VINYL TOLUENE MODIFIED ALKYD RESINS

VT can be used to prepare a wide variety of alkyd coating resins. In general, the base alkyd is formulated to use low cost VT to reduce the oil length of the vehicle. For example using VT with a very long-oil soya alkyd produces improved drying time and hardness. These improvements are realized without reducing the good naphtha solubility of the vehicle.

OIL AND BASE ALKYD SELECTION

The type of oil used in the copolymer reaction is an important variable. Variations in the chemical structure such as degree of unsaturation, type of unsaturation and degree of polymerization have an effect on the product. Copolymers prepared from heavy-bodied oils have higher viscosities, faster drying rates and greater utility for protective coatings than those based on lower viscosity oils. Conjugated oils react readily with VT to form compatible products without use of a catalyst.

VT reactivity with unconjugated oils is less active and appears to be a function of the Iodine value of the oil. Use of a small amount of suitable catalyst allows production of products with good homogeneity from any of the convential drying and semi-drying oils. Copolymers of maximum hardness, toughness and flexibility can be prepared by using one of the highly reactive oils such as dehydrated castor oil.

VT modified alkyd properties depend upon the base alkyd resin used. Close attention must be given to the choice of polyhydric alcohols and the average functionality of the acids in addition to the type and amount of drying oil used. Viscosity buildup, dry time and film integrity are influenced by the functionality of both the polyhydric alcohol and acid constituents.

VT CONCENTRATION

Oils must be modified with a minimum of 35% VT to develop desirable hardness, Tg and drying characteristics of the copolymer. VT concentrations up to 65% are acceptable depending upon the characteristics desired. Use of more than 65% VT creates a hard polymer not suitable for general applications and limited to uses that require extremely short drying periods.

The VT/oil ratio also affects solution viscosity and the homogeneity of the product. Usually the homogeneity of the VT copolymer is improved as the ratio of VT to oil is increased. For example VT modifed linseed oil vehicles offer excellent solution clarity except with long-oil vehicles prepared from lower viscosity oils. These solutions exhibit slight turbidity but films prepared display the clarity and gloss of a homogeneous product.

The data shown below illustrates the usefulness of VT with all commercially important vegetable oils. The clarity of copolymers of VT and cottonseed, linseed, soyabean and sunflower oils improves as VT content increases.

Oil	Iodine Value	30% VT		40% VT		50% VT		60% VT	
		Solution	Film	Solution	Film	Solution	Film	Solution	Film
Cottonseed	100-115	Clear	Hazy	Clear	Hazy	Clear	Sl Hazy	Clear	Clear
Linseed Alkali Refined	175-180	Clear	V Sl Hazy	Clear	Clear	Clear	Clear	Clear	Clear
Dehydrated Castor G-H	135	Clear	Clear	Clear	Clear	Clear	Clear	Gel	Gel
Fish Oil	180-190	Sl Hazy	Clear	Sl Hazy	Clear	Sl Hazy	Clear	Sl Hazy	Clear
Soyabean Alkali Refined	125-130	Clear	Hazy	Clear	Hazy	Clear	Clear	Clear	Clear
Sunflower Alkali Refined	145-150	Sl Hazy	Sl Hazy	Sl Hazy	Sl Hazy	Clear	Clear	Clear	Clear

SOLVENT ADDITION

Copolymers of dehydrated castor oil contain more than 40% VT by the mass polymerization technique. Copolymers of heavy-bodied oils containing high VT concentrations are best made by polymerization in the presence of a suitable solvent. Heavy bodied and highly unsaturated oils with high VT ratios tend to form gelled products in mass polymerization. Addition of the solvent allows extending VT modification of these type oils into a medium or short oil range. Solvents such as mineral spirit or xylenes are typically added as 0-40% of the total charge.

