Eastman chlorinated polyolefins

Formulating with Eastman waterborne CPO adhesion promoters

Useful as:

- **Base resins for waterborne adhesion promoter primers**
- **Adhesion promoting additives for waterborne coatings**

Introduction

The application of paint to polypropylene and TPO (thermoplastic polyolefin) is difficult because of the poor adhesion of most coatings to these plastics. Eastman CPO adhesion promoters are effective in improving paint adhesion to these substrates. With Eastman CPO dispersions, it is possible to apply an adhesion-promoting primer from a waterborne system or to promote adhesion of a waterborne coating through use as an additive.

Physical properties

Eastman CP 310W, CP 347W, and CP 349W are water dispersions of the same CPO resin. Major differences are the neutralizing amine in each dispersion and the presence of ethylene glycol in CP 349W. Physical properties are shown in Table 1.

Table 1 **Typical properties**[a]

	Eastman CP 310W	Eastman CP 347W	Eastman CP 349W
Wt% solids	30	25	26
Wt% CPO	24	20	20
Solvent	—	—	5% ethylene glycol
pH @ 25°C	9–10	9–10	9–10
Amine	Ammonia	2-amino-2-methyl-1-propanol	2-amino-2-methyl-1-propanol
Stability			
Shelf, 1 yr	No change	No change	No change
50°C, 4 wk	Slight settle	No change	No change
Freeze-thaw	Good	Good	Good

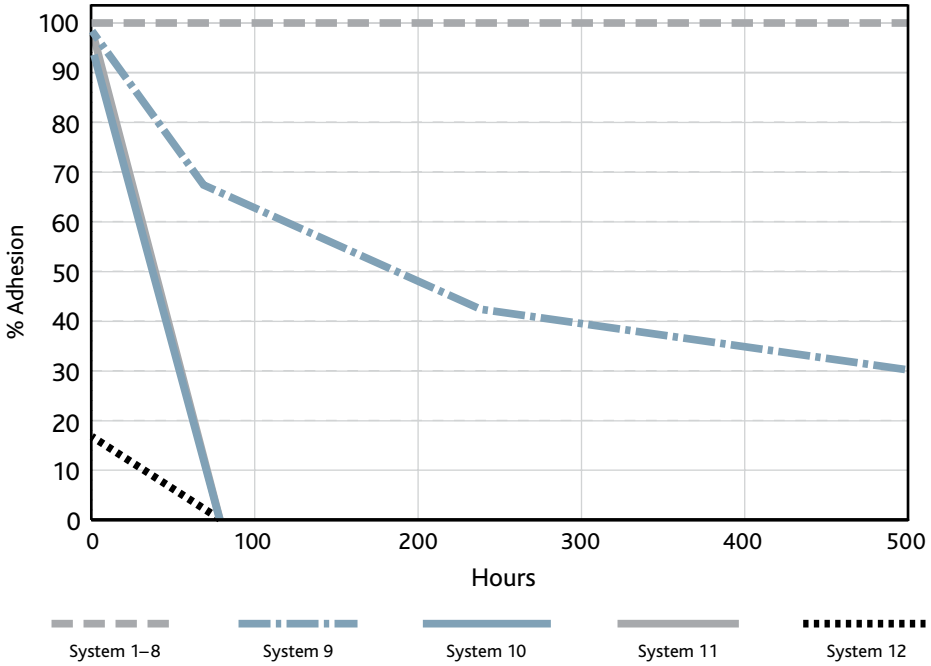
[a]*Eastman makes no representation that product in any particular shipment will conform exactly to the values listed.*

Generally, the faster evaporating ammonia in CP 310W makes it more useful in adhesion-promoting primers that are air dried prior to application of the topcoat. The 2-amino-2-methyl-1-propanol in CP 347W and CP 349W makes them more compatible with other waterborne resins and therefore more useful as additives. However, there are exceptions to these generalizations, depending on the other components of the substrate/coating system.

Use as primers

Eastman CPO dispersions are useful as the base resin in adhesion-promoting primers. Primer performance with various topcoat systems is shown in Figure 1. This data shows that primer performance is generally comparable to that of solventborne CPOs.

