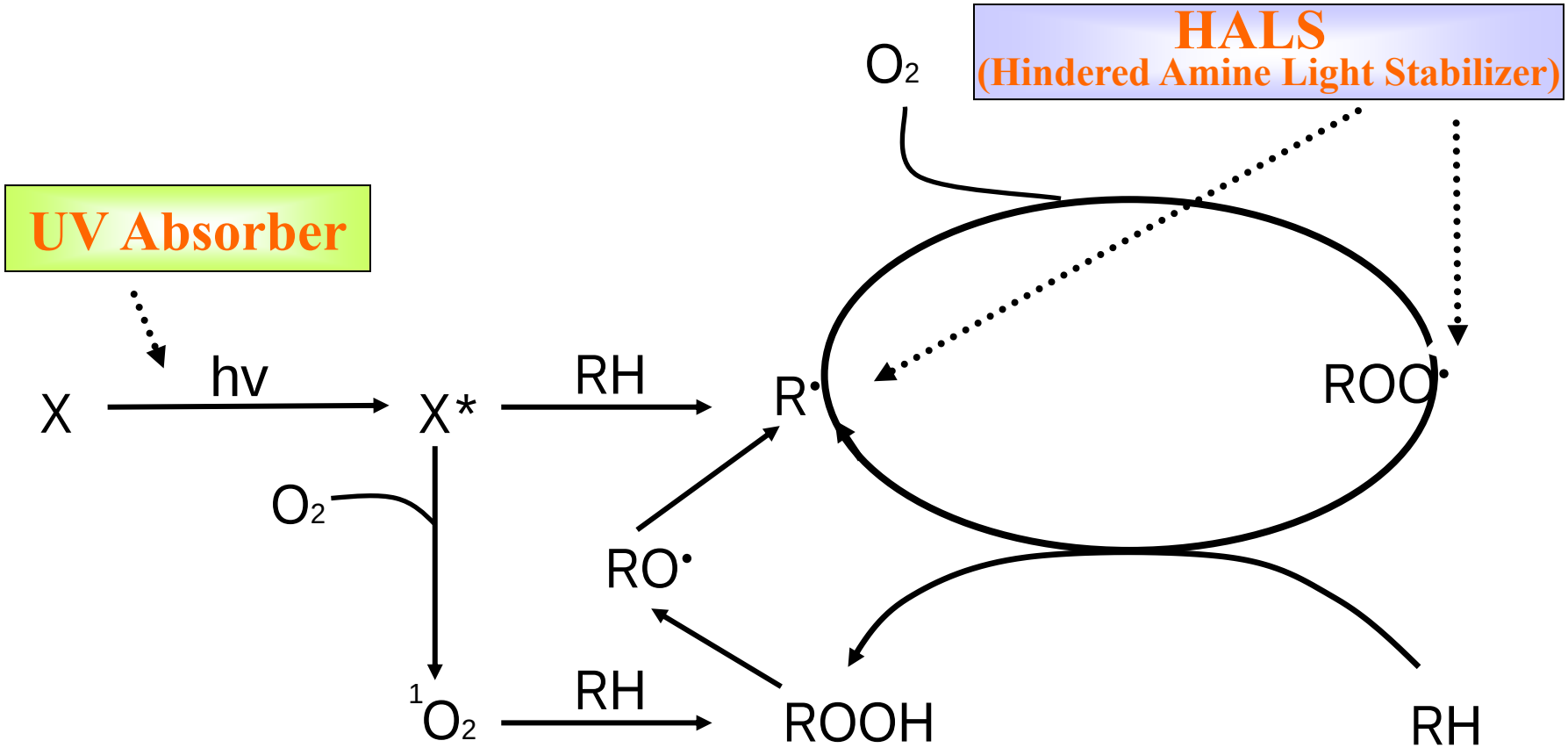
How To Prevent Degradation From Happening



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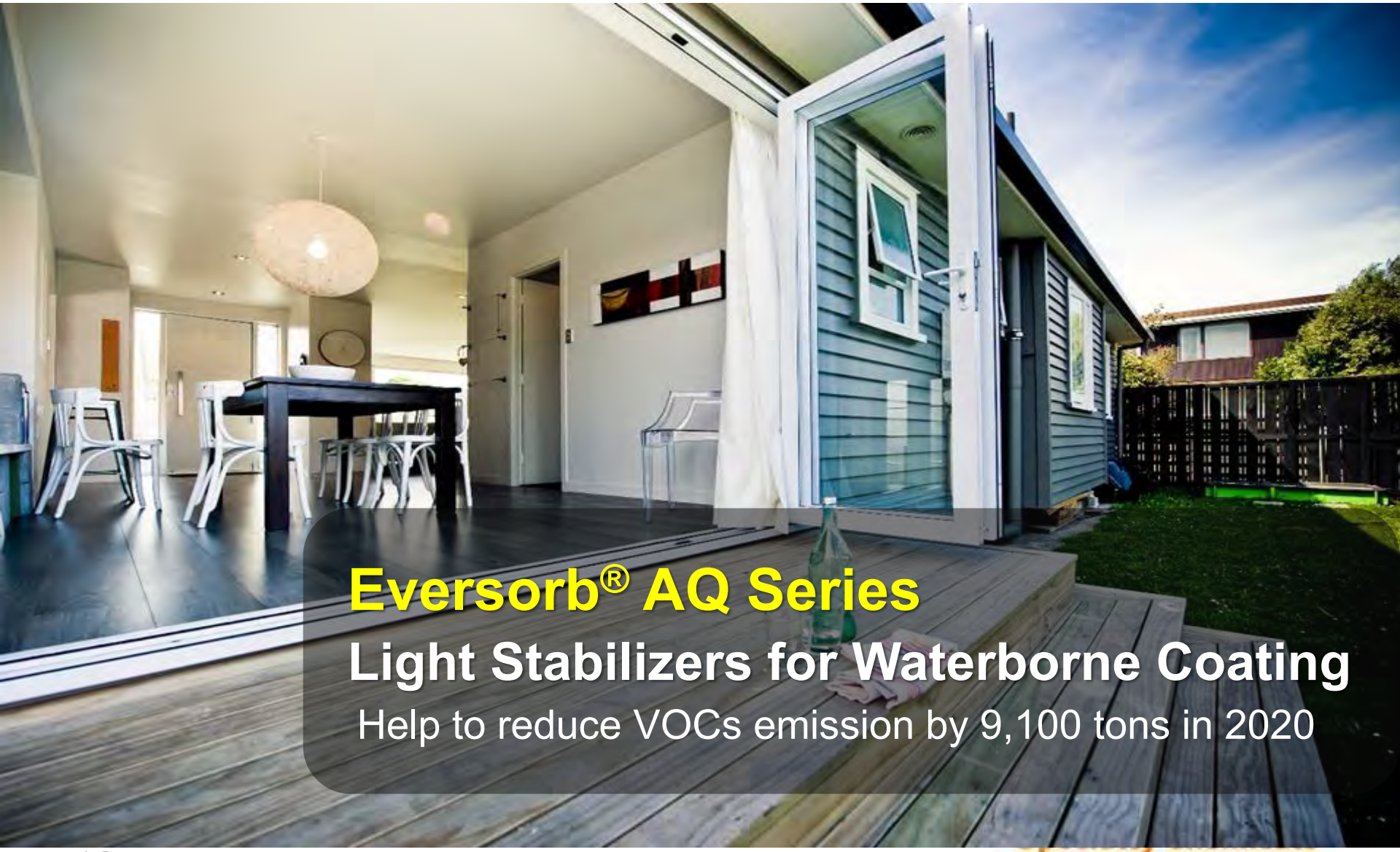
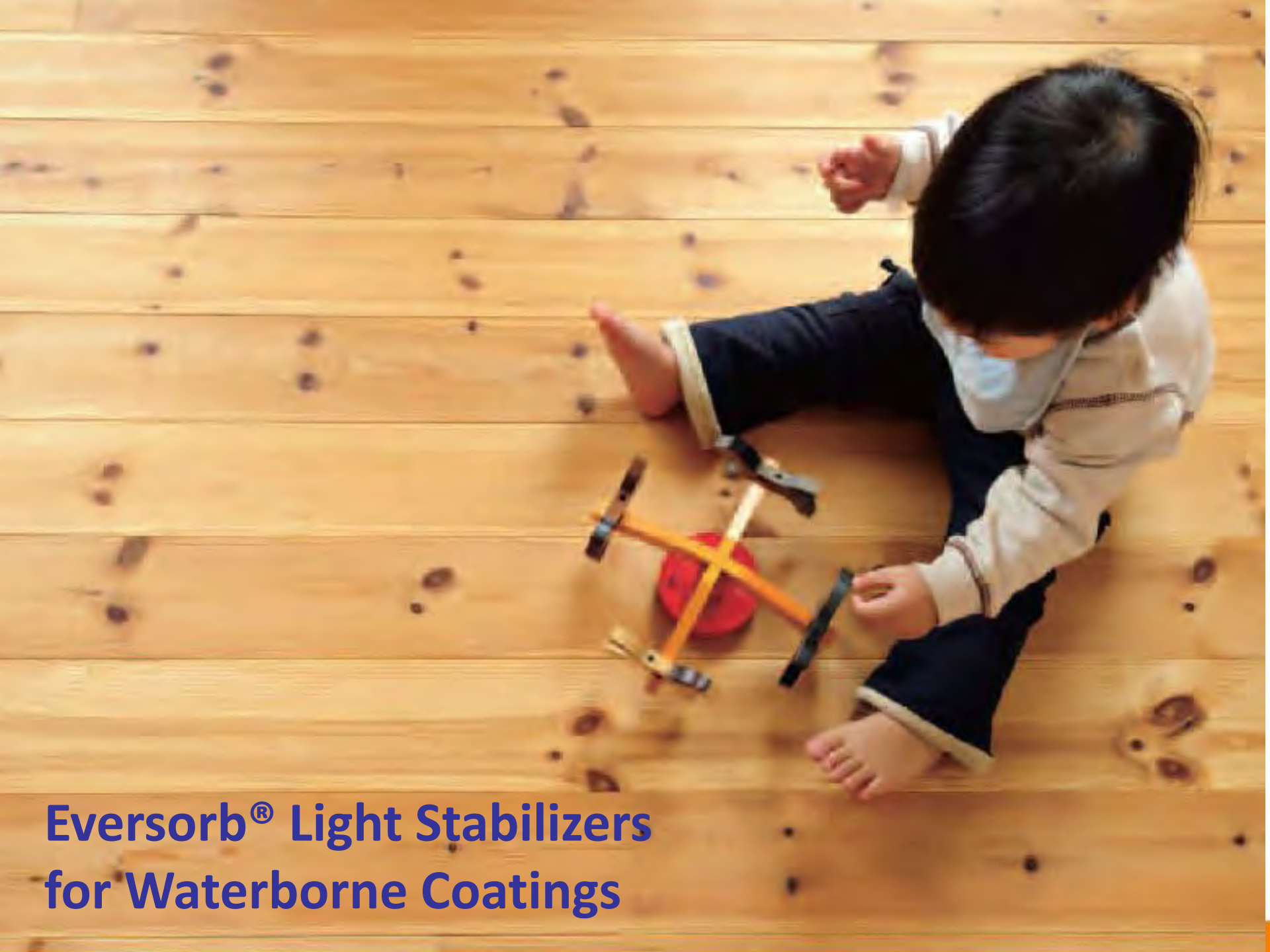

