

Eastman™ cellulose esters technical tip

Controlling yellowing in wood coatings

Introduction

When used in wood coatings, one of the most valued properties of Eastman™ cellulose acetate butyrate (CAB) is its resistance to yellowing when exposed to ultraviolet light. This property is very important when producing wood coatings that will be exposed to sunlight, applied to light colored wood, or used in white pigmented systems.

Nitrocellulose, the most commonly used cellulose derivative in these applications, is disadvantaged due to its tendency to turn yellow when exposed to UV light. This instability of nitrocellulose cannot be fully overcome by the use of UV stabilizers. The only option is to replace it with a more stable polymer.

The following photograph shows wood that has been treated with a white CAB primer and then finished with either an Eastman™ CAB or nitrocellulose lacquer. Half of each surface was then shielded and the sample was placed in a QUVB chamber (313 nm wavelength) for 24 hours.

After exposure, the coating with nitrocellulose lacquer is severely yellowed even with UV stabilizer, while the coating with Eastman CAB is unaffected. The formulas used to produce the samples are shown in Table 1.

Figure 1 UV stability of Eastman™ CAB vs. nitrocellulose in a wood coating

Eastman CAB acrylic lacquer without UV stabilizer 24 hours QUVB 313 1.3 yellowness index	Nitrocellulose lacquer with UV stabilizer 24 hours QUVB 313 15.9 yellowness index	Nitrocellulose lacquer without UV stabilizer 24 hours QUVB 313 18.3 yellowness index
Eastman CAB acrylic lacquer without UV stabilizer 0 hours QUVB 313 0.8 yellowness index	Nitrocellulose lacquer with UV stabilizer 0 hours QUVB 313 0.7 yellowness index	Nitrocellulose lacquer without UV stabilizer 0 hours QUVB 313 1.0 yellowness index

Yellowness index measured by Hunter Ultra Scan XE, (CIE Color Analysis)

Eastman™ CAB and nitrocellulose compatibility

It is often asked whether CAB and nitrocellulose can be mixed to improve the weathering of nitrocellulose. Unfortunately, this is not possible. It is very difficult to combine CAB and nitrocellulose, since they are not compatible with the same resins and have different solubilities. This often leads to the CAB or the nitrocellulose precipitating out of the solution during drying which results in whitening and poor film formation.

More importantly, CAB does not impart UV stability to nitrocellulose or other resins. Even if they had complete intercompatibility and identical solubility, the nitrocellulose fraction of the resin will still turn yellow and weather poorly.

Table 1 Wood coating basecoat and lacquer formulations

Component	White Eastman™ CAB acrylic basecoat, wt%	Nitrocellulose lacquer, wt%	Eastman CAB acrylic lacquer, wt%
Eastman™ cellulose acetate butyrate (CAB-551-0.2) ^a	—	—	10.0
Eastman™ cellulose acetate butyrate (CAB-381-0.5) ^a	4.0	—	—
Paraloid™ B-66 ^b	3.0	—	7.0
Santicizer™ 160 ^c	3.0	—	2.7
TiO ₂ :CAB chip 60/40 ^d	10.0	—	—
SF™-69 (1% in xylene) ^e	0.6	0.3	0.5
Diisononyl phthalate ^e	—	4.5	—
Duramac™ 5205 ^e	—	14.5	—
Nitrocellulose-DHX 30-35 (70% in isopropyl alcohol)	—	11.5	—
Eastman™ <i>n</i> -butyl acetate ^a	—	29.3	23.5
Methyl ethyl ketone	—	8.5	7.5
Eastman™ <i>n</i> -butanol (<i>n</i> -butyl alcohol) ^a	—	8.5	11.0
Eastman™ MAK (methyl <i>n</i> -amyl ketone) ^a	10.0	—	9.0
Tecsol™ C solvent, 95% ^{a,h}	10.0	—	12.5
Eastman™ ethyl acetate ^a	5.0	—	—
Eastman™ SAIB-90 (sucrose acetate isobutyrate—denatured ethanol) ^a	—	—	0.3
Eastman™ isobutyl acetate ^a	10.0	—	—
Toluene	39.4	5.0	7.0
VM&P naphtha	—	7.0	9.0
Eastman™ IBIB (isobutyl isobutyrate) ^a	—	6.0	—
Xylene	—	3.5	—
Eastman™ EB solvent (ethylene glycol monobutyl ether) ^a	0	1.4	—
Total	100.00	100.00	100.00
Tinuvin™ 328 UV stabilizer ^f	—	1.0 ^g	1.0 ^g

^aEastman Chemical Company

^bThe Dow Chemical Company

^cFerro Corporation

^dPenn Colour

^eMomentive

^fCiba

^g% by weight when used

^hEastman Chemical Company no longer makes or supplies Tecsol C. Equistar has a similar product called Filmex C but contains slightly less ethyl acetate.

Conclusion

Wood coatings based on Eastman™ cellulose acetate butyrate (CAB) have demonstrated superior yellowing resistance when exposed to ultraviolet light while similar nitrocellulose-based coatings demonstrate severe yellowing even with UV stabilizers.

Resistance to yellowing is a very important property when formulating wood coatings that will be exposed to sunlight, applied to light colored wood, or used in white pigmented systems.



**Eastman Chemical Company
Corporate Headquarters**

P.O. Box 431
Kingsport, TN 37662-5280 U.S.A.

Telephone:
U.S.A. and Canada, 800-EASTMAN (800-327-8626)
Other Locations, (1) 423-229-2000
Fax: (1) 423-229-1193

Eastman Chemical Latin America

9155 South Dadeland Blvd.
Suite 1116
Miami, FL 33156 U.S.A.

Telephone: (1) 305-671-2800
Fax: (1) 305-671-2805

Eastman Chemical B.V.

Fascinatio Boulevard 602-614
2909 VA Capelle aan den IJssel
The Netherlands

Telephone: (31) 10 2402 111
Fax: (31) 10 2402 100

**Eastman (Shanghai) Chemical
Commercial Company, Ltd. Jingan Branch**

1206, CITIC Square
No. 1168 Nanjing Road (W)
Shanghai 200041, P.R. China

Telephone: (86) 21 6120-8700
Fax: (86) 21 5213-5255

Eastman Chemical Japan Ltd.

MetLife Aoyama Building 5F
2-11-16 Minami Aoyama
Minato-ku, Tokyo 107-0062 Japan

Telephone: (81) 3-3475-9510
Fax: (81) 3-3475-9515

Eastman Chemical Asia Pacific Pte. Ltd.

#05-04 Winsland House
3 Killiney Road
Singapore 239519

Telephone: (65) 6831-3100
Fax: (65) 6732-4930

www.eastman.com

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