Eastman Methyl n-Amyl Ketone (MAK)
and
Eastman Methyl Isoamyl Ketone (MIAK)

Solvents for High-Solids Coatings

Title I of the Clean Air Amendment (CAA) requires that volatile organic compound (VOC) emissions from surface-coating processes be reduced. Many coating manufacturers suggest high-solids coatings as an alternative to conventional coatings in order to lower VOC emissions.

High-solids coatings are formulated with low molecular weight resins and/or oligomers containing functional groups that are cross-linked to produce a high-performance coating. Because of the lower solvent levels, curing conditions, and rheological characteristics of these coatings, the criteria for solvent selection differ significantly from those for low-solids coatings. Solvent activity, density, surface tension, evaporation rate, and boiling point assume greater importance. Experience has shown that ketone solvents such as *Eastman* MAK (methyl n-amyl ketone) and MIAK (methyl isoamyl ketone) provide the best overall balance of these properties for many high-solids coatings. This brochure contains information on the properties of *Eastman* MAK and MIAK in high-solids coatings.

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High Solvent Activity

High activity is an important solvent property when formulating coatings that must satisfy regulatory guidelines and, at the same time, have the proper application viscosity. Solution viscosity data in Table 1 show that *Eastman* MAK and MIAK are more effective in lowering the viscosity of high-solids resins than ester, aromatic hydrocarbon, and glycol ether solvents with similar evaporation rates.

Table 1

Solution Viscosity

		Solution Viscosity, cP, 25°C			
Solvent	**Evaporation Rate (n-BuOAc = 1)**	***Aroplaz*[a] 6755-A6-80 Polyester Resin (70 Wt % Solids)**	***Polymac*[b] HS 5776 Polyester Resin (65 Wt % Solids)**	***Paraloid*[c] AT-400 Acrylic Resin (65 Wt % Solids)**	***Acrylamac*[d] HS 2980 Acrylic Resin (70 Wt % Solids)**
Xylene	0.7	688	157	1,020	548
Eastman Methyl Isoamyl Ketone	0.5	661	85	860	389
n-Butyl Propionate	0.5	671	155	910	478
Eastman Methyl n-Amyl Ketone	0.4	528	123	772	498
Eastman PM Acetate	0.4	885	254	1,040	671
Isobutyl Isobutyrate	0.4	902	212	1,080	681
Aromatic 100	0.29	775	194	1,230	671
n-Pentyl Propionate	0.2	785	200	1,040	551
Eastman EP Solvent	0.2	902	249	969	621
Oxo-Hexyl Acetate	0.17	877	225	1,090	685
Eastman EEP Solvent	0.12	843	210	952	621
Eastman EB Solvent	0.06	960	311	1,010	665

[a]*Supplied by Reichold Inc. @ 80 wt % solids in a 65:35 blend of PM Acetate and Toluene. The resin was diluted to 70 wt % solids with solvent shown.*
[b]*Supplied by Eastman @ 85 wt % solids in PM Acetate. The resin was diluted to 65 wt % solids with solvent shown.*
[c]*Supplied by Rohm and Haas @ 75 wt % solids in* Eastman *MAK. The resin was diluted to 65 wt % solids with solvent shown.*
[d]*Supplied by Eastman @ 80 wt % solids in* Eastman *MAK. The resin was diluted to 70 wt % solids with solvent shown.*

Low Density

Because most VOC regulations limit the weight of solvent per volume of coating, the use of low-density solvents is beneficial. Lower density enables the formulator to add more volume of solvent for a given weight.

The data in Table 2 show that *Eastman* MAK and MIAK are lower in density than ester, aromatic hydrocarbon, and glycol ether solvents with similar evaporation rates. The low density of MAK and MIAK is a significant advantage in the formulation of low-viscosity, high-solids coatings.

Table 2

Effect of Solvent Density on Volume Solids and VOC Content of a High-Solids Coating

Components	Wt %
Ti-Pure R-902 TiO_2[a]	30.0
Paraloid AT-400 Acrylic Resin[b]	30.0
Cymel 303 Melamine Resin[c]	10.0
Solvent	30.0
	100.0