Eversorb® AQ Series
Light Stabilizers for Waterborne Coating
Help to reduce VOCs emission by 9,100 tons in 2020



Eversorb® Light Stabilizers for Waterborne Coatings

Regular UVA Obstacle in Waterborne System

Liquid Hydroxyphenyl-benzotrialzole (UVA)

1.Dispersed test in Acrylic Waterborne Resin

(5g UVA/100g -Acrylic Waterborne Resin)

filter

2.Dispersed test in PU Waterborne Resin

(5g UVA/100g -PU Waterborne Resin)

filter

Liquid benzotrialzole is not easy to disperse in waterborne resin

Eversorb *Liquid Light Stabilizers for Waterborne Coatings Test*

Liquid performance products (EVERSORB AQ Series)

1.Dispersed test in Acrylic Waterborne Resin

(5g EV-AQ1/100g -Acrylic Waterborne Resin)

filter

2.Dispersed test in PU Waterborne Resin

(5g EV-AQ1 /100g -PU Waterborne Resin)

filter

Liquid EV-AQ1 is easy to disperse in waterborne resin

Eversorb® AQ 1-- UV Stability in Waterborne System

(10g EV-AQ1/100g –DI Water)

Stirring

(10g UVA/100g –DI Water)

Stirring

Liquid EV-AQ1 specific for high clarity waterborne formulation

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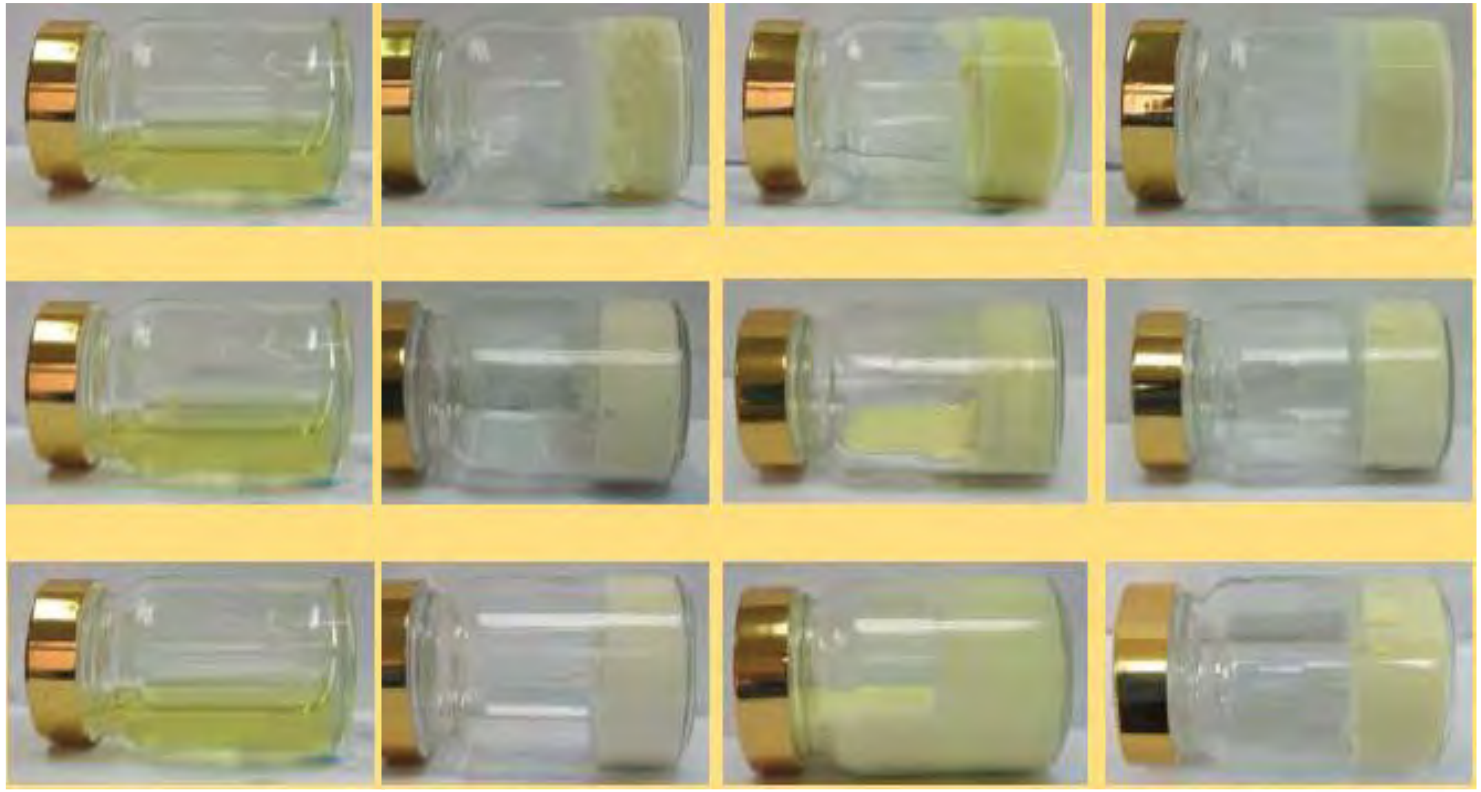
	AQ (Everlight)	DW (B com.)	DISP. (C com.)
Principle	Special treatment	NEAT Matrix model	Grinding and dispersing
Active Content	~90%	20-30%	~50%
Viscosity	High	Low	Medium
Storage Stability	Good	Good	Bad
Low Temp Stability	Good	Bad	Bad
Transparent in Water	Yes	X	X

Eversorb® AQ series are more stable than other commercial products

-20°C for 4 days



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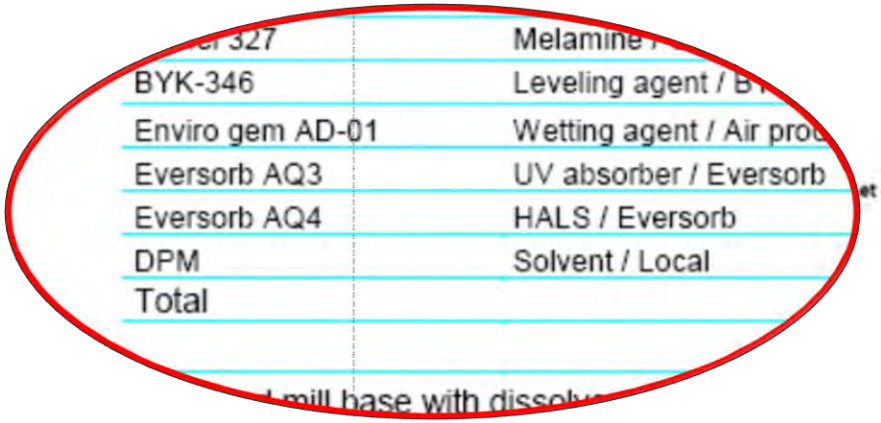
Light Stabilizers for Waterborne Coatings –
Eversorb® AQ

Light Stabilizers	Chemicals Class	Recommend System	Functions
EVERSORB AQ1	Blend UV-Absorber Plus HALS	-Nonionic -Amphoteric -Anionic	Prevent discoloration of clear coatings and enhanced gloss retention
EVERSORB AQ2	Blend UV-Absorber Plus HALS	-Cationic	Prevent discoloration of clear coatings and enhanced gloss retention
EVERSORB AQ3	UV-Absorber	-Nonionic -Amphoteric -Anionic	Prevent discoloration of clear coatings
EVERSORB AQ4	HALS	-Nonionic -Anionic	Prevent discoloration of pigmented coatings and enhanced gloss retention

Light Stabilizers for Waterborne Coatings – Eversorb® AQ

Light Stabilizers	Chemicals Class	Recommend System	Functions
EVERSORB AQ5	NOR HALS	-Nonionic -Anionic	•Prevent discoloration of pigmented coatings • Enhanced gloss retention • Suitable for alkyd and acidic systems
EVERSORB AQ6	UV-Absorber	-Nonionic -Anionic	•Prevent discoloration of clear coatings • High performance • Recommended for UV cut / filtering
EVERSORB AQ7	UV-Absorber	-Nonionic -Amphoteric -Anionic	Water-based UV curable
EVERSORB AQ8	Blend UV-Absorber Plus HALS	Nonionic -Amphoteric -Anionic	Prevent discoloration of clear and pigmented coatings and enhanced gloss retention for long term
EVERSORB AQ9	UV-Absorber	-Nonionic -Amphoteric -Anionic	High photo permanence

Listed in Covestro's Formulation



327	Melamine /
BYK-346	Leveling agent / BY
Enviro gem AD-01	Wetting agent / Air prod
Eversorb AQ3	UV absorber / Eversorb
Eversorb AQ4	HALS / Eversorb
DPM	Solvent / Local
Total	

mill base with dissolv

Bayer MaterialScience

Automotive Coatings **Guide Formulation 321/1**

Auto OEM

Water Borne 1K Mono coat

Key value proposition: good adhesion on CED & Good appearance

Bayhydrol U 241 / Bayhydrol U 2750 / Bayhytherm 3146 // Bayhydur BL XP2706 / Cymel 327

	Formulation	Function / Supplier	% by wt.
Mill base	Bayhydrol U 241	Resin / Bayer	3.54
	Distilled. water		3.47
	DMEA, 10% in dist. water	Neutralizer agent / Local	0.53
	Enviro gem AD-01	Wetting agent / Air products	0.42
	Tego 752W	Dispersant / Evonik	0.53
	R-960	Pigment / DuPont	19.34
	Distilled. water		1.69
	Rheolate 299	Thickening agent / Elementis	0.05
	Distilled. water		2.78
	Subtotal:		32.26
let down	Bayhytherm 3146	Resin / Bayer	28.38
	Bayhydrol U 2750	Resin / Bayer	13.50
	Bayhydur BL 2706 XP	Blocked - Isocynate / Bayer	14.51
	Cymel 327	Melamine / CYTEC	3.22
	BYK-346	Leveling agent / BYK	0.52
	Enviro gem AD-01	Wetting agent / Air products	0.50
	Eversorb AQ3	UV absorber / Eversorb	0.57
	Eversorb AQ4	HALS / Eversorb	0.29
	DPM	Solvent / Local	5.96
	Total		100.00

Preparation

1. Grind mill base with dissolver at 1,000-1,500 rpm for 20 min., then grind mill base including glass beads with shaker for about 1hour until particle size of mill base is less than 20 micrometer.
2. Add components in let-down into mill base under mixing for 15min at 1000rpm

Listed in Dow's Formulation

Coating Solution

High Performance Water-Based Wood Coating Solution for Joinery / Window Frame

Regional Product Availability
- Asia-Pacific

Description

Water-based wood coating solution for joinery / window frame which uses solid wood, such as China fir or cypress, as substrate. Clear coat together with stain will demonstrate the natural color and appearance of solid wood. Excellent impact resistance, exterior durability, water and stain resistance offers protection of the wood substrate from damage. Excellent early block resistance of acrylic polyurethane hybrid emulsion facilitates high manufacture efficiency.