POLYMERIZATION TEMPERATURE

The suitable reaction range for a VT/drying oil reaction is approximately 150-175 oC. Reaction temperatures in excess of 175 oC cause excessive monomer refluxing and result in a small amount of undesirable polymerization in the vapor phase. Reaction temperatures below 150 oC sometimes cause cloudy or gelled products to form.

Generally the temperature affects the polymerization speed by slightly increasing as temperature increases. Temperature affects solution and film clarity since products prepared at lower temperature have a greater cloud tendency.

CATALYSTS

Organic peroxides are the most commonly used catalysts based on effectiveness, availability, handling convenience and storage stability. Peroxide performance in the VT/drying oil reaction shows considerable variation associated with the rate of peroxide decomposition to form free radicals. Generally, slower decomposing catalysts are preferred over more rapidly decomposing catalysts. Peroxides that require a temperature of 100 oC or more for a half-life of four hours in ethylenedichloride solution produce the most satisfactory copolymers.

FORMULATIONS

Deltech Europe, Ltd. has developed VT Alkyd formulations for various applications:

R-114 VT (Vinyl Toluene) ALKYD COATING RESIN

Resin Properties	High Gloss / Fast Drying	
Application:	Enamel Finishes - Aerosol / Rapid dry brush	
Liquid Resin Properties*	**Units**	**Typical Value**
Modification	% VT	20
NV	%	75
Viscosity	dPa.s	3.5-4.5
Acid Value		12
Oil		Linseed (58)
PA	%	15
Solvent		D40
Polyol		Penta

R-115 VT (Vinyl Toluene) ALKYD COATING RESIN

Resin Properties	High Gloss / Fast Drying	
Application:	Enamel Finishes - Aerosol / Rapid dry brush	
Liquid Resin Properties*	**Units**	**Typical Value**
Modification	% VT	20
NV	%	75
Viscosity	dPa.s	3.5-4.5
Acid Value		12
Oil		Linseed (58)
PA	%	15
Solvent		White Spirit
Polyol		Penta

R-116 VT (Vinyl Toluene) ALKYD COATING RESIN

Resin Properties	High Gloss / Fast Drying	
Application:	Enamel Finishes - Aerosol / Rapid dry brush	
Liquid Resin Properties*	**Units**	**Typical Value**
Modification	% VT	20
NV	%	75
Viscosity	dPa.s	4.5-6.0
Acid Value		12
Oil		Linseed (58)
PA	%	15
Solvent		SBP6
Polyol		Penta

R-242 VT (Vinyl Toluene) ALKYD COATING RESIN

Resin Properties	High Gloss / Fast Drying	
Application:	Spray Application-Stoving / Industrial systems	
Liquid Resin Properties*	**Units**	**Typical Value**
Modification	% VT	36
NV	%	50
Viscosity	dPa.s	1.5-2.5
Acid Value		12
Oil		Linseed (36)
PA	%	19
Solvent		SBP6
Polyol		Glycerol

R-280 VT (Vinyl Toluene) ALKYD COATING RESIN

Resin Properties	High Gloss / Fast Drying
Application:	Ink - Clear/Base coats

Liquid Resin Properties*	Units	Typical Value
Modification	% VT	30
NV	%	80
Viscosity	dPa.s	80-100
Acid Value		10
Oil		Linoleic (48)
PA	%	18 (Iso P)
Solvent		260-290 dist
Polyol		Penta/TMP

R-281 VT (Vinyl Toluene) ALKYD COATING RESIN

Resin Properties	High Gloss / Fast Drying
Application:	Exceptional Clarity for Clear Ink Varnishes

Liquid Resin Properties*	Units	Typical Value
Modification	% VT / % TBS	27 / 3
NV	%	80
Viscosity	dPa.s	80-100
Acid Value		10
Oil		Linoleic (48)
PA	%	18 (IsoP)
Solvent		260-290 dist
Polyol		Penta/TMP

*These properties represent typical values obtained on samples prepared and tested according to accepted testing conditions. They are intended as guidelines only.

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