

# Eastman™ EEH solvent

A coalescing aid and retarder solvent with a good balance of physical properties for use in waterborne and solventborne coating systems

## Features

- Slow evaporation rate
- Low water solubility
- High coalescing efficiency
- Excellent hydrolytic stability
- Low surface tension
- Mild odor
- Non-HAP, non-SARA 313

Eastman™ EEH solvent<sup>1</sup> is a slow-evaporating, colorless, water-immiscible material that is useful as a retarder solvent and coalescing aid in coating systems. It is an effective solvent in cathodic electrodeposition primers. The slow evaporation rate of Eastman EEH solvent compared with other commercial glycol ethers such as hexyl Cellosolve™ and Eastman™ EB reduces volatilization of the solvent from the dipping tank and gives good flow

and leveling of the coating in the baking ovens. The low water solubility of Eastman EEH solvent minimizes solvent loss in the ultrafiltrate with cathodic systems and makes this product an efficient solvent to use with these coatings. With its good coalescing activity, slow evaporation rate, and stability in water systems, Eastman EEH solvent is being used in other, newer waterborne coatings. It is not on EPA's Hazardous Air Pollutant (HAP) list or SARA 313.

## Solubility

For its molecular weight range, Eastman EEH solvent has good activity for many of the resins used in coatings. The activity of the solvent molecule is enhanced by the multifunctionality of the ether and primary alcohol groups. Table 1 lists the solubility of different classes of coating resins in Eastman EEH solvent.

Table 1 Resin solubility in Eastman™ EEH solvent

Resin	Type	Supplier	Solubility
Paraloid™ B-66	Acrylic	Rohm and Haas	Soluble
CAB-381-0.5	Cellulose acetate butyrate	Eastman	Insoluble
Epon™ 1001	Epoxy	Hexion Specialty Chemicals	Soluble
Cymel™ 303	Melamine	Cytec	Soluble
RS™ 1/2-sec	Nitrocellulose	Bergerac	Insoluble
Paphen™ PKHH	Phenoxy	Phenoxy Associates	Insoluble
Versamid™ 115	Polyamide	Cognis	Soluble
Resimene™ 980	Urea	Ineos	Soluble
UCAR™ VYHH	Vinyl chloride/acetate	Dow Chemical Company	Insoluble

Note: See Eastman publication M-282 for additional solubility information on Eastman™ EEH glycol ether.

<sup>1</sup>Eastman™ EEH glycol ether is a mixture of ethylene glycol 2-ethylhexyl ether and diethylene glycol 2-ethylhexyl ether (~85/15 wt%). Typical properties of the compound are available in Eastman Publication M-221.

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## Coalescing efficiency

Glycol monoethers are widely used as coalescing aids in emulsion/dispersion/latex systems, where their primary function is to enhance coalescence of the particles during the final stages of film formation, thereby promoting good film integrity. One measure of coalescing efficiency is the effect of the coalescing aid concentration on the

minimum film-forming temperature (MFFT) of the emulsion polymer. Table 2 lists the minimum film-forming temperatures of three latex emulsions at two concentrations of coalescing aid. Eastman EEH solvent was significantly more efficient than many of the other solvents at reducing the MFFT of the emulsions.