Figure 1 **Humidity resistance of CPO primers[a,b] % Retained adhesion**



System		Primer[d]	Blisters[e]	Time, h
1	PEBC	CP 343-1	—	—
2		CP 310W	10F	168
3		CP 347W	—	—
4		CP 349W	—	—
5	WBBC	CP 343-1	10F	168
6		CP 310W	10F	168
7		CP 347W	—	—
8		CP 349W	10F	168
9	2KPUR	CP 343-1	—	—
10		CP 310W	8M	71
11		CP 347W	10F	72
12		CP 349W	10F	71

[a] *50°C Cleveland humidity resistance (ASTM D4585). Substrate: Basell™ 3131 thermoplastic olefin.*

[b] *CPO primer reduced to 5%–10% CPO, spray-applied to give a 5–10 micron dry film thickness, and dried 6 h @ 25°C. Topcoats were spray-applied and dried as directed. Data is mean % retained adhesion (ASTM D3359B), for 3 replicate panels after indicated duration in test.*

[c] *PEBC = OEM metallic polyester basecoat/clearcoat, baked for 20 min @ 127°C. WBBC = OEM waterborne basecoat/acrylic clearcoat, baked for 20 min @ 127°C. 2KPUR = OEM 2K elastomeric polyester urethane, baked for 30 min @ 80°C.*

[d] *CP 343-1 control applied as 5% solution in toluene. CPO dispersions reduced 1 part dispersion/2 parts water prior to application.*

[e] *Blister size and density per ASTM D714. Time indicates point in test at which blisters appeared.*

Primer formulations

To be an effective adhesion-promoting primer, the CPO film layer should be about 3–5 microns thick. CPOs are soft materials, and if the primer layer is too thick, it will tear apart, resulting in what appears to be an adhesion failure but is actually a cohesive failure. To achieve proper film thickness in a spray application, the CPO dispersion is usually reduced to 5–10 wt% solids prior to application.

Generally, CPO dispersion primers are formulated to help the waterborne system wet out the plastic and to reduce foam. Note that defoamers and additives that promote wet-out can sometimes reduce adhesion-promoting performance. This can be seen with the heavier alcohols in Table 2. Some glycol ether solvents can adversely affect adhesion, even though they appear to improve substrate wet-out.

Table 2 **Effect of alcohols and defoamers on Eastman CP 310W, foaming tendency and adhesion performance**

			% Retained adhesion[b]	
Alcohol/defoamer	Wt%[a]	Foaming	PP[c]	TPO[d]
None	—	Severe	100	100
Eastman *n*-propyl alcohol	20	Moderate	100	100
Eastman *n*-butyl alcohol	10	Slight	100	100
Eastman isobutyl alcohol	5	Moderate	100	100
	10	None	100	100
Eastman methyl amyl alcohol	5	None	60	200
	10	None	0	50
Eastman 2-ethylhexyl alcohol	5	Moderate	40	100
	10	Moderate—dispersion gelled	—	—
BYK™ 22 defoamer	0.1	Slight	100	100
BYK 23 defoamer	0.1	Slight	85	95
BYK 24 defoamer	0.4	Moderate	85	100
BYK 25 defoamer	0.6	Moderate	80	100
BYK 33 defoamer	0.6	Moderate	95	100
BYK 45 defoamer	0.3	Slight	90	90

[a] *Based on total weight of CP 310W.*

[b] *ASTM D3359B.*

[c] *Polypropylene homopolymer P4G42-011.*

[d] *Himont™ 3131 thermoplastic polyolefin.*

Defoamer was added and CP 310W was shaken by hand.

CP 310W reduced 1 part CP 310W to 2 parts water, spray applied to give a 5-micron dry-film thickness, dried 6 h @ 25°C.
Topcoat is OEM metallic polyester basecoat/acrylic clearcoat, baked 30 min @ 121°C.

Some higher molecular weight solvents can also adversely affect hot box stability if present at too high a concentration. It is suggested that any materials added to the CPO dispersion to aid wet-out or coalescence or to reduce foam be evaluated for their effect on adhesion-promoting performance and stability.

Tables 3 A, B, and C show suggested starting-point waterborne primer formulations for polypropylene substrates. These may be used to construct formulations to meet specific needs. The purpose of the polyurethane thickening agent in the formulation shown in Table 3 C is to allow the coating to "sit" on the substrate during solvent and water evaporation with minimal drawback. Other types of thickeners may also be used. The use of a thickener may allow for less use of solvents as wetting agents. Thickening agents should be diluted and added with agitation for best formulation stability.

Table 3 Waterborne primer formulations for polypropylene substrates

(A)

Substrate	Wt%
Eastman CP dispersion[a]	29.0
Isobutyl alcohol	5.0
Texanol™ ester-alcohol	1.0
Water	65.0
	100.0

[a]*CP 310W, CP 347W, or CP 349W.*

(B)

Substrate	Wt%	Wt%
Eastman CP dispersion[a]	29.0	29.0
Eastman EEH solvent	2.0	—
Texanol™ ester-alcohol	—	3.0
Water	69.0	68.0
	100.0	100.0

[a]*CP 310W, CP 347W, or CP 349W. When using CP 310W, these formulations may have poor stability after long storage (>200 h @ 50°C).*

(C)

Substrate	Wt%
Eastman CP dispersiona	29.10
Henkel™ DSX-1514 polyurethane thickener	0.90
BYK™ 22	0.01
Deionized water	69.99
	100.00

[a]*CP 310W, CP 347W, or CP 349W.*

***Note**: Dilute the DSX-1514 in some or all of the water and add it under agitation.*

Use as additives

Eastman CPO dispersions can be added directly to waterborne coating formulations to improve adhesion to polypropylene-based substrates. Generally all three dispersions are compatible with most preneutralized dispersion resins. CP 347W and CP 349W are also compatible with many amine-neutralizable solution resins.

