Eastman Solvents Technical Tip

Choosing a Replacement for ExxonMobil *Exxate* Solvents (TT-19C)

INTRODUCTION

ExxonMobil Corporation is discontinuing its complete line of *Exxate* solvents (mixed alkyl acetates). Eastman offers the formulator a broad range of options for replacing these *Exxate* solvents. It is possible that some may be used as a direct substitute thus minimizing reformulating cost. In other systems, it may be necessary to adjust the solvent balance of the coating to satisfy the requirements of the specific end use and performance requirements.

Odor Constraints

All solvents have an inherent aroma or odor when they evaporate. However, some solvent aroma can be more noticeable than others and, although offensive, can be quite subjective. Eastman offers an array of ester solvents known for their pleasant odor.

Environmental Concerns

Reduced-VOC Content

For formulators targeting reduced-VOC content, Eastman offers a broad line of ketone solvents such as *Eastman* C-11 ketone. C-11 ketone has a lower density than both *Exxate* 800 and 900 (7.02 versus 7.30 and 7.25 lbs/gal, respectively). When the *Exxate* solvents are replaced with *Eastman* C-11 ketone on an equal volume basis, the VOC content is reduced. This feature, combined with high solvent activity and low neat viscosity, makes *Eastman* C-11 ketone and other ketone solvents (i.e., *Eastman* MAK) very good choices for formulators targeting low-VOC requirements.

High Transfer Efficiency

High electrical resistance permits electrostatic spray users to improve the transfer efficiency of their applied coating. It also improves paint utilization and helps reduce volatile emissions. Several *Eastman* solvents provide high electrical resistance including *Eastman* EEP solvent, 2-Ethyhexyl acetate, EB acetate, n-Butyl propionate, and *Texanol* ester alcohol.

Non-HAP

All suggested replacements for the *Exxate* line are non-HAP substitutions (except *Eastman* EB Acetate) making their use level unrestricted by Title III of CAAA.

Improve Application Conditions

Low Water Content

Eastman offers a wide variety of solvents with a range of solvency and evaporation rate with low initial water content (water content is 0.05% maximum–see Table 6). Low water content is important in the formulation of moisture-sensitive coatings (i.e., 2-K polyurethane).

Good Flow and Leveling

Because the replacement solvents Eastman has suggested in this technical tip are slow evaporating, they help promote flow and leveling in the final paint film, reducing the need for costly flow and leveling additives.

Coalescents for Latex Paints

Texanol ester alcohol and *Eastman* EEH are excellent choices for those formulators requiring a replacement for the slower *Exxate* solvents such as 1000 and 1200 in architectural paint applications. *Texanol* and *Eastman* EEH are slow evaporating, non-HAP, high-boiling solvents with low water miscibility, low surface tension, good hydrolytic stability, and high electrical resistance. These properties provide good film integrity, good touch-up properties, and good scrub resistance. In addition, both *Eastman* EEH and *Texanol* meet the LVP exemption set by the California Air Resources Board for volatile organic compounds in consumer products (California Code of Regulation, Title 17, Article 2, and Section 94510).

The cost and effectiveness of the suggested replacement solvents should be determined in accordance with the performance requirement for a given application.

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Tables 1–5 show the physical properties of the *Exxate* products compared to suggested *Eastman* solvents and blends. For additional reformulating assistance visit Eastman's Solvent Reformulation Request Wizard at www.eastman.com.

Blend 1: 79.6 wt% *Eastman* MAK : 20.4 wt% *Eastman* 2-Ethylhexyl Acetate
Blend 2: 79.4 wt% *Eastman* n-Butyl Propionate : 20.6 wt% *Eastman* 2-Ethylhexyl Acetate
Blend 3: 79.6 wt% *Eastman* IBIB : 20.4 wt% *Eastman* 2-Ethylhexyl Acetate

Table 1: Physical Properties of *Exxate* 600 and Suggested Replacements

All solvent replacements for *Exxate* 600 are available in urethane grade.