Table 2 Effect of coalescing aid on minimum film-forming temperature

Coalescing solvent	MFFT, °C (°F)		
	Styrene acrylic emulsion <sup>a</sup>	Vinyl acetate/ acrylic emulsion <sup>b</sup>	Vinyl acetate emulsion <sup>c</sup>
<b>Concentration of coalescing solvent—4%<sup>d</sup></b>			
Eastman™ EEH solvent	8 (47)	2 (36)	11 (51)
Texanol™ ester alcohol	10 (50)	6 (42)	12 (54)
Eastman™ DE solvent	15 (59)	7 (45)	13 (56)
Eastman™ DB solvent	13 (55)	3 (37)	9 (49)
Eastman™ DB acetate	—	2 (36)	5 (41)
<b>Concentration of coalescing solvent—8%<sup>d</sup></b>			
Eastman EEH solvent	<0 (<32)	<0 (<32)	<0 (<32)
Texanol ester alcohol	3 (37)	<0 (<32)	<0 (<32)
Eastman DE solvent	9 (48)	6 (42)	11 (52)
Eastman DB solvent	6 (42)	<0 (<32)	2 (36)
Eastman DB acetate	—	<0 (<32)	<0 (<32)
No coalescing solvent	30 (86)	12 (54)	>16 (>60)

<sup>a</sup>Rhoplex™ HG-74 from Rohm and Haas.

<sup>b</sup>Flexbond™ 325 from Air Products & Chemicals Co.

<sup>c</sup>Fuller™ PD 058 from H. B. Fuller Co.

<sup>d</sup>Based on emulsion solids.

## Effect on MFFT

In acrylic and copolymer latexes, Eastman EEH solvent was similar in performance to Eastman DB acetate, a very active coalescing solvent. However, esters, such as Eastman DB acetate, generally cannot be used in high-pH acrylic latex systems because of poor hydrolytic stability. Eastman EEH solvent has no ester linkages in its chemical structure and therefore exhibits good hydrolytic stability in all latex

systems. At the lower concentration of coalescing aid, Eastman EEH solvent gives MFFT values an average of 11% lower than Eastman™ Texanol ester alcohol; at the higher concentration, the performances of the two products are very similar. Eastman EEH solvent is equal to or more efficient than diethylene glycol monoethers in reducing the minimum film-forming temperature.

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### Evaporation rate

Eastman EEH solvent is slow-evaporating and high-boiling. Its measured evaporation rate is faster than those of other coalescing solvents such as Eastman DB acetate and Texanol ester alcohol (Table 3).

The faster evaporation rate makes Eastman EEH solvent desirable in applications where relatively “fast release” of the coalescing aid from the coating film is required to maximize hardening rate.

Table 3 Relative evaporation rates of high-boiling solvents

Solvent	Evaporation rate ( <i>n</i> -Butyl acetate = 1)
Eastman EEH solvent	0.003
Eastman DB solvent	0.003
Texanol ester alcohol	0.002
Eastman DB acetate	0.002

### Surface tension and electrical resistance

With the development of low-VOC coatings and high-transfer-efficiency application techniques, the surface tension and electrical resistance values of organic solvents are of increasing interest. Eastman EEH solvent fills both the need for a slow-evaporating solvent possessing low surface tension and a glycol monoether with relatively high electrical resistance.

Solvents with low surface tension assist in wetting the substrate to which a coating is applied and thus improve flowout and leveling. The surface tension of Eastman EEH solvent is lower than the values associated with most other slow-evaporating solvents, as Table 4 shows.

Table 4 Surface tension of high-boiling solvents

Solvent	Dynes/cm @ 20°C (68°F)
Eastman EEH solvent	27.6
Texanol ester alcohol	28.9
Eastman DB acetate	30.0
Eastman DB acetate	30.0
Eastman DE solvent	32.2

Most glycol ether solvents, because of their very polar nature, have low electrical resistance values when measured with the Ransburg paint resistance tester. Eastman EEH solvent has unusually high resistance for an active solvent with a primary hydroxyl group attached. Table 5 gives the electrical resistance of the high-boiling glycol monoethers.

Table 5 Electrical resistance of glycol ether solvents

Solvent	Megohms
Eastman EEH solvent	1.5
Texanol ester alcohol	0.13
Eastman DB solvent	0.11
Eastman DE solvent	0.06

### Stability

Since the ether linkage of Eastman EEH solvent exhibits good hydrolytic stability in the alkaline pH range in which waterborne coatings are often formulated, the solvent can be used in systems of broad pH latitude.



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