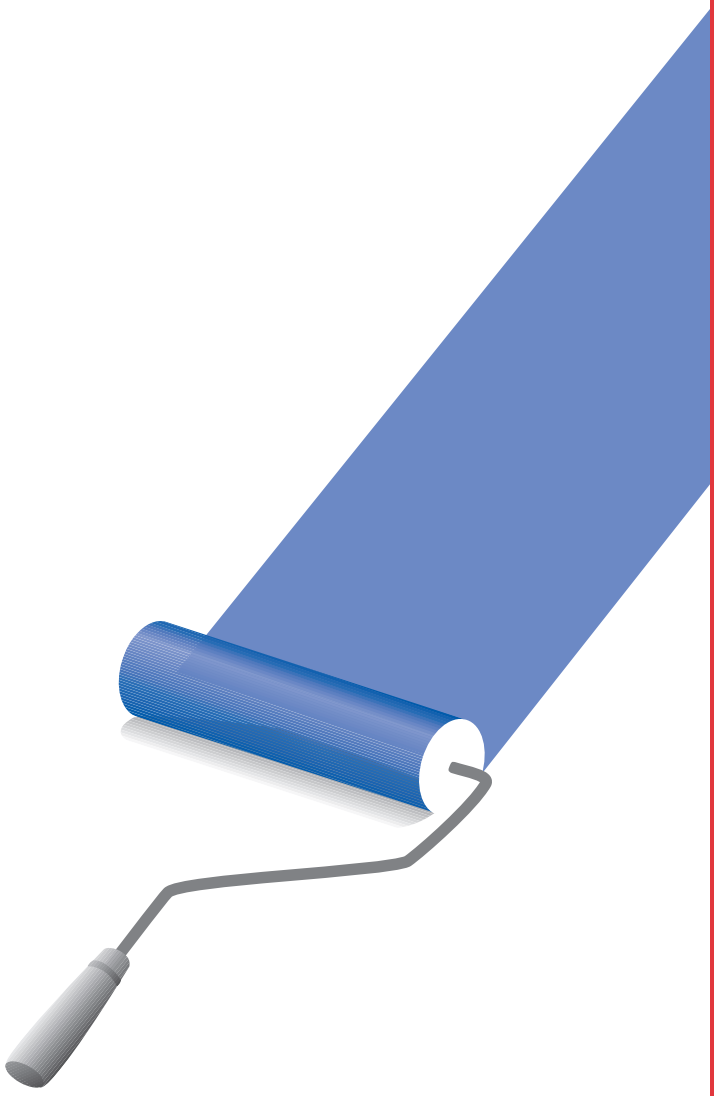
Texanol Ester Alcohol

The Coalescing Aid for Latex Paints



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Introduction

The majority of emulsion polymers used in latex paints do not form a film at moderate temperatures, and almost all will not form a film under adverse conditions such as temperatures approaching 0°C (32°F) or under high relative humidity. A coalescing aid is a necessary additive in latex paints that helps in the film-formation process. Coalescing aids are usually very slow-evaporating solvents such as glycol ethers, glycol ether esters, and ester alcohols. They combine with the emulsified polymer particles and soften them, which reduces the minimum film-formation temperature during the drying process to produce a better film than would otherwise be possible. In addition to lowering the minimum film-formation temperature (MFFT) of latex paint, a coalescing aid improves weather resistance, scrubbing resistance, cleanability, touch-up ability, and color development.

Texanol ester alcohol is an excellent coalescing aid for latex paint formulations. It performs effectively in polyvinyl acetate homopolymer, copolymer, and terpolymer latices as well as in 100% acrylic, styrene-acrylic, butadiene-styrene, and ethylene-vinyl acetate latices.

Table 1

Typical Properties of *Texanol* Ester Alcohol[a]

Specific gravity @ 20°C/20°C	0.95
Weight/volume @ 20°C	
kg/L	0.95
lb/gal (U.S.)	7.90
Solubility @ 20°C, wt%	
In water	3.0
Water in	0.9
Evaporation rate (n-butyl acetate = 1)	0.002
Refractive index @ 20°C	1.4423
Vapor pressure @ 20°C, mm Hg (Pa)	0.010 (1.33)
Vapor pressure @ 25°C, mm Hg (Pa)	0.013 (1.73)
Boiling range @ 760 mm, °C	
Initial boiling point	255
Dry point	260.5
Freezing point, °C (°F)	−50 (−58)
Flash point, Cleveland Open Cup, °C (°F)	120 (248)

