EASTMAN

Eastman performance solvents—technical tip

Eastman MIAK and MAK in high solids automotive refinish clearcoats

Introduction

High performance with lower VOC

Eastman MIAK (methyl isoamyl ketone) and MAK (methyl *n*-amyl ketone) are solvents with slow evaporation rates that enable formulators to create high performance, low VOC coatings with excellent flow, providing smooth films with fewer defects. These specialty ketones, just two of the many products offered in the Eastman Performance Solvent portfolio, provide a unique solution to the formulation challenges presented by high solids systems that are now moving into Europe and other regions. Eastman MIAK and MAK, in particular, can provide formulators a means to achieve smooth films and high gloss in 420g/L VOC 2K formulations. Refinish clearcoats and primers and other 2K systems will certainly benefit from the low density, high activity, slow evaporation rate, and fast release provided by ketone solvents. More than any other solvents, Eastman's specialty ketones create value for formulators by providing a tool to deliver smooth and glossy finishes from high solids coatings.

Key attributes

Some of the key performance attributes that Eastman MIAK and MAK bring to low VOC coatings include:

- **High activity**—Supplies low VOC solutions and smooth films.
- **Low density**—Provides less VOC per volume of coating.
- **Slow evaporation rate**—Allows the coating to flow and cross-link into a smooth film.

Data

The effect of solvent density on coating VOC

The density of a solvent has a major effect on the VOC content of a coating formulation. Solvent density is the mass of a given volume of solvent. The density value indicates how much volume a given mass of solvent will occupy in a coating formulation. A solvent with a low density value will contribute less VOC than one with a higher density value. Tables 1 and 2 demonstrate how a solvent with lower density contributes less VOC to the sample formulation.

Table 1 **Sample formulation**

Component	Weight %
Acrylic resin	55
Additives	2
NCO cross-linker	12
Solvent	31
Total	100

Table 2 **Solvent effect on VOC**

Solvent	Density g/mL	Coatings VOC/g/L
Eastman MIAK (methyl isoamyl ketone)	0.78	414
Eastman MAK (methyl *n*-amyl ketone)	0.79	416
PM acetate	0.95	445
Xylene	0.89	435

Eastman MIAK and MAK enable high performance films with low VOC

2K refinish clearcoats (and primers) are generally composed of an acrylic component mixed with an isocyanate cross-linker component prior to application. To achieve higher application solids for lower VOC (420 g/L) coatings, low MW (molecular weight) acrylic resins are used. The lower MW resins tend to flow out less during the drying process resulting in orange peel and other defects such as craters. Orange peel can cause low gloss and low DOI (distinctiveness-of-image) in the finished coating.

The high activity and slow evaporation rate of Eastman MIAK and MAK ketones enable flow and leveling in high solids systems even when lower MW resins are used.

Automotive refinishing starting point formulation with Eastman MIAK

The formulation in Table 3 demonstrates the incorporation of Eastman MIAK as an active retarder solvent in a clear, high solid, urethane topcoat coating for automotive refinishing. Table 4 shows the formulation constants.

Table 3 Clear, high solids, urethane topcoat formulation

Component	Weight %
Acrylamac™ 2314[a]	55.0
Eastman MPK (methyl *n*-propyl ketone)	3.4
Eastman *n*-butyl acetate	10.5
Eastman *n*-propyl propionate	8.4
Eastman MIAK (methyl isoamyl ketone)	8.2
Tinuvin™ 292[b]	0.3
Tinuvin™ 1130[b]	1.0
BYK™-300[c]	0.3
Mix 5 minutes	
Desmodur™ N-3390[d]	12.9

[a] *PCCR USA, Inc.*

[b] *Ciba Specialty Chemicals Corporation*

[c] *BYK-Chemie GmbH*

[d] *Bayer Aktiengesellschaft*

Table 4 Formulation constants

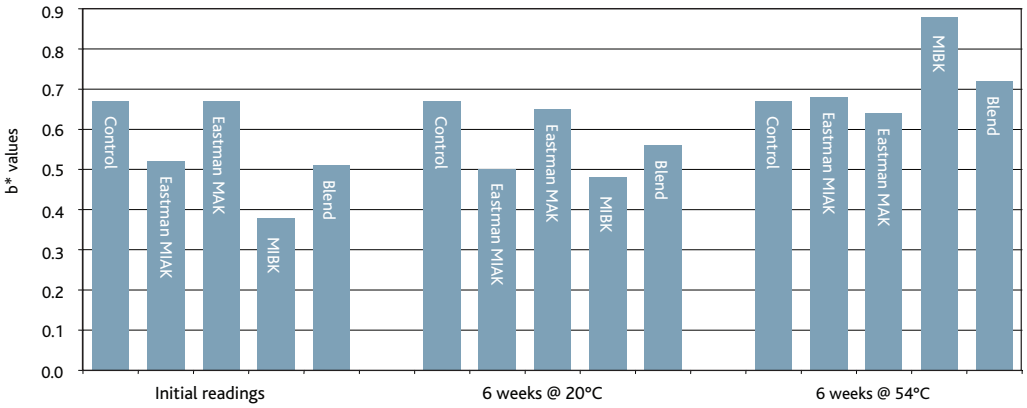
Formulation constants	Value
% NV (weight) calculated	57
NCO/OH ratio	1.1/1
Viscosity @ 25°C, #4 Ford cup, s	22

Yellow color development in clearcoats with ketone solvents

When ketone solvents are used as process solvents to cook resins at high temperatures, care must be taken to avoid yellow color development in the resin. However, ketone solvents do not contribute to yellowing when used as a resin let-down solvent or when added to a coating formulation. To demonstrate that the use of ketone solvents as formulation additives does not result in yellowing, the following comparison was made.

An acrylic solution resin, supplied at 60% solids in xylene, was changed to 20% solids by adding one of the following solvents: Eastman MIAK, Eastman MAK, MIBK, or a blend of butyl acetate, Eastman *n*-butyl propionate, toluene, Eastman EEP, Eastman MPK (23/10/12/5/12). The acrylic solvent solutions were evaluated for color development by measuring CIE L*a*b* values and yellowness index before and after storage for six weeks at 20°C and at 54°C. The measurements were carried out using a Hunter Lab UltraScan XE spectrophotometer and the Hunter Lab measurement method for measuring color in transparent liquids using a 10-mm path length. b* values less than 1.0 are not visually detectable. As seen in Figure 1, none of the solvents tested added any visually detectable color compared to the control and no color developed during the six weeks of the test.

Figure 1 **Solvent contribution to resin solution yellowness**



Conclusion

As regulations force formulators to reduce VOC from their high performance coatings, Eastman MIAK and MAK, two of Eastman's specialty ketone solvents from the Eastman Performance Solvent portfolio, can help the formulator maintain that high performance while reducing VOC. Eastman provides formulators with high activity, low density ketone solvents that enable them to meet performance and VOC targets. Eastman Performance Solvents combined with Eastman's excellent technical service and product and formulation knowledge help make the task of meeting these high performance and low VOC objectives much easier for today's formulator.

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