Application Example

Exterior wooden window frames have high exterior durability requirements.

General Guideline
- Clear primer, clear top coat
- Two coats (one primer, one top coat) or three coats (two primers, one top coat)
- Spray application

Key Features
- Excellent early block resistance, print resistance
- Excellent exterior durability
- Excellent water resistance
- Excellent flexibility, impact resistance

Clear Coat – Suggested Starting Point Formulation

Material Name	Weight (g)	Function
PROSPERSE™ 130	680	Acrylic polyurethane hybrid emulsion
Deionized water	100	/
DOWANOL™ PnP	25	Coalescent
DOWANOL™ DPnP	10	Coalescent
DOWANOL™ DPnB	10	Coalescent
Tego Foamex 843	3	Defoamer
BYK 346	3	Wetting agent
Acematt TS-100	30	Matting agent
Michem 93935	20	Wax emulsion
Tego 410	5	Anti scratch additive
Eversorb AQ-1	3	UV absorber
ROCIMA™ 350	2	Biocide
ACRYSOL™ RM-8W	2	Rheology modifier
ACRYSOL™ RM-5000	15	Rheology modifier
ACRYSOL™ RM-12W	30	Rheology modifier
Deionized water	62	/
Total	1000.0	
Solid content (%)	34	
Viscosity (KU)	95	

Application Guideline
- Air / airless spray
- One / two primer and one top coat
- Wet film thickness of primer: 250 um
- Curing condition of primer: RT or 30-40°C baking
- Wet film thickness of top coat: 250 µm
- Curing condition of top coat: RT or 30-40°C baking
- Packaging time: 24 hours

Listed in ASHLAND's Formulation

ASHLAND

Paint type **Transparent topcoat for brush application**
Based on Acronal LR9014
Code GL LR9014 NMS450

Material	Weight %	Function	Supplier
Acronal LR9014	65.00	Binder	BASF
Water	18.00	Vehicle	-
Drewplus S-4386	0.50	Defoamer	Ashland Specialty Ingredients
Eversorb AQ1	2.00	UV protection	Everlight Chemical Industrial
Nuosept BM11	0.20	In-can preservation	Ashland Specialty Ingredients
Texanol	1.60	Co-solvent	Eastman Chemicals
Drewfax 860	0.50	Surfactant	Ashland Specialty Ingredients
Drew 210-886	0.60	Defoamer	Ashland Specialty Ingredients
Fungitrol L30DPG	0.30	Film preservative	Ashland Specialty Ingredients
Aquaflow NMS-450	3.20	Rheology modifier	Ashland Specialty Ingredients
Water	8.09	Viscosity adjustment	-
pHlex™ 400	0.01	pH adjustment	Ashland Specialty Ingredients
Total	100.00		

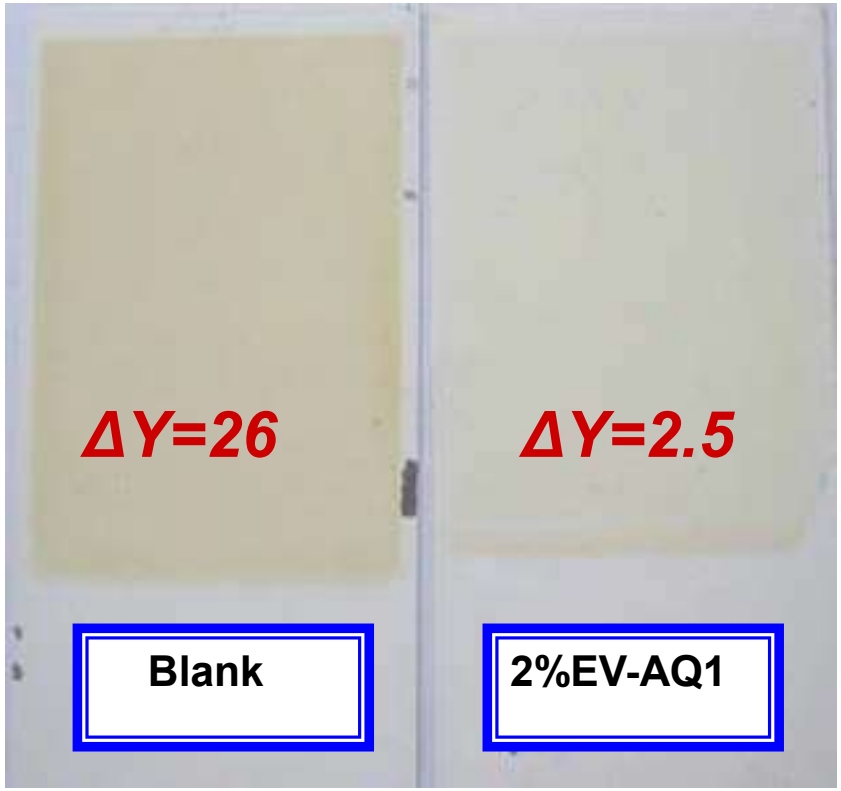
Physical properties		
Pigment volume concentration	0.0	%
Non-volatile weight	32.7	%
Non-volatile volume	31.4	%
Density	1.020	Kg/L

Rheology		
Viscosity :	3500	mPa.s
pH : At 25°C	8.0-8.5	
Fineness :	< 10	µm.

Paint properties						
Leveling (NYPC)	5	-	Gloss	60°	80	GU
Sag resistance	200	microns				

Enhanced Color & Gloss Retention of Acrylic Waterborne Clear Coatings

Resin : Acrylic (AC) Waterborne Clear Coating
Exposure Time : 500 hours Additives:EVERSORB AQ1
Test Methods : ASTM G154-1 (Q-U-V with UVB-340 light bulb)



After Test

Before Test

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Enhanced Color Retention of Acrylic Waterborne Pigmented Coatings

Resin ： Acrylic(AC) Waterborne Coating
Pigmented :Island green NO. 420-6
Exposure Time : 2000 hours Additives:EVERSORB AQ4
Test Methods ：ASTM G154-2 (Q-U-V with UVB-313 light bulb)

Fig.2-1 Delta difference color (ΔE)

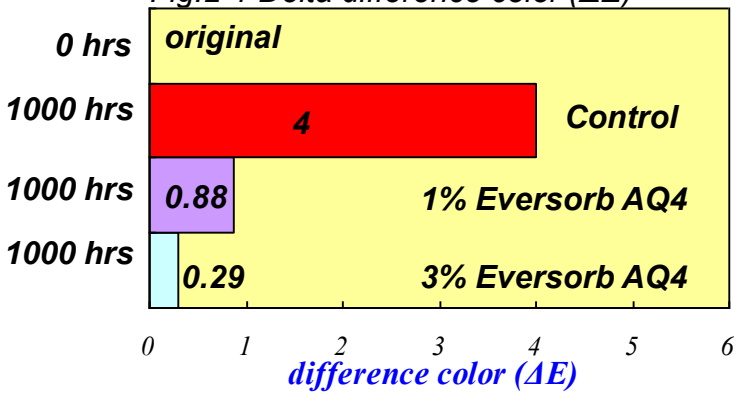
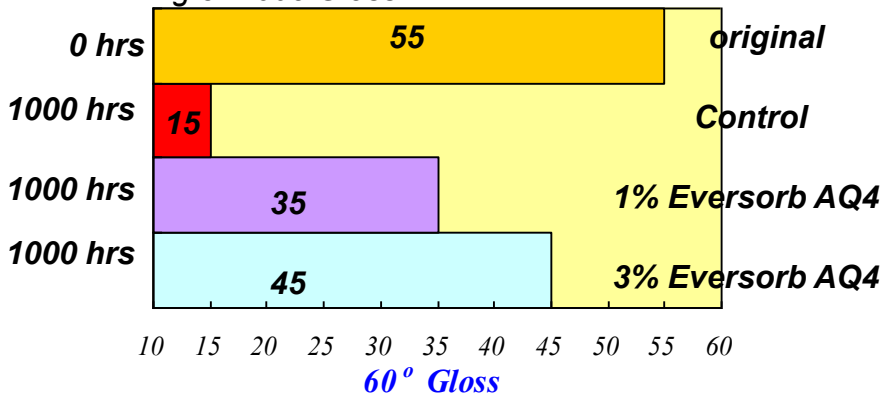
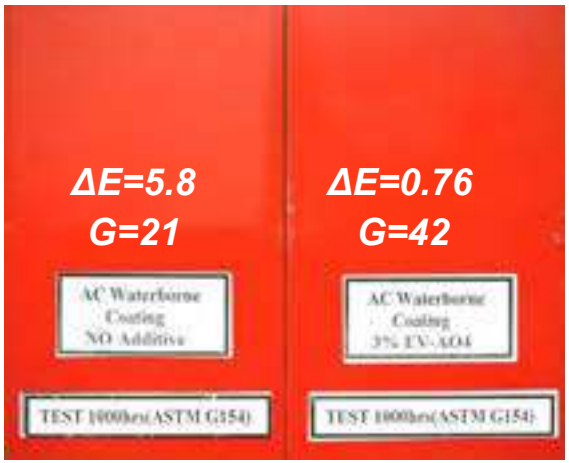
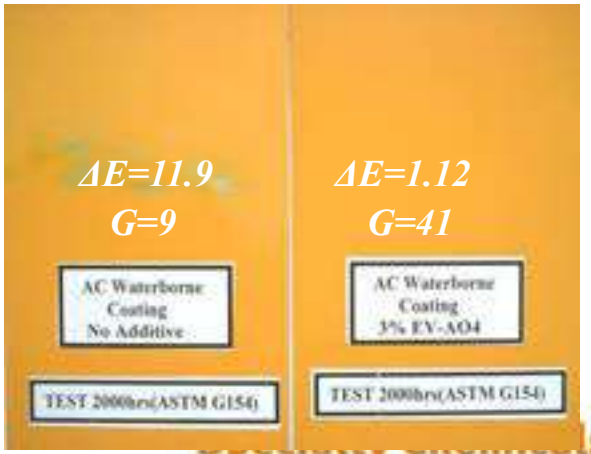