[a]*Properties reported here are typical of average lots. Eastman makes no representation that the materials in any particular shipment will conform exactly to the values given.*

Guidelines for Use

Level of Addition

The most important consideration in the determination of the optimum level of coalescing aid addition is the MFFT of the emulsion polymer. Harder polymers have higher MFFTs and, to achieve the same level of coalescence, require more coalescing aid compared to softer polymers. A level of 5% to 10% *Texanol* ester alcohol based on polymer solids would be a good starting point in formulating a latex paint. To determine the optimum level of coalescing aid addition, it may be necessary to determine the response of a particular emulsion polymer to the addition of coalescing aid using an MFFT bar machine and a testing protocol such as ASTM D2354.

Incorporation

Texanol ester alcohol is easy to incorporate into latex paints. It can normally be added under agitation during any stage of paint manufacture. If gelling should occur with the addition of *Texanol*, it can usually be avoided by premixing the coalescing aid prior to addition with a portion of the water and surfactant used in the letdown stage.

Performance in Latex Flat and Semigloss Paints

Texanol ester alcohol was evaluated in an acrylic semigloss latex paint and a PVA-acrylic flat latex paint to determine its effect on paint properties (see Table 2).

Table 2

Starting Point Formulations Used in Laboratory Evaluations

Acrylic Semigloss Latex Paint[a]		PVA-Acrylic Flat Latex Paint[a]	
Materials[b]	**Pounds**	**Materials[b]**	**Pounds**
Pigment Grind		Pigment Grind	
Water	110.0	*Methocel* J-12-HS (3%) thickener	100.0
Pigment disperser MD 20	6.0	*Tamol* 731 (25%) dispersant	6.0
Propylene glycol	5.0	*AMP*-95 amino alcohol	2.0
Surfynol DF-210	1.0	*Bubble Breaker* 3056-A defoamer	2.0
Kronos 2090 titanium dioxide	227.5	*Igepal* CO-610 surfactant	3.0
Snowflake White calcium carbonate	40.0	*Texanol* ester alcohol	—[d]
		Tronox CR-812 titanium dioxide	175.0
		Satintone #1 aluminum silicate	100.0
		Snowflake White calcium carbonate	125.0
		Celite 499 silica	50.0
Letdown		Letdown	
Acronal 296D	611.8	Water	276.0
Water	51.9	*Bubble Breaker* 3056-A defoamer	1.0
Surfynol DF-210	1.4	*Methocel* J-12-HS (3%) thickener	100.0
Texanol ester alcohol	—[c]	*Flexbond* 325 PVA-acrylic emulsion	180.0
Propylene glycol	7.0		

[a] *Starting point formulation for laboratory evaluations. Commercial formulations may require other additives such as biocides, freeze-thaw stabilizers, etc.*
[b] *See Raw Material Suppliers listing on back cover for identification of vendors.*
[c] *Levels of 12.2, 18.35, 24.5, and 30.6 were evaluated.*
[d] *Levels of 4, 8, and 12 pounds were evaluated.*

Minimum Film-Formation Temperature

Texanol ester alcohol is an effective coalescing aid for 100% acrylic, polyvinyl acetate (PVA) homopolymer and copolymer emulsions, and styrene-acrylic emulsions as evidenced by the degree to which it lowers the minimum film-formation temperature (MFFT). The effects of various concentrations of *Texanol* on the MFFT of four commonly used emulsions are shown in Table 3. This testing illustrates the need to confirm the performance of *Texanol* in a specific emulsion system, as the optimum level of coalescing aid addition is strongly dependent on the composition of the emulsified polymer.

Table 3

Minimum Film-Formation Temperature

Texanol Ester Alcohol Wt %[a]	*Rhoplex* HG-74 Acrylic[b]		*Acronal* 296D Styrene-Acrylic[b]		*Rhoplex* AC-2507 Acrylic[b]		*Flexbond* 325 PVA-Acrylic[b]	
	°C	°F	°C	°F	°C	°F	°C	°F
0	16	61	12	53	14	57	12	54
2	14	57	9	49	6	43	7	45
4	11	52	4	40	2	36	4	40
6	7	45	0	32	<0	<32	1	34
8	4	39	<0	<32	<0	<32	<0	<32

[a]*Based on resin solids.*
[b]*Average values for 5 MFFT determinations, ASTM D2354.*

Package Stability

The effect of *Texanol* ester alcohol on package stability was tested according to ASTM D1849. Paints were stored for 1 month under accelerated aging conditions that simulate some of the effects of storage at room temperature for 6 to 12 months. While some viscosity change occurred in the styrene-acrylic system, the results with no coalescing aid added indicate that most of the viscosity drift is not due to the effect of *Texanol* addition. This indicates *Texanol* ester alcohol has excellent hydrolytic stability, even in the presence of the high pH of an acrylic-based paint.

