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Solvent substitution or replacement options for MIBK

Methyl isobutyl ketone (MIBK) is a familiar solvent to the coatings industry. Due to its solvency properties and its medium evaporation rate, it finds its way into many coatings applications. While MIBK offers excellent performance and versatility, some agencies have expressed health concerns with this solvent. For example, MIBK is listed as a hazardous air pollutant (HAP) according to Title III of the Clean Air Act Amendments of 1990.

More recently, a new concern has been brought to light by the International Agency for Research on Cancer (IARC, a subgroup of the World Health Organization). The IARC has recently reviewed all the available toxicological data on MIBK and have announced that they intend to classify MIBK as Group 2B, possibly carcinogenic to humans.

In response to this intent by IARC, the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) has announced that they intend to list MIBK under Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986, as "known to the state to cause cancer or reproductive harm."

The purpose of this technical brief is to inform our customers of the recent intent by the IARC to classify MIBK as a Group 2B carcinogen and the intent by OEHHA to place MIBK on the Proposition 65 list. It is also intended to provide alternative solvent options for substituting or replacing MIBK.

Solvent requirements are usually specific, and they vary from application to application. Because of this, it is not very common for a solvent to be replaced with a single other solvent without making some adjustments to the formulation and/or the process. Sometimes, a more viable option is to substitute with a blend of solvents.

Blending solvents is a good approach because it allows formulators to dial in a specific evaporation profile and solvency to match the performance of the solvent they are looking to replace. This could allow formulators to make a substitution without making further adjustments to the paint formula. Table 1 shows 3 different solvent blends that should provide similar performance to MIBK.

Table 1 Solvent blends

	Control wt%	Blend #1 wt%	Blend #2 wt%	Blend #3 wt%
Solvent				
Methyl isobutyl ketone	100	–	–	–
Methyl propyl ketone	–	80	50	30
Methyl isoamyl ketone	–	20	25	–
Methyl acetate	–	–	25	–
Isobutyl acetate	–	–	–	70
Relative evaporation rate (RER), nBuOAc = 1	1.6	1.6	1.6	1.6
Hansen solubility parameters				
Dispersion	7.5	7.8	7.7	7.5
Polar	3.0	3.5	3.4	2.4
Hydrogen bonding	2.0	2.2	2.5	2.8
Total	8.3	8.8	8.8	8.4

These solvents were selected based on their properties and their performance reducing various coatings resins. Tables 2 and 3 contain select solvent properties and Brookfield viscosities with different resins. For more solvent properties, refer to the Solvent Selector Chart, Eastman publication M-167. For more resin solubility information, refer to the Resin Solubility Chart, Eastman publication M-282C (www.eastman.com or contact 800-EASTMAN).

While current market conditions are commanding an unusually high price per lb for MIBK, the blends proposed in this brief would more than likely be lower cost alternatives. Table 4 compares the benefits of the 3 different blends and their relative cost difference to MIBK based on the current market.

Table 2 Solvent properties

Solvent	RER, nBuOAc = 1	Density, lb/gal	Water solubility, wt% (in water/water in) @ 20°C	Electrical resistance, megohms
Eastman™ methyl acetate	6	7.8	22.0/7.3	0.4
Eastman™ MPK	2.3	6.74	3.1/4.2	0.3
Eastman™ MIBK	1.6	6.67	2.0/1.0	0.4
Eastman™ isobutyl acetate	1.4	7.25	0.7/1.6	>20
Eastman™ MIAK	0.5	6.76	0.5/1.2	0.6

Table 3 Resin solubility—Brookfield viscosities

Solvent	Acrylic PARALOID™ B-66 (40 wt%)	Cellulose acetate butyrate CAB-381-0.5 (8 wt%)	Epoxy EPON™ 1001 (50 wt%)	Isocyanate Desmodur™ N 100 (50 wt%)	Polyester POLYMAC™ 057-5776 (65 wt%)	Vinyl acetate AYAA (20 wt%)
Eastman™ MIBK	390	15	68	9	105	45
Eastman™ methyl acetate	340	14	40	7	57	45
Eastman™ MPK	240	13	40	8	71	38
Eastman™ isobutyl acetate	1200	28	110	12	145	65
Eastman™ MIAK	650	20	90	11	85	50

Table 4 Benefit and cost comparison

	Benefit	Cost relative to current MIBK list price*
Blend #1	Performance	Lower
Blend #2	25% lower VOC	Lower
Blend #3	Most economical	Lower

**Based on current market conditions and subject to change*

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