VINYL TOLUENE IN VINYL ESTER RESINS

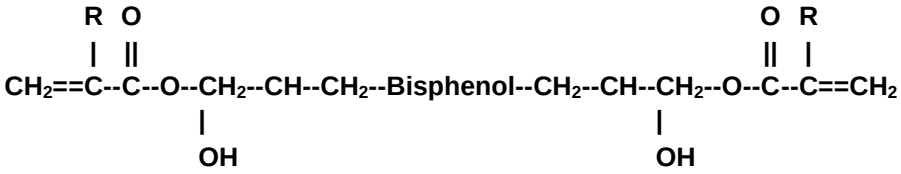
Continuing restrictions on VOC emissions to protect the environment and reduce personnel exposure requires a reduction in styrene emissions for manufacturers and consumers of vinylester resins. The challenge is emission reduction while maintaining the structural integrity or corrosion resistance of the finished fibre reinforced product *(R. Schumacher, Chem. Ind., 3-92)*

VINYLESTER CHEMISTRY

Vinylesters are produced by the esterification of an epoxy resin with an unsaturated monocarboxylic acid. The reaction product is then dissolved in a reactive diluent at 35-45 weight %.

Terminated double bonds are reactive sites in vinylesters and provide the high degree of cross-linking depending upon the functionality of the epoxy resin.

Bisphenol-A Epoxy Vinylester:



Vinylesters are very chemically stable. The excellent toughness which is comparable to epoxy resin is provided by the Bisphenol-A or Novalak part of the molecule. The phenylether bonds provide outstanding corrosion resistance and ester group number is limited by the terminated acid. Limiting ester groups causes improved alkali and hydrolysis stability as compared to unsaturated polyester resins. Commercially available vinylesters are based on Bisphenol-A or Novalak backbone structures and typically use styrene monomer as the reactive diluent.

IMPROVEMENTS USING VT

Replacing a portion or all of the styrene monomer diluent in the vinylester formulation with VT can provide significant improvements without adversely affecting resin characteristics. The table below shows resin characteristics for a resin with styrene monomer or VT diluent.

	VT 45 WT%	Styrene 45 WT%
Physical Properties		
Viscosity (25°C), cps	400	350
Density (25°C), g/ml	1.03	1.04
Casting Properties[1]		
Tensile Strength, psi	12300	12400
Tensile Modulus, psi	470000	490000
Elongation, %	6.7	6.0
Flexural Strength	23000	18000
Flexural Modulus	520000	450000
Tg, °C	99	105

(1)Catalyst - 0.3% Co-naphthenate (6% Co)
Cure - 16 hour ambient temperature
Postcure- 2 hour 155 °C

Replacing styrene monomer with VT provides improved drying characteristics and higher temperature stability. The resin properties with VT substitution are similar to the styrene based resin with the exception of the Tg *(M. N. White, T. W. Cowley, 45th Annual Conference, Composite Institute/SPI, 2-90).*

Resistance to corrosion is improved as shown in the figure below by the % of weight increase or loss in alkaline and acid solutions:

Vinylester Corrosion Resistance - VT vs Styrene

Weight Gain/Loss %

Styrene	**4.1**	**-10.7**	**0.7**	**1.2**
VT	**2.0**	**-7.5**	**0.5**	**1.5**

Replacing all or part of the styrene monomer with VT also provides a direct reduction in emission of volatile styrene and reduced shrinkage of cured parts:

Effect on Volatile Emission -Substitution of VT for Styrene

Weight Loss
m^2(15 min)

% VT in Monomer Mixture

Applications for this type vinylester formulation include coatings for heavy duty systems in chemical or power plants and fibre reinforced products such as pipes, storage tanks, transportation containers and chemical plant equipment.