Table 4

Stormer Viscosity, Kreb Units

	Styrene-Acrylic Latex Paint			PVA-Acrylic Latex Paint	
Texanol Ester Alcohol Wt %[a]	Initial	Aged @ 52°C	*Texanol* Ester Alcohol Wt %[a]	Aged @ Room Temperature[b]	Aged @ 52°C
0	69	82	4	77	68
3	74	89	8	77	71
5	79	91	12	77	72

[a]*Based on resin solids.*
[b]*Same as original viscosity.*

Freeze-Thaw Stability

The addition of high levels of *Texanol* ester alcohol can have a detrimental effect on freeze-thaw stability of latex paints. Since *Texanol* ester alcohol is an active coalescing aid, it has the tendency to promote the fusion of emulsion particles and therefore decrease the stability of the latex in severe conditions.

While the decrease in freeze-thaw stability produced by the use of a coalescing aid is normally small, this effect is usually manifested as an increase in viscosity after completion of a freeze-thaw cycle, although coagulation sometimes can occur at very high levels of *Texanol* addition. When used at normal levels, *Texanol* ester alcohol is usually not detrimental to the freeze-thaw stability of a latex paint. The paint formulator should keep this in mind when using *Texanol* ester alcohol. Freeze-thaw stability can usually be improved by the use of a stabilizer such as ethylene glycol or propylene glycol.

Scrub Resistance

Texanol ester alcohol provides a significant improvement in the scrub resistance of a latex paint because it promotes film formation and improves film durability after the coalescing aid evaporates. This effect is most often noted when paint is applied under adverse conditions such as low temperature and high relative humidity. To illustrate this, test panels were coated with styrene-acrylic and PVA-acrylic paints containing *Texanol* ester alcohol and conditioned for 1 week (see Table 5, footnotes b and c). The panels were then tested for scrub resistance using ASTM D2486. Note that until the *Texanol* ester alcohol concentration in the styrene-acrylic system reached 4%, a film was not formed and scrub resistance was zero.

Table 5

Scrub Resistance (Scrub Cycles)

Texanol Ester Alcohol Wt %[a]	Styrene-Acrylic Latex Paint[b]	*Texanol* Ester Alcohol Wt %[a]	PVA-Acrylic Latex Paint[c]
0	0[d]	0	Not tested
2	0[d]	4	60
4	336	8	80
5	365	12	210

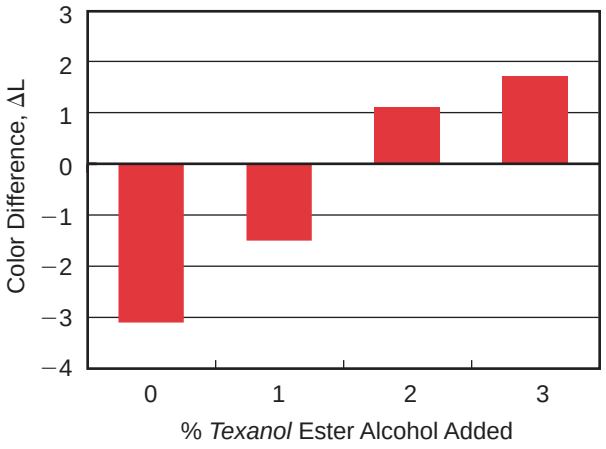
[a]*Based on resin solids.*
[b]*Tested at 4.4°C (40°F)/50% relative humidity, 1 week aging.*
[c]*Tested at 10°C (50°F)/80% relative humidity, 1 week aging.*
[d]*No film formed at these conditions.*

Color Development

Texanol ester alcohol aids uniformity of color over a wide range of temperature and humidity conditions. Uncoalesced or poorly coalesced tinted latex paint will have a rougher surface when dried at low temperature or high humidity than at moderate temperatures. The rougher surface causes a greater degree of light scattering and therefore less color appears to develop. In other words, surfaces coated with the same uncoalesced or poorly coalesced paints applied at different temperatures will produce different apparent colors. An effective coalescing aid such as *Texanol* ester alcohol provides equal film formation at low temperatures and high humidity as well as moderate application conditions and therefore results in more uniform color development. The effect of *Texanol* ester alcohol concentration on color development of panels painted and dried at a temperature of 6°C (43°F) for 36 hours is demonstrated in Figure 1.