Fig.3-2 60o Gloss

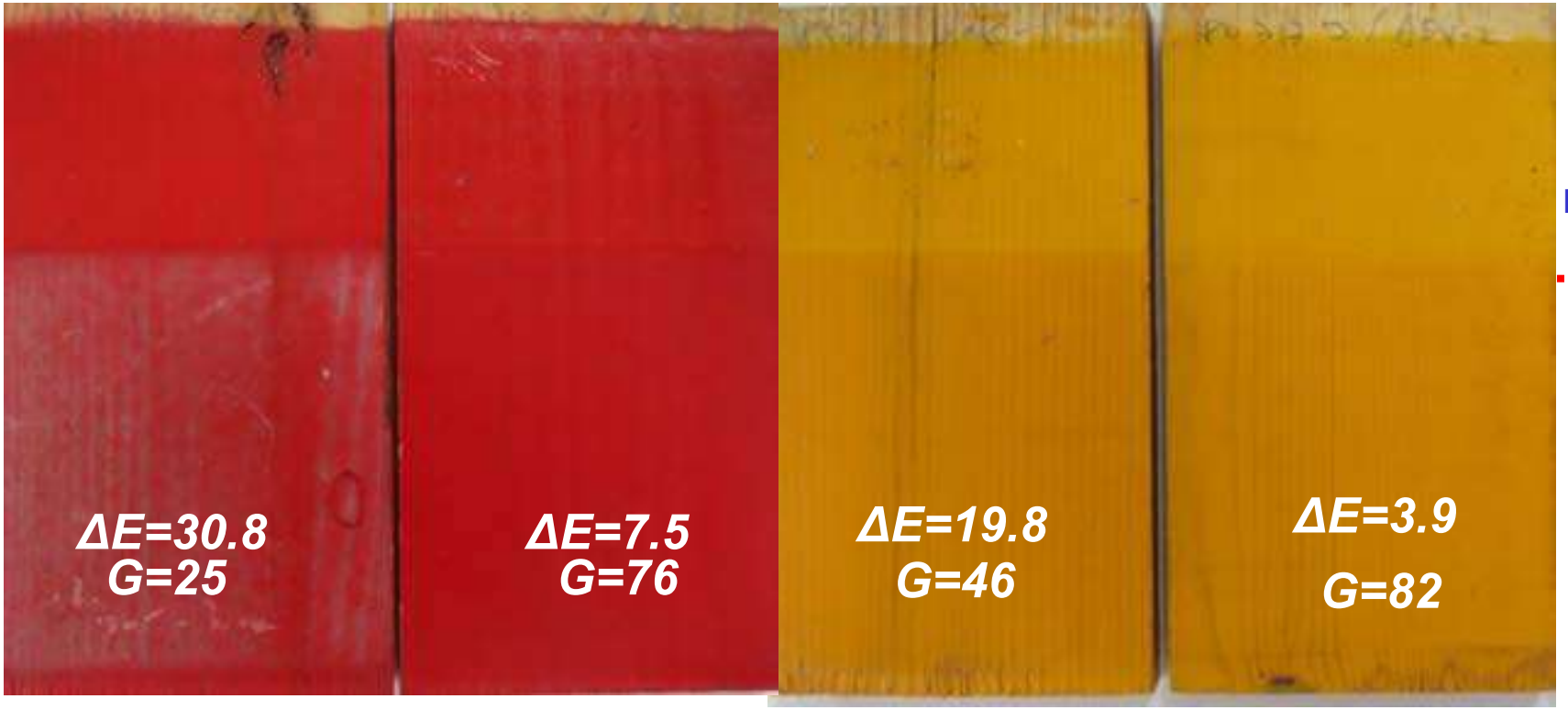






Enhanced Color Retention of Acrylic Waterborne Pigmented wood Coatings

Resin ： Acrylic(AC) Waterborne Coating
Exposure Time : 5200 hours Additives:EVERSORB AQ4
Test Methods ：ASTM G154-1 (Q-U-V with UVA-340 light bulb)



Blank	2% EV-AQ4	Blank	2% EV-AQ4

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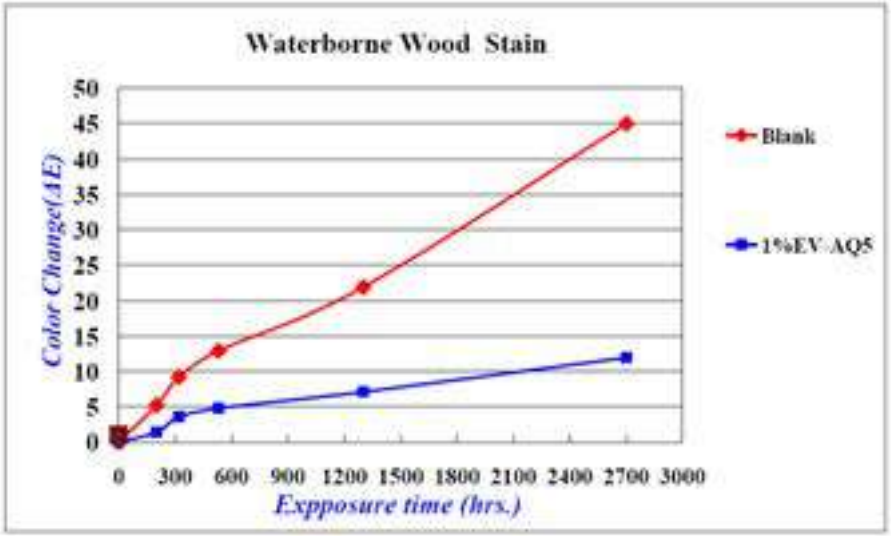
Eversorb® AQ5
Weathering Test for Waterborne Wood Stain Coating

Resin : Acrylic/Alkyd Waterborne Wood Stain
Exposure Time : 2700 hours Additives:EVERSORB AQ5
Test Methods : ASTM G154-1 (Q-U-V with UVB-340 light bulb)



Blank

1% EV-AQ5

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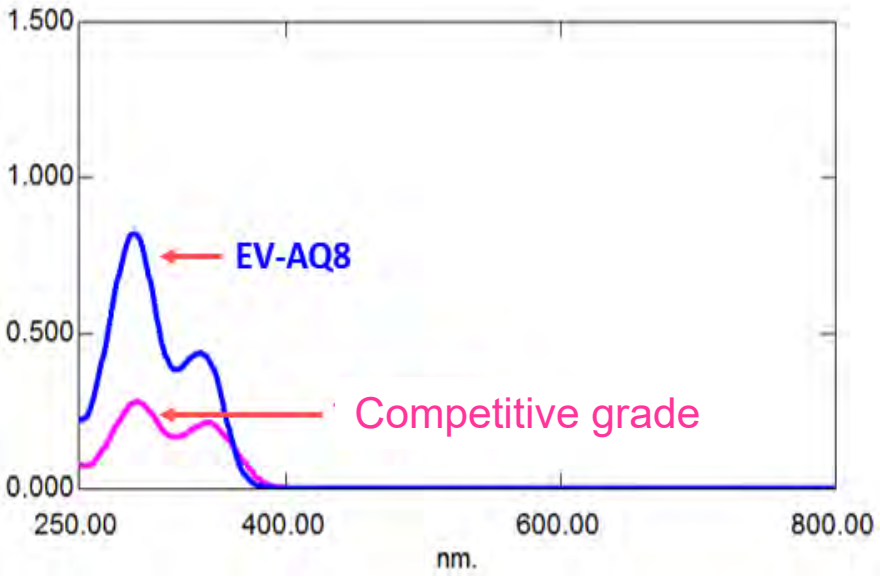
Eversorb® AQ8 vs. Competitive grade

- Labeling Free

Waterborne Light Stabilizer
(Triazine+NOR HALS)



Eversorb AQ8 **Competitive grade**

Specialty Chemicals
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Enhance Durability of Waterborne Resin on Wood

- **Resin**：**Waterborne** Acrylic Resin
- **Test model**：ASTM G154-2 (313nm)
- **Test time**：168 hrs
- **Test energy :** 0.71W/m^2
- **Dosage :** 2% light stabilizers

-- No Additive -- --EV-AQ1-- --EV-AQ8-- --Competitive grade-

ΔE=21 *ΔE=9.2* *ΔE=3.8* *ΔE=14*

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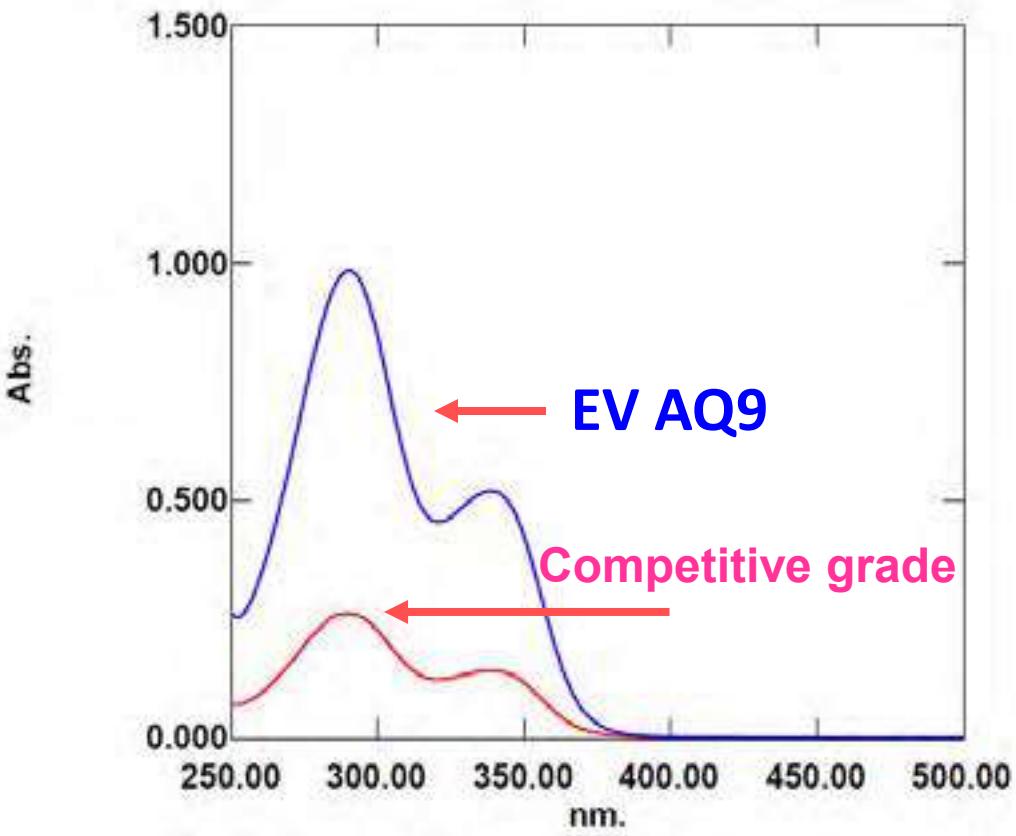
Eversorb® AQ9 vs. Competitive grade