Solvent	Density @ 20°C	Volume % Solids	VOC g/L (lb/gal)
Eastman Methyl Isoamyl Ketone	6.76	53.4	377.0 (3.15)
Eastman Methyl n-Amyl Ketone	6.80	53.5	378.2 (3.16)
Xylene	7.20[d]	55.1	389.0 (3.25)
Aromatic 100	7.27[d]	55.2	390.2 (3.26)
n-Butyl Propionate	7.29	55.2	390.2 (3.26)
n-Pentyl Propionate	7.30	55.3	390.2 (3.26)
Oxo-Hexyl Acetate	7.30	55.3	390.2 (3.26)
Eastman EB Solvent	7.51	55.9	395.0 (3.30)
Eastman EP Solvent	7.59	56.3	397.3 (3.32)
Eastman EEP Solvent	7.91	57.3	404.5 (3.38)
Eastman PM Acetate	8.06	57.7	408.1 (3.41)

[a]*Du Pont*
[b]*Rohm and Haas—supplied at 75% NV in* Eastman *MAK—calculation based on 100% NV resin*
[c]*Cytec*
[d]*15°C*

Low Surface Tension

In many high-solids coatings, the surface tension of the coating increases as the solids content increases. This higher surface tension can contribute to poor sprayability, insufficient wetting, cratering, and "picture framing." Because all nondispersed coating components influence surface tension, the use of solvents with low surface tension should help minimize surface defects. Table 3 shows surface tension values for medium- to slow-evaporating solvents.

Table 3

Solvent Surface Tension

Solvent	Surface Tension dynes/cm, 20°C
Isobutyl Isobutyrate	23.2
Oxo-Hexyl Acetate	25.0
n-Butyl Propionate	25.1
Eastman Methyl Isoamyl Ketone	25.8
Eastman Methyl n-Amyl Ketone	26.1
Eastman PM Acetate	26.4
n-Pentyl Propionate	26.5
Eastman EB Solvent	26.6
Eastman EEP Solvent	27.0[a]
Eastman EP Solvent	27.9[b]
Xylene	28.7
Aromatic 100	29.0

[a]*23°C*
[b]*25°C*

Slow Evaporation Rate

The proper solvent evaporation profile for a high-solids coating depends on many factors—method of application, desired surface appearance, wet-film thickness, and curing conditions. Since most of the solvent content of high-solids coatings comes from the resins, little adjustment of the solvent system is possible. However, the solvent system must evaporate slowly enough to prevent solvent popping, prevent paint particles from drying during application and losing their electrostatic charges, and provide sufficient flow and leveling. Medium- to slow-evaporating solvents such as *Eastman* MAK and MIAK provide good application characteristics in high-solids coatings applications. Evaporation rates for specific solvents are supplied in Table 1.

Boiling Point

Eastman MAK and MIAK are useful as polymerization solvents for high-solids acrylic resins. The high boiling point of MAK (150°C) and MIAK (144°C) aids in the production of low molecular weight acrylic resins with narrow molecular weight distribution. Other important properties are good solvent activity for the resin and chemical processing stability. Acrylic resins prepared in MAK and MIAK are useful for formulating high-solids coatings that meet demanding performance standards yet satisfy lower VOC emissions guidelines. MAK and MIAK are also useful as let-down solvents for high-solids alkyd and polyester resins because of their high boiling point, high solvent activity, and chemical stability.

Table 4 lists some commercial acrylic, alkyd, and polyester high-solids resins which, as supplied, contain either *Eastman* MAK or MIAK.

Table 4

Commercial Resins Supplied in *Eastman* MAK or MIAK

Resin	Supplier	*Eastman* Solvent
Paraloid AT-400[a]	Rohm and Haas	MAK
Paraloid AT-410[a]	Rohm and Haas	MAK
Coroc Resin A-3866-M[a]	CCP/Polymer Products Inc.	MAK/Xylene
Coroc Resin A-4069-K3[a]	CCP/Polymer Products Inc.	MAK
Acrylamac HS 2980[a]	Eastman	MAK
Joncryl 500[a]	S. C. Johnson	MAK
Beckosol 12-501[b]	Reichold, Inc.	MAK
Macopol HS 2758[b]	Eastman	MAK
Duramac HS 5797[b]	Eastman	MIAK/n-BuOAc
Rezimac HS 5747[c]	Eastman	MAK/n-BuOAc
Duramac 7784[d]	Eastman	MAK

[a]*High-solids acrylic*
[b]*High-solids alkyd*
[c]*Silicone-modified polyester*
[d]*Conventional alkyd*

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Material Safety Data Sheets providing safety precautions that should be observed in handling and storing Eastman products are available online or on request. You should obtain and review the available material safety information before handling any of these products. If any materials mentioned are not Eastman products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be observed.

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