SOLVENTS

Eastman EEH Solvent[1]

A Coalescing Aid and Retarder Solvent With a Good Balance of Physical Properties for Use in Waterborne and Solventborne Coating Systems

[1]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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Contents

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 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 ½-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 Publication M-282 for additional solubility information on* Eastman *EEH glycol ether.*

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

	MFFT, °C (°F)		
Coalescing Solvent	**Styrene Acrylic Emulsion[a]**	**Vinyl Acetate/ Acrylic Emulsion[b]**	**Vinyl Acetate Emulsion[c]**
Concentration of Coalescing Solvent—4%[d]			
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)
Concentration of Coalescing Solvent—8%[d]			
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)

[a]Rhoplex *HG-74 from Rohm and Haas.*
[b]Flexbond *325 from Air Products & Chemicals Co.*
[c]Fuller *PD 058 from H. B. Fuller Co.*
[d]*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 *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.

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 (n-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 Solvent	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
Eastman EB Solvent	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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