- Labeling Free

Waterborne Light Stabilizer (Triazine)



•Eversorb AQ9 **Competitive grade**

Enhanced Color & Gloss Retention of Acrylic Waterborne Clear Coatings

Resin : Acrylic (AC) Waterborne Clear Coating
Exposure Time : 1500 hours Additives: Competitive grade vs. EV-AQ9
Test Methods : ASTM G154-2 (Q-U-V with UVB-313 light bulb)

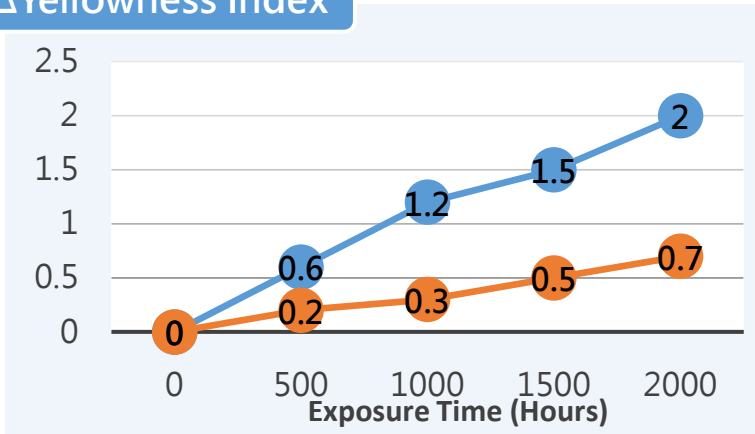
ΔY=26	ΔY=8.4	ΔY=2.2
Blank	2% Competitive grade	2% EV-AQ9

Long-term Durability & High Performance Light Stabilizer-Eversorb® AQ9

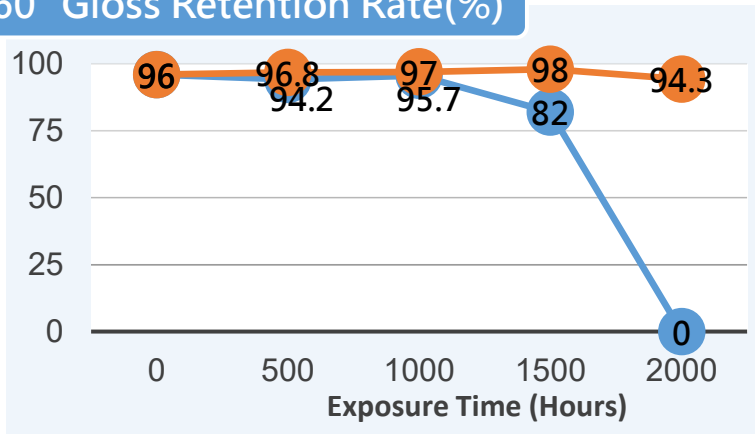
Test Condition

- **Resin** : Waterborne acrylic white coating
- **Test Method** : ASTM G155-1 (Xenon)
- **pH Value** : 8-8.5
- **Dry thickness** : 35μm
- **Test Time** : 2,000hrs

ΔYellowness Index



60° Gloss Retention Rate(%)



Blank 1% Eversorb® AQ9 + 1% Eversorb® AQ4

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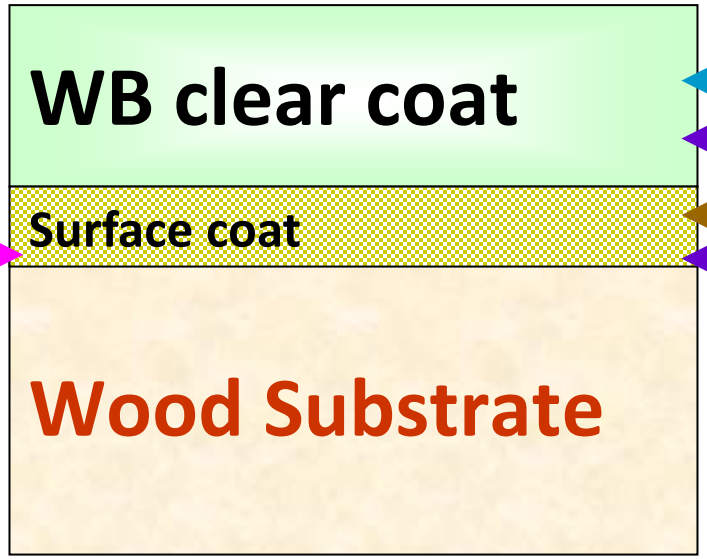
Total Solution of Light Stabilizers for Natural Wood Products



WB wood coating **light stabilizers**

EV- AQ Series

WB wood pretreatment

Lignin stabilizers

EV- SB Series

WB wood pretreatment

Tannic acid stabilizers

EV- TA Series

wood pretreatment

Wood Wax Oil stabilizers

NLS Series

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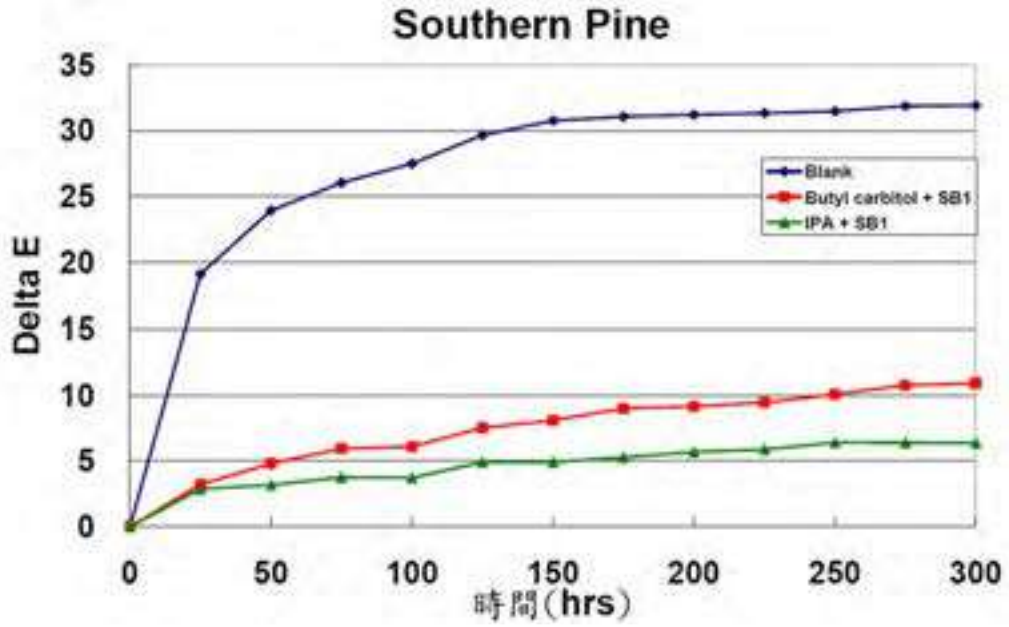
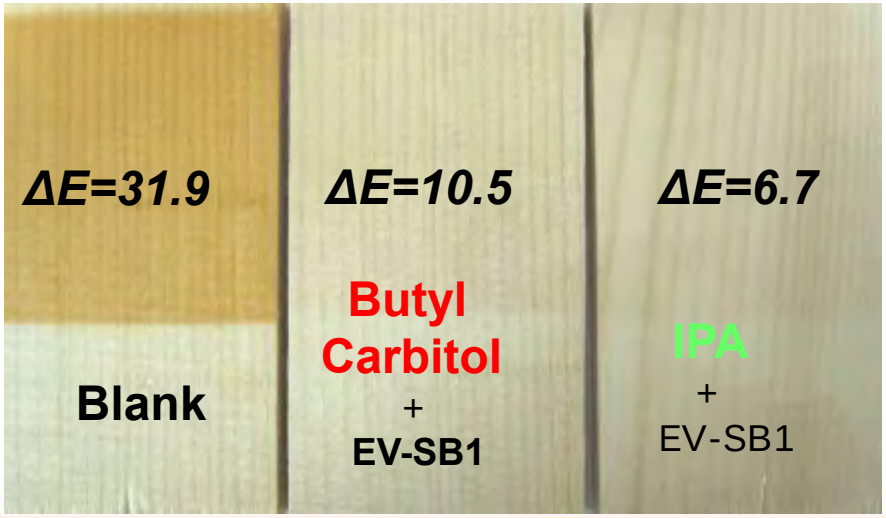
Eversorb® SB1 –

The Light Stabilizer for Wood Pre-treatment



Southern pine

ASTM G154-1
Exposuret : Q-U-V with UVA-340 light bulb



(Exposed)

(Covered)

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Eversorb® TA1 –

The Light Stabilizer for Tannic Acid

2% TA1 mixed with 20% Tannic Acid

After exposing with UVA-340 light bulb for 8hrs

Before ***After*** ***Before*** ***After***

33.3 82.2

(Iodine Color)

20% Tannic acid

18.3 19.2

(Iodine Color)

20% Tannic acid

+

2% TA1

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EV-TA1:

- Reducing effect of tannic acid for wood after exposing

3% TA1 in top coat over 20% Tannic acid pretreatment *(on Southern Pine)*

Exposure Unit : Q-U-V with UVA-340 light bulb

Only Top Coat

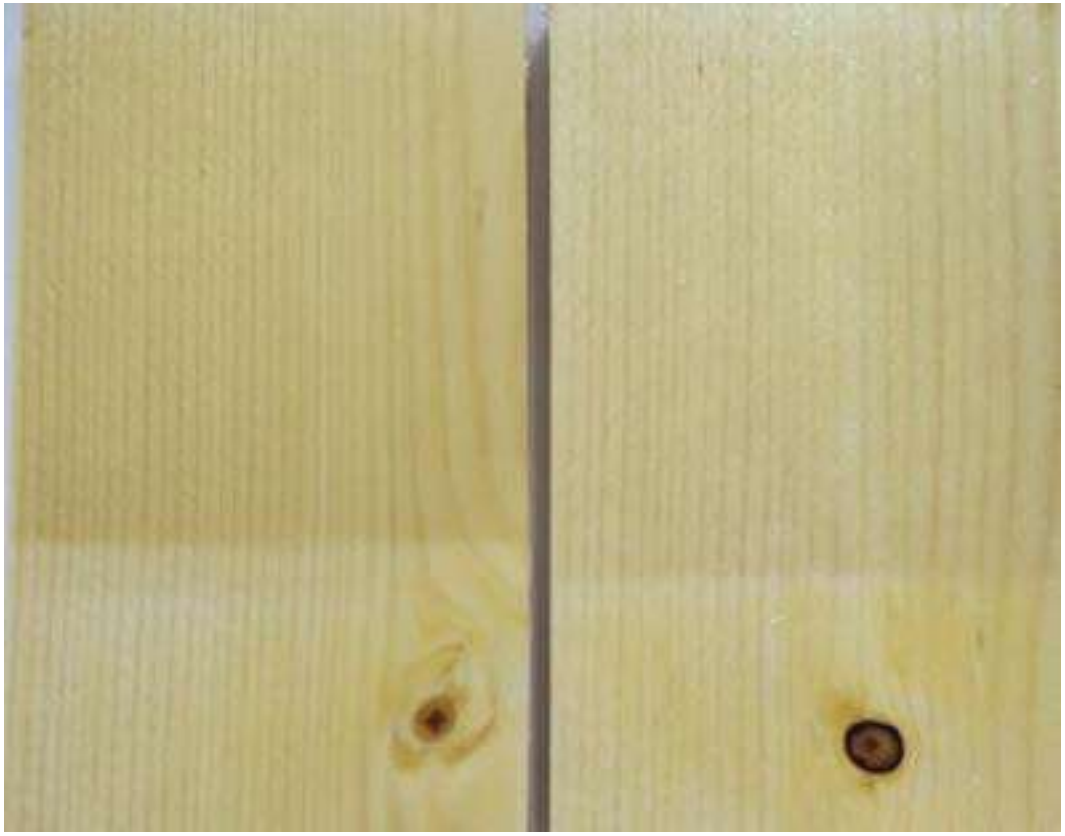
Top Coat /20% Tannic acid in the pretreatment

3% TA1 in Top Coat/ 20% Tannic acid in the pretreatment

Eversorb® 108 –

Solution for Solving Wood Wax oil and Improving Weathering

Exposure Unit :
Q-U-V with UVA-340 light bulb for 24 hours



Blank 1% EV-108

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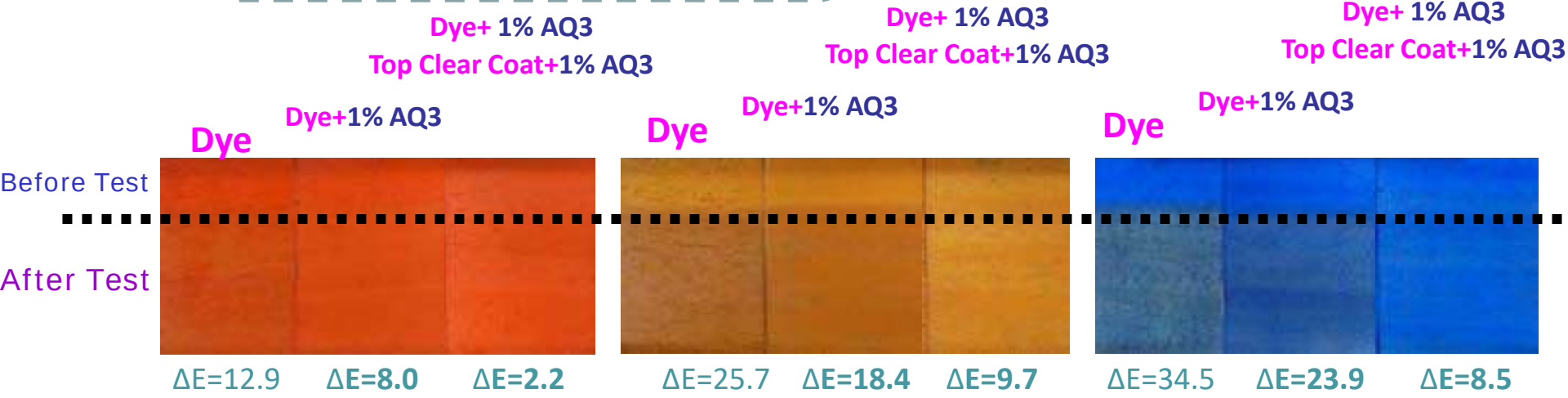
Total Solution of Light Stabilizers for Wood Veneer Products

Test Condition

Test Method : 340nm light blub
Time:˙72hrs



Specialty Chemicals
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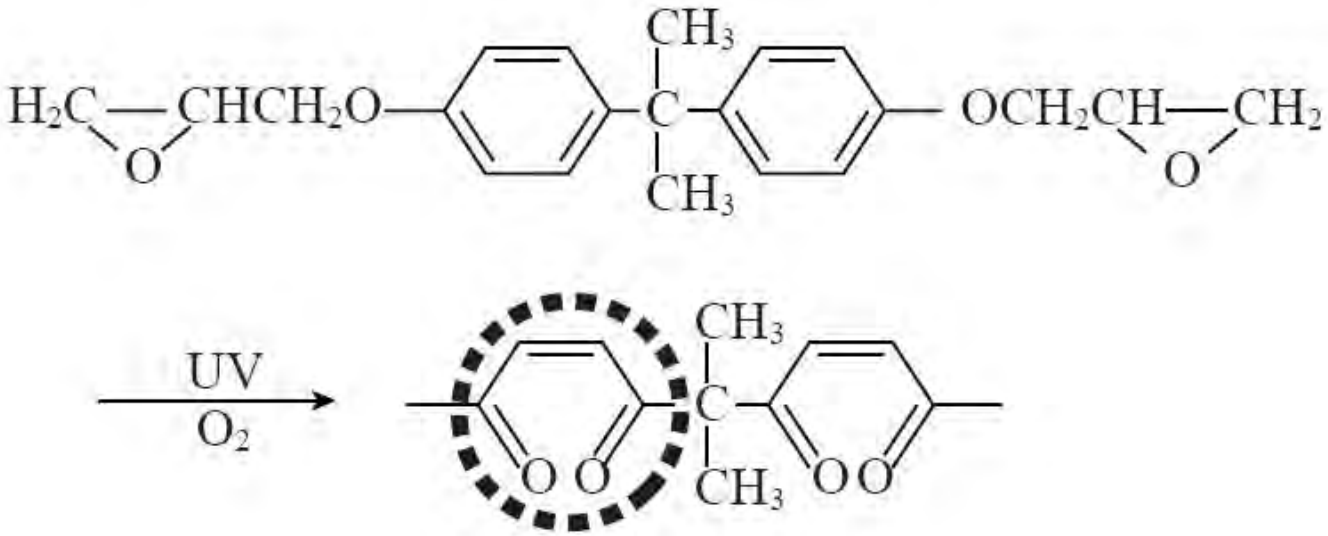
Recommendations for Industrial and Functional Coatings




Eversorb® EP Series –
Light Stabilizers for Epoxy

Degradation of Epoxy



Eversorb® EP Series

Product Name	Appearance	Compatible System	Viscosity (20°C / cps)	Recommended Dosage	Applications	Features
Eversorb® EP4	Yellow Liquid	Solvent	8,000 - 10,000	0.5% ~ 3% Based on Solids Content	Industrial Coatings	Enhance Weatherability of Solvent-borne Coatings (General)
Eversorb® EP5S		Anionic Cationic Amphoteric	500 - 1,500		Industrial Coatings	Enhance Weatherability of Waterborne Coatings (General)
Eversorb® EP5C		Anionic Cationic Amphoteric	3,500 - 6,500		Floor Coatings Wall Coatings Anti-corrosion Coatings Metallic Coatings	Enhance Weatherability of Special Waterborne Coatings (Advanced)
Eversorb® EP6		Solvent	1,200 - 1,800		Floor Coatings Metallic Coatings Architectural Coatings	Enhance Weatherability of Solvent-borne Coatings (Economy)

Eversorb® EP Series –
Light Stabilizer for Solvent-based Epoxy

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Enhanced Color Retention of Epoxy resin

- Eversorb EP4: a liquid light stabilizer
- Use level: 0.5 to 2.0 wt% based on total resin solids (A+B).
- Effective in amine-based epoxy systems, e.g. epoxy flooring, wall coatings, and wind mill applications.




Design of Experiment (DOE)

PART-A: D.E.R 324 (DOW)
PART-B: D.E.H 530 (DOW)
(Modified Cycloaliphatic Amine)
A:B=1:1(wt%)

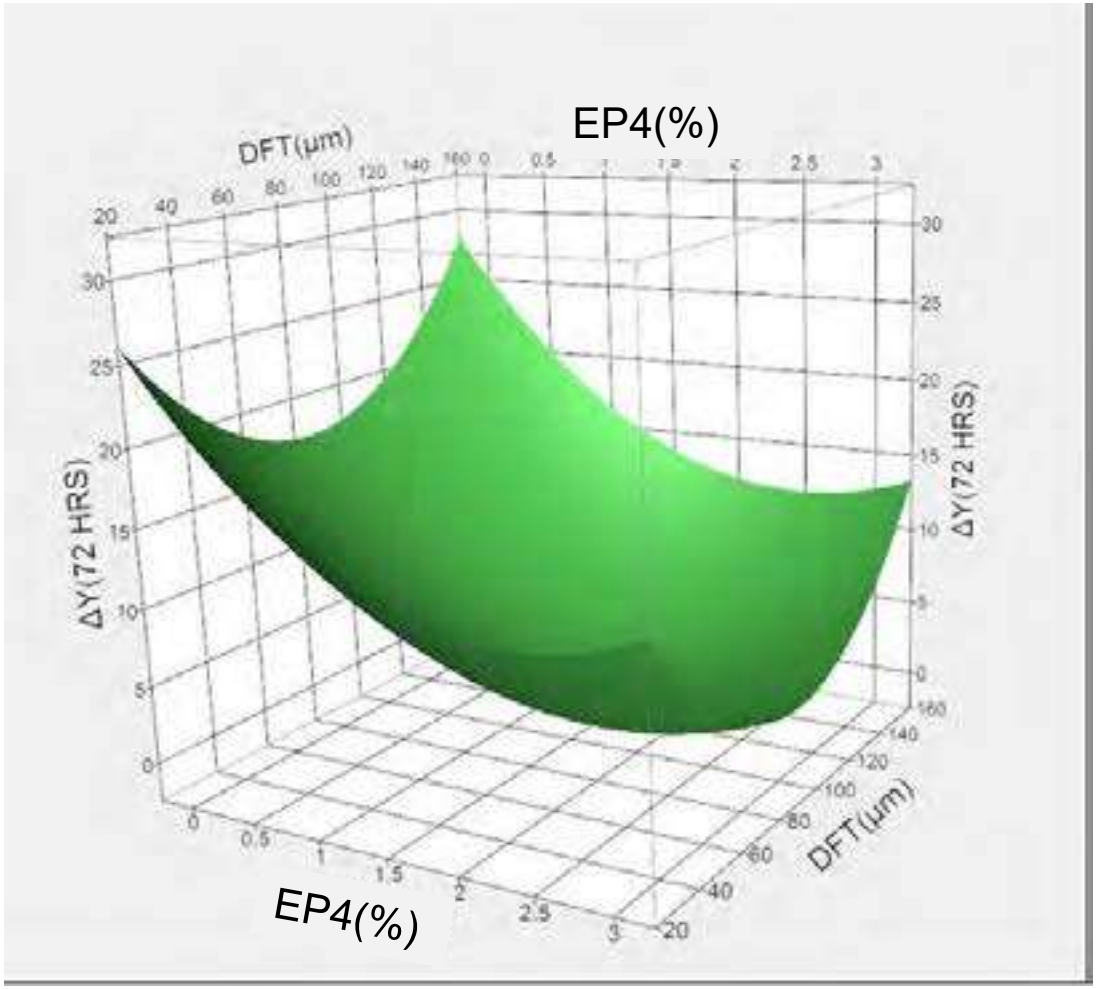
Exposure: QUV 340nm (70℃*1.35W/m2)
Test Time: 72hrs