All three CPO dispersions improve adhesion of many acrylic dispersion resins. Of the three, CP 349W provides the best performance with polyurethane dispersion resins. CP 310W is generally not useful as an additive to polyurethane dispersion resins. The amount of CPO dispersion needed to improve adhesion depends on the substrate and other coating components.

The data in Table 4 illustrates compatibility of Eastman CPO dispersions in combination with a variety of coatings resins. Adhesion improvement is also shown.

Table 4 **Resin compatibility and retained adhesion**[a]

		Compatibility			% Retained adhesion on PP				% Retained adhesion on TPO			
Resin[b]	Type	CP 10W	CP 347W	CP 349W	0% CPO	10% CP 310W	10% CP 347W	10% CP 349W	0% CPO	10% CP 310W	10% CP 347W	10% CP 349W
Dispersion resins												
Neocryl™ XA5090	Acrylic	C	C	C	0	80	100	100	0	100	100	100
Neocryl XA6015						100	0	0		0	0	0
Neocryl A612								100		100	100	100
Neocryl A623						50	100					
Joncryl™ 530						0	0	0			0	0
Joncryl 537						10				0		
Rhoplex™ CL-104						100	50	100		40	100	50
WL92						0	40			100		100
Rhoplex CL-10						100	0					70
HP5035	Urethane					0	10	80				100
HP1035							0	50		50	50	
Neorez™ R960								0		0	0	0
NeoPac™ R-9000							10	100		80	100	100
XP7028							0	0		0	0	
XP7015							80	100			100	
Urotuf™ L50							0					
Witcobond™ W236							20					
Witcobond W40							10					
Solution resins[c]												
Chempol 31-1744	Acrylic	INC	C	C	0	—	100	100	0	—	100	100
WR97												
Aquamac™ 1610	Alkyd		INC				—	50			—	
Mirasol™ 02A4603			C				100	100			100	

Legend: C = Compatible INC = Incompatible PP = P4G42-011 polypropylene homopolymer TPO = Himont™ 3131 thermoplastic olefin

[a] *CPO dispersions were added to resins to give 10% CPO based on resin solids.*

[b] *Suppliers listed on page 6.*

[c] *Resins were neutralized with amine in CPO dispersion: ammonium hydroxide for CP 310W; AMP-95 for CP 347W and CP 349W.*

Nonpolypropylene applications

Eastman CPO dispersions may be useful in promoting adhesion of waterborne coatings to plastics other than polypropylene. An example of this is illustrated in Table 5, which shows that CPO dispersion primers improve adhesion of a waterborne automotive OEM basecoat to polyphenylene oxide (PPO).

Table 5 **Adhesion of waterborne basecoat over CPO primer on polyphenylene oxide**

Substrate	Primer	% Retained adhesion
Noryl™ PX0844-780 polyphenylene oxide	None	0
	CP 310W	100
	CP 347W	95

Raw material suppliers

Product	Supplier
Aquamac™ 1610 resin	McWhorter
Basell™ 3131 thermoplastic olefin	Basell Polyolefins Company N.V.
BYK™ defoamers DSX-1514	BYK Chemie
Chempol 310-1744	Arkema
Henkel™ polyurethane thickener	Cognis Corporation
HP1035 resin	Cytec
HP5035 resin	Cytec
Joncryl™ 530 resin	SC Johnson
Joncryl 537 resin	SC Johnson
Mirasol™ 02A4603 resin	Osborne
Neocryl™ A-612 resin	Zeneca
Neocryl A-623 resin	Zeneca
Neocryl A-6015 resin	Zeneca
Neocryl XA-5090 resin	Zeneca
NeoPac™ R-9000 resin	Zeneca
Neorez™ R-960 resin	Zeneca
Noryl™ PX0844-780 polyphenylene oxide	GW Technologies, Inc.
Paraloid ™ WR97 resin	Dow Chemical
Rhoplex™ CL-103 resin	Dow Chemical
Rhoplex CL-104 resin	Dow Chemical
Rhoplex WL92 resin	Dow Chemical
Urotuf™ L50 resin	Reichhold
Witcobond™ W236 resin	Witco
Witcobond W404 resin	Witco
XP7015 resin	Miles
XP7028 resin	Miles

Storage and handling of waterborne CPOs

Water reducible adhesion-promoting dispersions generally exhibit good stability properties. Studies have shown that samples of each dispersion showed no performance change after five freeze-thaw cycles. **If freezing occurs, thaw and mix before using.**

EASTMAN

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

GN-411D 1/14