

VINYL TOLUENE IN RADIATION CURABLE COATINGS

Unsaturated Polyester Resins (UPR) dissolved in styrene or other unsaturated monomers were used in the early development of radiation cured coatings (*R. Holman et al., UV & EB Curing Formulation for Printing Inks, Coatings and Paints, SITA-Technology, 1988*). UPR products continue to be used for in radiation curing applications due to a significant cost advantage over more advanced systems.

UPR FORMULATION

A typical UPR formulation suitable for producing a styrene based resin for radiation curing is shown below (*C. G. Roffey, Photopolymerization of Surface Coatings, J. Wiley & Sons, 1982*):

| Material | Quantity |
|----------------------|---------------|
| 1,2 Propylene Glycol | 2.1 mole |
| Phthalic Anhydride | 1.0 mole |
| Maleic Anhydride | 1.0 mole |
| Styrene Monomer | 35% by weight |
| Inhibitor | 50-1000 ppm |

Glycol and acid anhydrides are agitated and heated under nitrogen purge to remove reaction water. Reaction completion is determined by testing acid value and viscosity to desired end point. After cooling to 100-130 °C, 30-40% by weight of styrene monomer and suitable polymerization inhibitor are added.

In this formulation, maleic anhydride provides the unsaturation. Other acids and glycols can be used to provide differing UPR properties.

APPLICATIONS

UPR radiation cured coatings are primarily used for wood finishing applications such as fillers, sealers and top coats. These products offer good hardness, toughness and solvent and heat resistance but flexibility and chemical resistance are poor.

UPR coatings based on styrene monomer are slow curing and cause high styrene emissions during application and curing.

IMPROVEMENTS USING VT

Replacing a portion or all of the styrene monomer in the UPR formulation can provide significant improvements:

| Material | Quantity |
|----------------------|-----------------|
| 1,2 Propylene Glycol | 2.1 mole |
| Phthalic Anhydride | 1.0 mole |
| Maleic Anhydride | 1.0 mole |
| 1,6 Hexanediol | 0.6 mole |
| VT | 37% by weight |
| Inhibitor | 50-1000 ppm |

UPR radiation cure coatings based completely on VT exhibit an increase in curing speed and improvement in hardness compared to styrene based products. Complete VT replacement also eliminates the high styrene emissions during application and curing. To compensate for resin changes associated with the increased hardness an internal flexibilizer is added to the formulation.

Resin properties can be varied by replacing only a portion of the styrene monomer with VT and adjusting the flexibilizer addition accordingly.