Table The evaluation of optimal results：

RUN	EP4: Conc. (%)	DFT : Film Thickness (μm)	ΔY : Delta Yellowness Index (72h)
1	0	30	21.26
2	0	50	16.73
3	0	150	22.26
4	1	30	12.87
5	1	50	8.4
6	1	150	13.85
7	3	30	9.3
8	3	50	6.7
9	3	150	9.7

Response surface methodology

Response of ΔY



Eversorb ® EP4-
Enhanced Color Retention of Epoxy Clear Coatings

PART-A: D.E.R 324 (DOW)

PART-B: D.E.H 530 (DOW)

A:B=1:1(wt%)

Exposure: QUV 340nm (60℃*0.71W/m2)
Test Time: 72hrs
Additive: 2 wt% base on epoxy (A+B)
Measurement: Delta yellowness index (ΔYI)

Before Test

After Test

Specialty Chemicals
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ST17016-Enhanced Color Retention after Heating

PART-A: D.E.R 324 (DOW)

PART-B: D.E.H 530 (DOW)

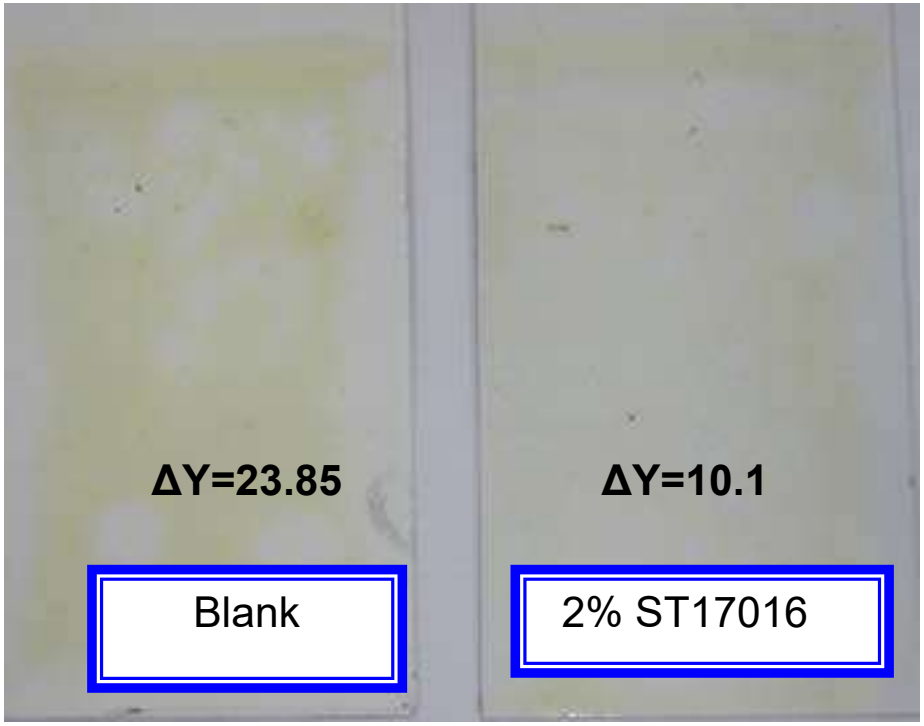
A:B=1:1(wt%)

Condition: Heating at 125℃

Test Time: 7.5hrs

Additive: 2 wt% base on epoxy (A+B)

Measurement: Delta yellowness index (ΔYI)



Specialty Chemicals
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Eversorb® EP Series –
Light Stabilizer for Waterborne Epoxy

Specialty Chemicals
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Eversorb ® EP5S-

Enhanced Color Retention of Waterborne Epoxy Clear Coatings

PART-A: POLYPOX E403 (DOW)

PART-B: POLYPOX IH 7005W (DOW)

A:B=1:1(wt%)

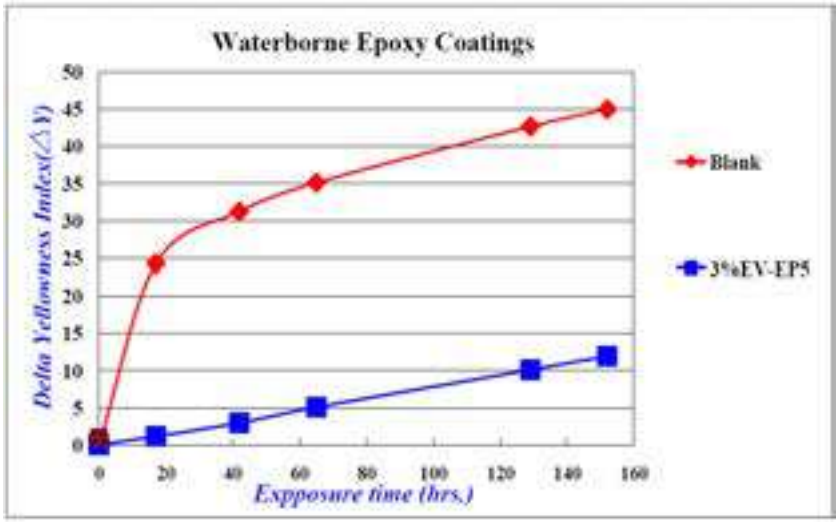
Thermal curing: 24hrs @ 25℃

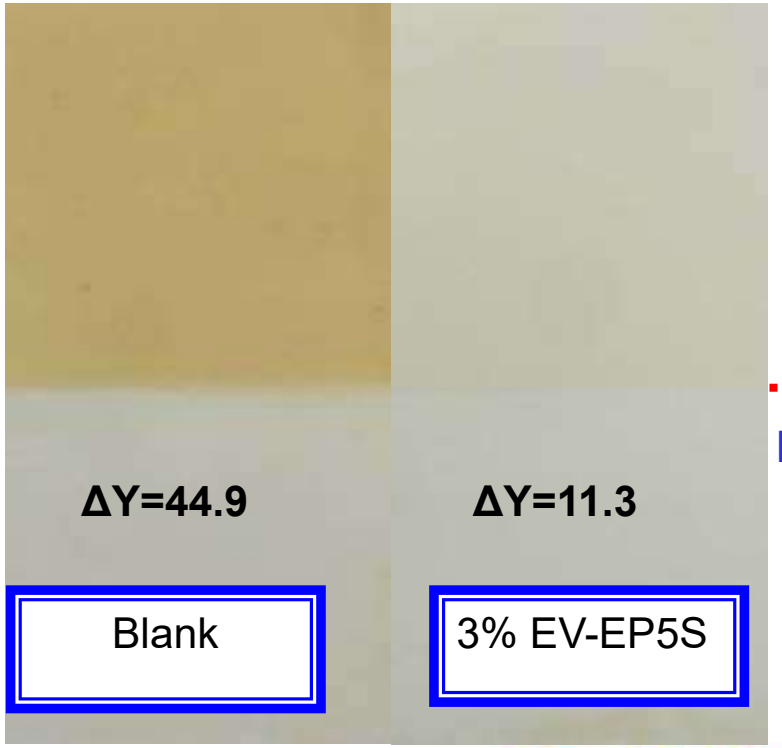
Exposure: QUV 340nm (70℃*1.35W/m2)

Test Time: 152hrs

Additive: 3 wt% base on epoxy (A+B)

Measurement: Delta yellowness index (ΔYI)





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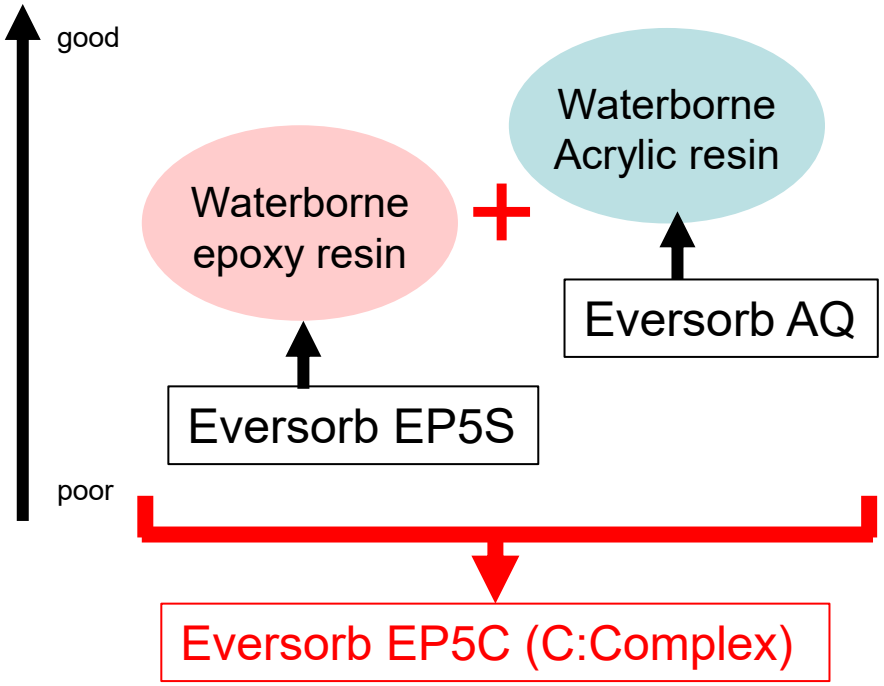
Eversorb ® EP5C-
High Performance for Waterborne Epoxy Acrylate Clear Coatings