	***Exxate* 600**[a]	***Eastman* EEP**	**Blend 1**	**Blend 2**	**Blend 3**
Evaporation Rate (n-Butyl Acetate = 1)	0.17	0.12	0.17	0.17	0.17
Weight/Volume, lb/gal	7.30	7.91	6.90	7.29	7.16
Surface Tension, dynes/cm @ 20ºC	25.0	27.0[b]	25.9	25.9	25.9
Water Solubility, wt% @ 20ºC					
In Water	0.01	2.9	<0.4	<0.2	<0.1
Water In	0.60	2.2	1.0	0.6	0.5
Electrical Resistance, megohms	>20	20	0.6	>20	>20
Hansen Solubility Parameters[c]					
NonPolar	7.7	7.9	7.9	7.7	7.5
Polar	1.4	1.6	2.5	1.6	1.4
Hydrogen Bonding	2.9	4.3	2.1	2.8	2.8
Total	8.4	9.1	8.5	8.3	8.1
Urethane Grade[d]	Yes	Yes	Yes (both)	Yes (both)	Yes (both)
Hazardous Air Pollutant[e] (HAP)	No	No	No (both)	No (both)	No (both)

[a] *ExxonMobil Corporation*
[b] At *23ºC*
[c] *Shown as* $[cal/cm^3]^{½}$
[d] *Water content is 0.05% maximum.*
[e] *Title III of the Clean Air Act Amendments (CAAA) of 1990*

You may find more information on suggested replacements for *Exxate* 600 in the Eastman technical tip titled "*Selecting an Effective Replacement for* Exxate *600*" available on eastman.com.

Table 2: Physical Properties of *Exxate* 700 and Suggested Replacements

	***Exxate*[a] 700**	***Eastman* EEP**	***Eastman* 2-EHA**
Evaporation Rate (n-Butyl Acetate = 1)	0.07	0.12	0.04
Weight/Volume, lb/gal	7.27	7.91	7.27
Surface Tension, dynes/cm @ 20ºC	26.0	27.0[b]	25.8
Water Solubility, wt% @ 20ºC			
In Water	0.01	2.9	0.03
Water In	0.58	2.2	0.6
Electrical Resistance, megohms	>20	20	>20
Hansen Solubility Parameters[c]			
NonPolar	7.1	7.9	7.7
Polar	3.3	1.6	1.4
Hydrogen Bonding	2.3	4.3	2.5
Total	8.2	9.1	8.2
Urethane Grade[d]	Yes	Yes	Yes
Hazardous Air Pollutant[e] (HAP)	No	No	No

[a]*ExxonMobil Corporation*
[b]At *23ºC*
[c]*Shown as* $[cal/cm^3]^{½}$
[d]*Water content is 0.05% maximum.*
[e]*Title III of the Clean Air Act Amendments (CAAA) of 1990*

Table 3: Physical Properties of *Exxate* 800 and Suggested Replacements

	***Exxate* 800[a]**	***Eastman* 2-EHA**	***Eastman* EB Acetate**
Evaporation Rate (n-Butyl Acetate = 1)	0.03	0.04	0.03
Weight/Volume, lb/gal	7.30	7.27	7.84
Surface Tension, dynes/cm @ 20ºC	26.0	25.8	30.3
Water Solubility, wt% @ 20ºC			
In Water	0.02	0.03	1.1
Water In	0.35	0.6	1.6
Electrical Resistance, megohms	>20	>20	>20
Hansen Solubility Parameters[b]			
NonPolar	7.2	7.7	7.5
Polar	3.2	1.4	2.2
Hydrogen Bonding	2.0	2.5	4.3
Total	8.1	8.2	8.9
Urethane Grade[c]	Yes	Yes	Yes
Hazardous Air Pollutant[d] (HAP)	No	No	Yes

[a]*ExxonMobil Corporation*
[b]*Shown as* $[cal/cm^3]^{½}$
[c]*Water content is 0.05% maximum.*
[d]*Title III of the Clean Air Act Amendments (CAAA) of 1990*

Table 4: Physical Properties of *Exxate* 900 and Suggested Replacements

	***Exxate* 900**[a]	***Eastman* EGDA**	***Eastman* C-11**
Evaporation Rate (n-Butyl Acetate = 1)	0.012	0.02	0.02
Weight/Volume, lb/gal	7.25	9.22	7.02
Surface Tension, dynes/cm @ 20°C	26.4	33.7	27.5
Water Solubility, wt% @ 20°C			
In Water	0.02	16.4	0.02
Water In	0.29	7.6	0.9
Electrical Resistance, megohms	>20	5.0	1.5
Hansen Solubility Parameters[b]			
NonPolar	7.2	7.9	7.9
Polar	2.9	2.3	1.0
Hydrogen Bonding	1.8	4.8	2.0
Total	8.1	9.5	8.2
Urethane Grade[c]	Yes	No	No
Hazardous Air Pollutant[d] (HAP)	No	No	No

