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Eastman specialty ketones

Reducing the solvent content in a precatalyzed wood lacquer

Ketone technical tip

Ketones offer formulators multiple benefits in solventborne coatings. They have lower density and higher solvent activity than other solvents. Direct property comparisons of Eastman specialty ketones—MPK, MAK, and MIAK with other solvents are easily located at www.eastman.com. However, a majority of commercial coatings contain a mix of solvents which provide an evaporation rate profile that ensures proper flow and film formation under varying application conditions. As VOC regulations continue to tighten, formulators are challenged to develop coatings with lower solvent content and reduced VOC emissions. This technical tip illustrates how the use of ketones can reduce the solvent content of a traditional CAB/acrylic precatalyzed lacquer while maintaining the same weight solids, solution viscosity, and evaporation rate.

Eastman's solvent reformulation wizard was used to determine an evaporation rate (ER) value for the control solvent blend. Replacement blends 1–6 were designed to have the same ER value as the control (Table 1). Applying a coating with the proper evaporation rate profile reduces the likelihood of the formation of surface defects, especially when sprayed under varying temperature/humidity conditions.

Resin solids by weight were held constant in all formulas and the resulting solutions reduced to a viscosity of 20 sec using a #4 Ford Cup. This step allowed the comparison of the efficiency of each solvent blend in reducing coating solution viscosity (Table 1).

As shown in Table 1, the control formula has no ketones but does contain traditional, commodity solvents such as PM solvent and PM acetate. Both solvents provide a suitable evaporation rate but are not as efficient in solution viscosity reduction (more solvent required to achieve the targeted viscosity) than the replacement blends containing ketones with one exception—blend 3. The reason for the improved performance in blends 1, 2, 4, 5, 6 (less solvent required to meet targeted viscosity) is the superior solvent activity and lower density of ketone solvents when compared to other oxygenated solvent families.

Table 1 *(units in grams)*

	Control	Blend 1	Blend 2	Blend 3	Blend 4	Blend 5	Blend 6
Components	No ketones	No PM or PMOAc	Acetone added	VMP no toluene	50/50 MIAK/MPK	60/40 MPK/MIAK	Lower MPK
n-butanol	4.13	17.58	17.44	17.72	17.85	17.58	17.71
Toluene	30.72	17.8	17.66	—	18.07	17.8	17.94
PM acetate	23.51	—	—	—	—	—	—
PM solvent	24.74	—	—	—	—	—	—
MPK	—	30.54	5.83	8.88	29.82	35.24	17.76
Denatured alcohol	32.99	35.6	35.32	35.89	36.15	35.6	35.87
MAK	—	28.19	—	—	—	—	—
MIAK	—	—	37.88	41.46	29.82	23.49	29.6
Acetone	—	—	14.57	—	—	—	—
Methyl acetate	—	—	—	14.81	—	—	11.84
VM&P naphtha	—	—	—	17.95	—	—	—
Propyl acetate	20.62	—	—	—	—	—	—
Total solvent blend	**136.71**	**129.71**	**128.7**	**136.71**	**131.71**	**129.71**	**130.72**
ER (*n*-BuOAc = 1)	1.2	1.3	1.2	1.3	1.4	1.5	1.4
CAB 553-0.4	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Acrylamac™ 232-1700	21.08	21.08	21.08	21.08	21.08	21.08	21.08
Cymel™ 303 LF	3.74	3.74	3.74	3.74	3.74	3.74	3.74
Cymel UI-19-1	16.15	16.15	16.15	16.15	16.15	16.15	16.15
BYK™ 333	0.17	0.17	0.17	0.17	0.17	0.17	0.17
BYK 141	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Butyl acid phosphate	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Total	**194**	**187**	**186**	**194**	**189**	**187**	**188**
Weight difference in solvent needed to meet spray viscosity (in grams)	Control	7 g less	8 g less	0 g (same as control)	5 g less	7 g less	6 g less
% difference		3.74	4.3	0	2.65	3.74	3.19

All of the formulas containing Eastman specialty ketones required less solvent to reach a spray viscosity of 20 seconds on a #4 Ford cup (see Table 2) except blend 3. This blend contained VM&P naphtha in place of toluene. The Hansen solubility parameter value (total) of the diluent VM&P naphtha is lower than that of all other solvents, including the diluent toluene, which reduces the overall solvent activity of the blend. As a result, a greater quantity of this solvent blend (when compared to the other blends containing ketones) was required to reduce the viscosity of the coating solution to the designated target.

Table 2

#4 Ford cup (sec)	Control No ketones	Blend 1 No PM or PMOAc	Blend 2 Acetone added	Blend 3 VMP no toluene	Blend 4 50/50 MIAK/MPK	Blend 5 60/40 MPK/MIAK	Blend 6 Lower MPK
Initial	28.8	27.5	26.7	31.1	28.0	27.7	27.0
Reduced	20.2	20.7	20.6	20.4	20.2	20.6	19.9

Table 3

	Evaporation rate (*n*-BuOAc= 1)	Total	Nonpolar	Polar	Hydrogen bonding
n-butanol	0.5	11.3	7.8	2.8	7.7
Toluene	1.9	8.9	8.8	0.7	1.0
PM acetate	0.4	9.4	7.6	2.7	4.8
PM solvent	0.7	10.0	7.6	3.1	5.7
MPK	2.3	8.9	7.8	3.7	2.3
Denatured alcohol	1.7	13.0	7.7	4.3	9.5
MAK	0.4	8.6	7.9	2.8	2.0
MIAK	0.5	8.3	7.6	2.8	2.0
Acetone	6.3	9.8	7.6	5.1	3.4
Methyl acetate	6.0	9.2	7.6	3.5	3.7
VM&P naphtha	1.6	7.4	7.4	0.0	0.1
Propyl acetate	2.3	8.6	7.5	2.1	3.7

Although these examples do not cover all the solvent options available in a formulator's tool box, the effectiveness of reducing solution viscosity when using Eastman's specialty ketones is evident. Excellent solvent activity, low density, plus low- to mid-range evaporation rate, make ketones ideal solvents for industrial coatings.

Contact 1-800-EASTMAN or www.eastman.com for help finding the right blend for your application.

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