

Eastman Solvents Technical Tip

Suggested Replacements for MEK (TT-33A)

INTRODUCTION

Eastman Chemical Company has received several requests to provide recommendations for solvents or solvent blends that can be used to replace MEK. The information below was developed using Eastman's Solvent Reformulation Wizard. Estimated properties of solvent blends, including solubility parameters and evaporation rate, are provided. A thorough evaluation should be made to determine if a solvent or blend provides suitable performance for a specific application.

Table 1: Reformulation Summary^{a,b}

Solvent	Control	Reformulation #1 Weight %	Reformulation #2 Weight %
MEK (Methyl ethyl ketone)	100	-	-
Eastman MPK (Methyl n-Propyl ketone) ^c	-	100	40
Eastman methyl acetate	-	-	60
Total	100	100	100
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Relative evaporation rate (R.E.R)	3.867	2.34	3.686
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Hansen solubility parameters			
Dispersion	7.6	7.8	7.687
Polar	4.4	3.7	3.587
Hydrogen bonding	2.5	2.3	3.091
Total	9.131	8.934	9.028

^aAll values are by weight., ^bThese solvent blends are only suggested starting points for developing alternative systems. They should be thoroughly evaluated to determine their suitability for specific application., ^cMPK (methyl n-Propyl ketone) is not on EPA's HAP or SARA list, but it does contain <= 10 wt% MIBK, which is on both lists.

DISCUSSION

Reformulation # 1 – Eastman MPK (Methyl n-Propyl Ketone)

Eastman MPK provides a versatile alternative for formulators looking to replace MEK. MPK is a readily available alternative for use alone or in combination with other solvents to provide the required balance of solvency and evaporation rate.

Key Attributes

- **Excellent solvent activity:** Yields solutions with low viscosities for a variety of polymers.
- **Low density:** Combined with high solvent activity helps formulators meet VOC guidelines.
- **Medium evaporation rate:** Good balance of application and drying characteristics, particularly for air-dry, high-solids alkyd enamels and cellulosic lacquers.
- **Urethane grade:** Suitable for use with moisture-sensitive polymers.
- **Non-HAP^a:** Alternative to HAP solvents.
- **Lower flammability:** MPK's higher flash point vs. that of MEK makes it a good choice when direct replacement of MEK is required based on safety concerns.

^aMPK (methyl n-Propyl ketone) is not on EPA's HAP or SARA list, but it does contain <= 10 wt % MIBK, which is on both lists.

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Reformulation #2: *Eastman* MPK and Methyl Acetate Blend

While MPK can be an effective alternative to MEK, for those formulators requiring a faster evaporating replacement the combination of *Eastman* MPK and *Eastman* methyl acetate is another viable solution. *Eastman* methyl acetate is a fast-evaporating, mild odored, active solvent for a broad range of coating and ink resins. Because of its fast evaporation rate, methyl acetate should be useful as the fast-evaporating component in high/low solvent systems and in other applications where fast solvent release and quick dry-to-touch time are needed. Methyl acetate can be blended with MPK to provide the customized formulation properties necessary for the particular application.

Key Attributes

- **Excellent solvent activity:** Dissolves a wide range of polymers and yields solutions with low viscosities.
- **Low MIR value:** Help formulators of aerosol coatings for CA meet MIR guidelines.
- **Lower VOC:** Aids formulators in meeting VOC limits.
- **Higher electrical resistance and higher flash point than MEK.**
- **Low odor:** Suitable for odor sensitive applications.
- **Urethane grade:** Suitable for use with moisture-sensitive polymers.
- **Non-HAP:** Use level not restricted by Title III of CAA.

Table 2: Reformulation Summary

Solvent	SARA	HAP	Volume	Weight %
<i>Eastman</i> MPK (Methyl n-Propyl ketone) ^c	No	No	43.488	40
<i>Eastman</i> methyl acetate	No	No	56.512	60
Total			100	100

^aMPK (methyl n-Propyl ketone) is not on EPA's HAP or SARA list, but it does contain ≤ 10 wt % MIBK, which is on both lists.

Table 3: Physical Properties

Property	Reformulation #2
Viscosity, cp	0.441
Surface tension @20°C (dynes/cm)	25.805
Refractive index @25°C	1.373

Table 4: Evaporation Data

Time	126.971s
Relative evaporation rate (R.E.R.)	3.686 (n-Butyl acetate = 1.0)
Ethyl ether number (E.E.N.)	3.283 (Ethyl ether = 1.0)

Applications and Benefits of *Eastman* MPK and Blends

- **Cleaners**
(Metal degreasing, cleaning fluids, industrial wipes)

Methyl ethyl ketone (MEK) is no longer permitted in most solvent cleaning operations due to its fast evaporation rate. Slower evaporating solvents such as *Eastman* MPK (methyl n-Propyl ketone) have been introduced as replacements for wipe cleaning operations. From cleaning to pre-treatment, tests prove *Eastman* MPK is an effective

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non-HAP solvent alternative to MEK and toluene. Eastman MPK satisfies the rigorous aerospace performance requirements and has been selected as a replacement for MEK in both military and commercial aircraft hand wipe cleaning. It is environmentally friendly, non ODS (ozone depleting substance), SNAP^a approved, slower evaporating alternative solvent for use in cleaning applications.

^aSNAP refers to the Significant New Alternatives Program developed by the US Environmental Protection Agency for replacing ODS.

Benefits of *Eastman MPK* in Cleaners

- Not listed as Hazardous Air Pollutant (HAP).
- The slower evaporation rate for MPK solvent when compared to MEK, allows for more of the MPK solvent to remain in the wipe material during cleaning.
- Although MPK has slower evaporation rate when compared to MEK, this does not delay the cleaning process.
- Good cleaning performance with MPK solvent in hand wipe cleaning reported for the following:
 - Removal of soils and hydraulic oils
 - Removal of adhesives
 - Cleaning of paint guns
- **Coatings OEM and special purpose**
(High-solids, nitrocellulose lacquers, paper coatings, metal can and coil coatings)
Eastman MPK is an active solvent for most synthetic resins including acrylics, polyesters, cellulose, epoxies, vinyls, and alkyds. Its high solvency, low density, and medium evaporation rate make it attractive as a letdown solvent for high-solids resins and formulating coatings with low VOC content.
- **Additional applications**
 - Printing inks
 - Textile fabric coatings
 - Purge solvents
 - Vinyl coated fabrics
 - Vinyl organosol
 - Lacquer thinner

Regulatory Information

- **Readily biodegradable:** Based upon 1380/1800 BOD/COD ratio > 0.5.
- **NESHAP compliance:** Meets aerospace NESHAP compliance
- **MPK is listed as exempt on several inventories including:**
 - TSCA (US Toxic Substances Control Act)
 - DSL (Canadian Domestic Substances List) and CEPA (Canadian Environmental Protection Act)
 - EINECS (European Inventory of Existing Commercial Chemical Substances)
 - AICS/NICNAS (Australian Inventory of Chemical Substances and National Industrial Chemicals Notification and Assessment Scheme)
 - MITI (Japanese Handbook of Existing and New Chemical Substances)

CONCLUSION

The combination of *Eastman* methyl acetate's VOC exempt status, versatility, and solvency combined with *Eastman MPK*'s low weight per gallon, high solvent activity and high dilution ratio for hydrocarbons can allow formulators to create customized blends to achieve desired performance, comply with regulatory requirements, and provide cost effective solutions.

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