[a]*ExxonMobil Corporation*
[b]*Shown as* $[cal/cm^3]^{½}$
[c]*Water content is 0.05% maximum.*
[d]*Title III of the Clean Air Act Amendments (CAAA) of 1990*

Table 5: Physical Properties of *Exxate* 1000, 1200, and Suggested Replacements

	***Exxate* 1000**[a]	***Exxate* 1200**[a]	***Eastman* EEH**	***Texanol***[e]
Evaporation Rate (n-Butyl Acetate = 1)	0.006	0.002	0.003	0.002
Weight/Volume, lb/gal	7.25	7.29	7.42	7.90
Surface Tension, dynes/cm @ 20°C	26.4	28.0	27.6	28.9
Water Solubility, wt% @ 20°C				
In Water	nil	nil	0.2	<0.1
Water In	0.26	0.18	6.2	0.9
Electrical Resistance, megohms	>20	>20	1.5	>20
Hansen Solubility Parameters[b]				
NonPolar	7.2	7.5	7.8	7.4
Polar	2.9	0.9	2.0	3.0
Hydrogen Bonding	1.8	2.2	2.5	4.8
Total	8.1	7.9	8.4	9.3
Urethane Grade[c]	Yes	Yes	No	No
Hazardous Air Pollutant[d] (HAP)	No	No	No	No

[a]*ExxonMobil Corporation*
[b]*Shown as* $[cal/cm^3]^{½}$
[c]*Water content is 0.05% maximum.*
[d]*Title III of the Clean Air Act Amendments (CAAA) of 1990*
[e]*Eastman Chemical Company*

Table 6 shows *Eastman* solvents available in urethane grade. The slower solvents are noted by an asterisk. As noted in Table 1, all replacements for *Exxate* 600 are available in urethane grade.

Table 6: *Eastman* Solvents Available in Urethane Grade
Water content is 0.05%

Eastman n-Butyl Acetate	*Eastman* IBIB (Isobutyl Isobutyrate) *
Eastman n-Butyl Propionate *	*Eastman* Isopropyl Acetate
Eastman Methyl Acetate	*Eastman* MAK (Methyl n-Amyl Ketone) *
Eastman EEP Solvent (Ethyl 3-Ethoxypropionate) *	*Eastman* MIAK (Methyl Isoamyl Ketone) *
Eastman Ethyl Acetate	*Eastman* MPK (Methyl n-Propyl Ketone)
Eastman 2-Ethylhexyl Acetate	*Eastman* PM Acetate *
Eastman Isobutyl Acetate	*Eastman* n-Propyl Acetate
Eastman DE Acetate * (Diethylene Glycol Monoethyl Ether Acetate)	*Eastman* EB Acetate * (Ethylene Glycol Monobutyl Ether Acetate)

**Slower solvent*

Table 7: Suggested Eastman Replacements and Blends

Exxate 600	*Eastman* EEP Solvent (Ethyl 3-Ethoxypropionate)
	Blend 1: *Eastman* MAK (79.6 wt%):*Eastman* 2-Ethylhexyl Acetate (20.4 wt%)
	Blend 2: *Eastman* n-Butyl Propionate (79.4 wt%):*Eastman* 2-Ethyhexyl Acetate (20.6 wt%)
	Blend 3: *Eastman* IBIB (79.6 wt%):*Eastman* 2-Ethylhexyl Acetate (20.4 wt%)
Exxate 700	*Eastman* EEP Solvent (Ethyl 3-Ethoxypropionate)
	Eastman 2-Ethylhexyl Acetate
Exxate 800	*Eastman* 2-Ethylhexyl Acetate
	Eastman EB Acetate (Ethylene glycol monobutyl ether acetate)
Exxate 900	*Eastman* EGDA (Ethylene gycol diacetate)
	Eastman C-11 Ketone
Exxate 1000	*Eastman* EEH Solvent (Ethylene glycol 2-ethylhexyl ether)
	Texanol Ester Alcohol (2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate)
Exxate 1200	*Eastman* EEH Solvent (Ethylene glycol 2-ethylhexyl ether)
	Texanol Ester Alcohol (2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate)

CONCLUSION

Eastman Chemical Company can easily provide the coatings formulator several outstanding options for replacement of the discontinued ExxonMobil *Exxate* solvents. With either a direct replacement or with an adjustment to the solvent balance, Eastman's broad range of oxygenated solvents will enable the formulator to meet and maintain their customers' cost, specification, and/or performance requirements. For additional reformulating assistance, visit Eastman's Solvent Reformulation Request Wizard at eastman.com.

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