Figure 1

Color Development Effect of Addition of *Texanol* Ester Alcohol to a PVA Terpolymer-Based Flat Latex Paint



Performance of *Texanol* Ester Alcohol in a High-Gloss Paint Formulation Under Adverse Application Conditions

Texanol ester alcohol promotes good film formation in latex paints, even under adverse application conditions such as high humidity and low temperature.

To demonstrate the low-temperature, high-humidity film-formation capabilities of *Texanol* ester alcohol, a high-gloss acrylic formulation prepared with various coalescing aids was applied and tested under normal laboratory conditions and under more adverse conditions often encountered in normal use. The film-formation data shown in Table 6 indicates the added protection *Texanol* ester alcohol provides against latex paint failure that is due to low-temperature and high-humidity application conditions.

Table 6

Film Formation Protection Under Low-Temperature, High-Humidity Application Conditions[a]

	60° Gloss, °C/% RH		6-Week Scrub Cycles, °C/% RH	
Coalescing Aid	**20/65**	**4.5/95[b]**	**20/65**	**4.5/95[b]**
Texanol ester alcohol	73	68	1,350	805
DPnB[c]	65	—[d]	750	—[d]
Eastman EEH[c]	73	64	1,400	400
Eastman DB[c]	70	40[e]	675	570
Eastman EB[c]	73	—[f]	635	180

[a]*Rohm and Haas starting point formula XG-74-4.*
[b]*Samples held at 4.5°C (40°F)/95% RH for 36 hours, then 20°C (70°F)/65% RH thereafter.*
[c]*DPnB (dipropylene glycol n-butyl ether)*
EEH (ethylene glycol 2-ethylhexyl ether)
DB (diethylene glycol n-butyl ether)
EB (ethylene glycol n-butyl ether)
[d]*Paint gelled when cooled to 4.5°C (40°F).*
[e]*Dried films were grainy in appearance.*
[f]*Dried films exhibited "alligatoring" or "spiderwebbing."*

Summary

Texanol ester alcohol is an excellent coalescing aid for latex paint and imparts the following desirable properties to a paint formulation:

- *Texanol* ester alcohol is easy to incorporate into paints and, at proper levels, does not affect the stability properties of the paints.
- *Texanol* ester alcohol has a freezing point of −50°C (−58°F). Special handling is not normally necessary during cold weather as it is for some high molecular weight coalescing aids.
- *Texanol* ester alcohol provides good performance characteristics such as scrub resistance, color development, and package stability in paints.
- *Texanol* ester alcohol is an excellent coalescing aid for emulsion polymers. It has excellent hydrolytic stability, allowing it to be used with a wide variety of latex emulsions including high-pH acrylic.
- When added to a latex paint, *Texanol* ester alcohol is absorbed by the emulsion's polymeric particles, softening them and causing complete fusion as the water evaporates. Since *Texanol* ester alcohol is not in the water phase, applying the paint over a porous surface does not result in reduced coalescing efficiency because *Texanol* ester alcohol is not absorbed into the substrate along with the water.

Raw Material Suppliers

Material	Supplier
Acronal 296D	BASF
AMP-95 amino alcohol	Angus
Bubble Breaker 3056-A defoamer	Witco
Celite 499 Silica	Celite Corp.
Flexbond 325 emulsion	Air Products
Igepal CO-610 surfactant	GAF
Kronos 2090 titanium dioxide	Kronos
Methocel J-12 HS thickener	Dow
Pigment disperser MD 20	BASF

Material	Supplier
Propylene glycol	Eastman (distributors)
Rhoplex AC-2507	Rohm and Haas
Rhoplex HG-74	Rohm and Haas
Satintone #1 aluminum silicate	Englehard
Snowflake White calcium carbonate	ECC International
Surfynol DF-210	Air Products
Tamol 731 dispersant	Rohm and Haas
Texanol ester alcohol	Eastman
Tronox CR-812 titanium dioxide	Kerr-McGee

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