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Eversorb ® EP5C-

Enhanced Color Retention of Waterborne Epoxy Acrylate Clear Coatings

Eversorb® EP5C in Waterborne Clear Coat

- Test Standard：ASTM G154-2 (QUV with UVB-313 light bulb)
- Dosage：2% Eversorb® EP5C based on solids content
- Exposure Time：300 hrs

Fig.5 Physical Properties Comparison

	No Additive	Eversorb® EP5C
Exposure Time Before Obvious Chalking	180 hrs	600 hrs
Color Difference	ΔE > 5	ΔE < 3
Gloss Retention Rate	< 40%	> 80%

Fig.6 Appearance

Specialty Chemicals
特化事業處

Eversorb® AS Series –

The Novel Light Stabilizer for Polyaspartic

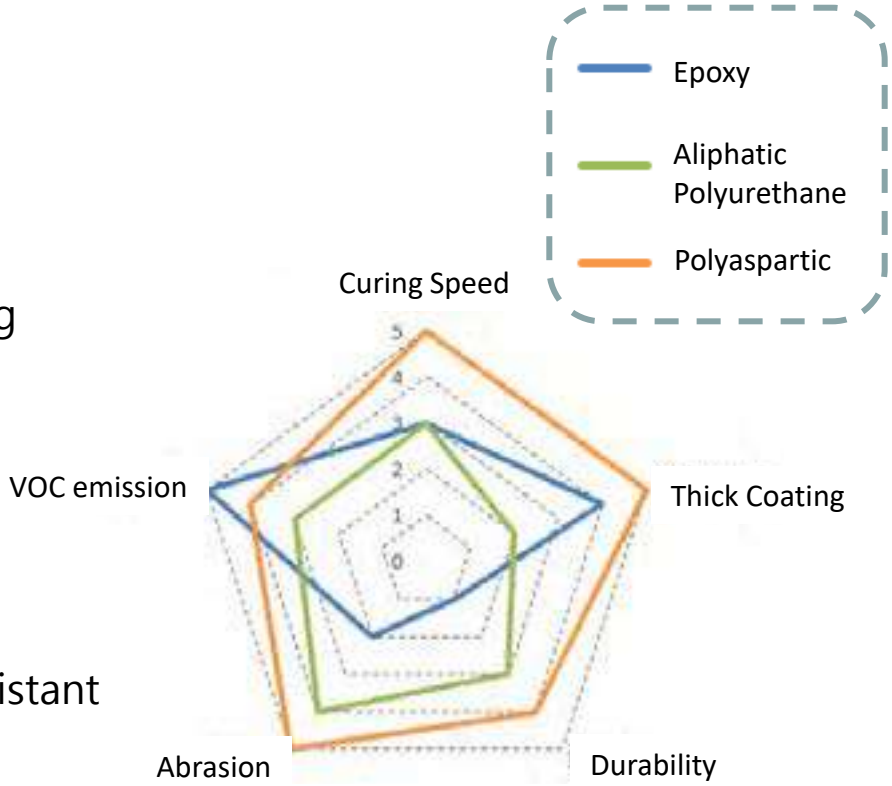
Polyaspartic for Next Generation Coatings

Fast Curing Speed

Thick Coating Layer

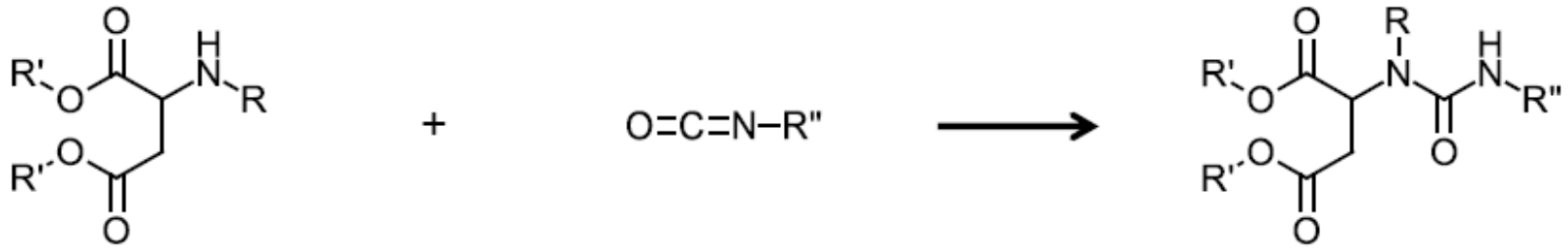
Good Durability

Great Abrasion Resistant



Source : https://customconcreteprepandpolish.com/epoxy-polyurethane-polyaspartic-coatings/

Synthetic of Polyaspartic

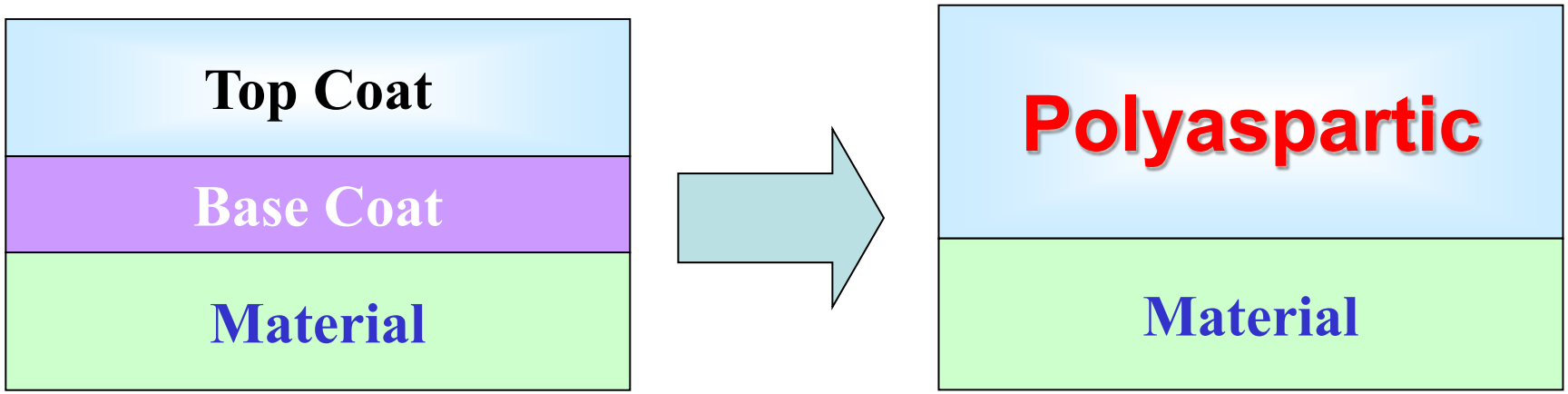


Aspartic Acid Ester Aliphatic Isocyanate Urea Structure

Polyaspartic Coatings – Examples for common applications

Information From Bayer

Productivity and cost efficiency



Eversorb® AS Series

Eversorb® AS1 Eversorb® AS2

Product Name	Appearance	Viscosity 20°C / mPa.s	Weatherability	Dosage	Applications
Eversorb® AS1	Light yellow liquid	5000 ~ 7000	●●●●●	0.5% ~ 3% (based on resin solids)	· Refinish coatings · Anti-Corrosion coatings · Floor coatings · Industrial coatings
Eversorb® AS2		2700 ~ 3300	●●●		

Enhanced Color and Gloss Retention of Polyaspartic - Eversorb AS Series

Resin ： Polyaspartic

Exposure Time : 3500 hours Additives:EVERSORB AS1& AS2

Test Methods ：ASTM G154-2 (Q-U-V with UVB-313 light bulb)

YI=20.57 G=21.3 Blank	YI=4.1 G=81 2% AS1	YI=8.69 G=62 2% AS2

Conclusions

1. Using UVA and HALS together can give you synergistic performance.
2. According to customer's requirements, you have the choices of our best products.

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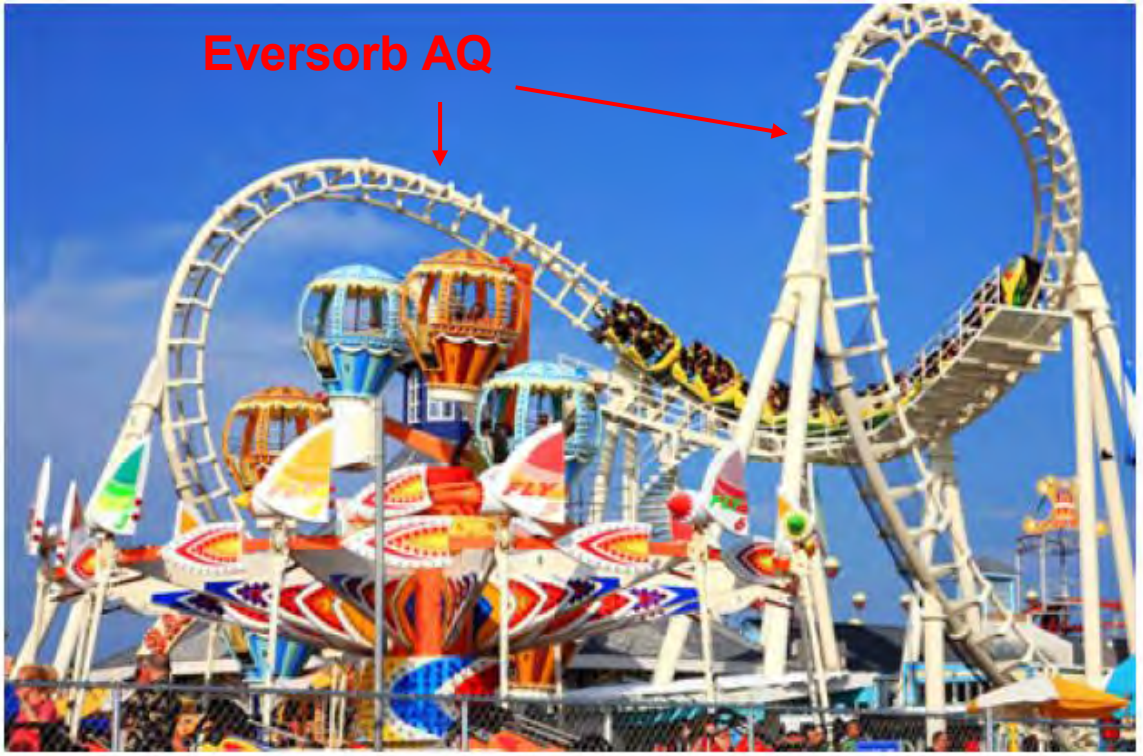

Thank you for your attention

Specialty Chemicals
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