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Studies on Polymerizable Coating Materials

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Vinyl ester resin of resorcinol (VER-R) was prepared and novel coating material, unsaturated polyurethane resin based on resorcinol (UPU-R) was synthesized by the condensation reaction of VER-R and Toluene diisocyanate. VER-R and UPU-R were polymerized on mild steel panels at 120°C for 1 hour. The resulting coated panels were characterized by; scratch hardness, flexibility, impact strength and chemical resistancy. The addition of simple vinyl monomer such as styrene improves the coating properties significantly.

Keywords: Resorcinol vinyl esters; polyurethanes; coatings; properties

INTRODUCTION

Vinyl esters are known primarily as materials for the manufacturing of paints and composites [1-8]. A substantial amount of the work on vinyl ester resin has been carried out in our laboratory [7]. The research focussed mainly on curing of vinyl ester resin by free radical and/or diisocyanate and/or by addition of other co-vinyl monomer. Hitherto, this type of study on vinyl ester resin based on resorcinol (VER-R) has not been carried out despite known versatility of VER-R resin [8, 9]. The present communication is the extension of our earlier work on the synthesis aspect of VER-R. The study concerns the novel coating material (UPU-R) polymerized on mild steel panels and its coating properties.

EXPERIMENTAL

Materials

All the chemicals used for the synthesis were of laboratory grade.

Synthesis of Resins

Vinyl ester resin (VER-R) and unsaturated polyurethane resin (UPU-R) were prepared by the methods described in [10]. The synthesis scheme is shown in Scheme 1.

Coating on Mild Steel Panels

Various resin systems were prepared using thinner comprising the solvent methyl cellosolve and were made free from coarse skin by passing through 150 μm sieve (IS: 460–1960). All such resin system were then coated on the mild steel panel (confirming to deep drawing quality as per IS: 513–1960, size 150 \times 1.25 mm) using flat brush conforming to IS: 384–1964. The coated mild steel panels were placed in vertical position for drying immediately, then examined after specific time intervals for the tack free test and cured thermally.

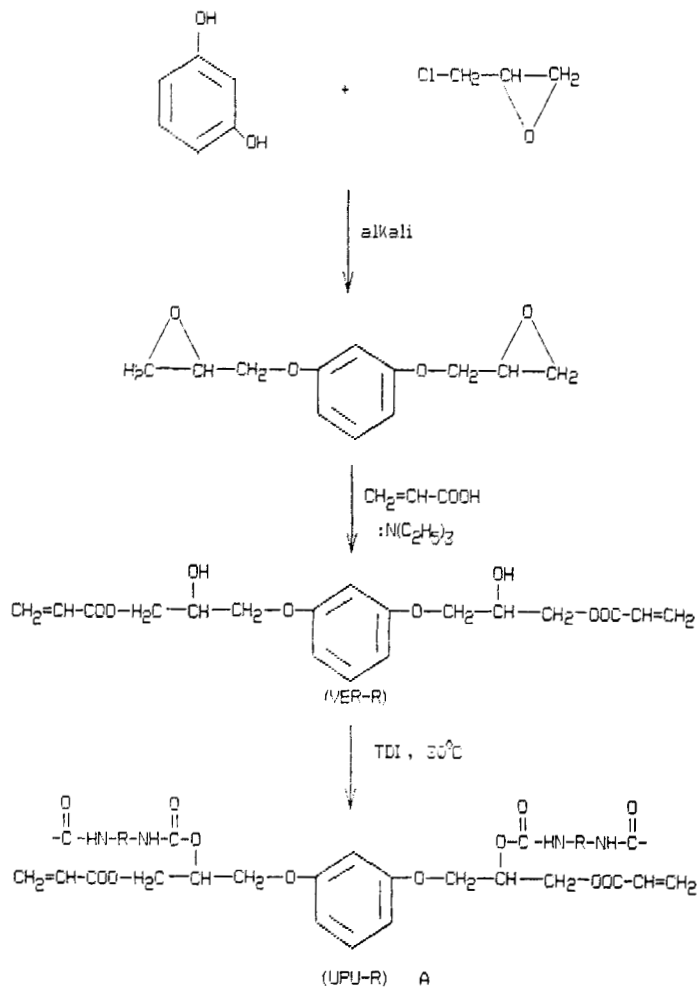
Measurements

All the samples were tested for flexibility test on 1/4" and 1/8" conical mandrel. Scratch hardness, impact resistance and chemical resistance also measured by following ASTM standard test. The scratch hardness of the coating was measured by mechanically operated sheen Scratch Hardness Tester.

The chemical resistance of the coatings was studied by dipping separately coated panels in 2% sulphuric acid, 2% alkali solution and acetone at room temperature for specified time.

RESULTS AND DISCUSSION

The viscous resins VER-R and UPU-R are soluble in common organic solvents such as acetone, benzene, dioxane, carbon tetrachloride etc.



Scheme 1

The resins coated on the mild steel panel were cured thermally using benzoyl peroxide (1% by wt of resin) as catalyst. The temperatures of curing were decided considering the temperature characteristics and activation parameters evaluated from dynamic scans.

Data furnished in Table I are regarding the scratch hardness impact strength and flexibility test of the coatings on the mild steel panels using various resin systems. As mentioned in the Table I, the two

TABLE I Flexibility, impact strength and stretch hardness of the vinyl ester resin and polyurethane resin based on resorcinol

<i>Resin</i>	<i>Styrene Content</i> (% by Wt)	<i>Flexibility</i>	<i>Impact Strength</i>	<i>Scratch hardness</i> (gm)
VER-R*	-	Pass	115	800
VER-R	10	Pass	128	850
VER-R	20	Pass	135	930
VER-R	30	Pass	150	990
UPU-R	-	Pass	200	1100
UPU-R**	10	Pass	225	1300
UPU-R	20	Pass	240	1410
UPU-R	30	Pass	270	1520

VER-R* = Vinyl ester resin based on resorcinol.

UPU-R** = Unsaturated polyurethane resin based on resorcinol.

types of resin systems VER-R and UPU-R have been synthesized for the study. An attempt has been made to discuss the effect of vinyl monomer (viz. styrene) on the coating proportions. These coatings on application using brush produced adherent and flexible coatings which here baked at 120 °C.

Flexibility and Adhesion

All resin systems passed flexibility test on 1/4" and 1/8" conical mandrel, which is expected of vinyl ester and urethane based coatings. All the coated mild steel panels passed stripping test for adhesion. These might be due to free hydroxyl group in vinyl ester and isocyanate group in polyurethane which contribute in the strong metallic bond formation with the surface of mild steel panels.

Scratch Hardness and Impact Resistance

The results of testing furnished in Table I reflects the UPU-R yields coatings with better scratch hardness and impact strength. In the reaction of VER-R with toluene diisocyanate, the urethane linkages are formed. The formation of urethane linkages improves the toughness of the coatings which may be ascribed for the higher scratch hardness and impact strength of UPU-R. The values of scratch hardness and impact

strength observed in VER-R resin systems may be responsible for the unsaturation present in the resin structure.

The incorporation of styrene in both the VER-R and UPU-R should improve the properties as it may increase the toughness of the resin system.

Water and Solvent Resistance

In case of water resistance, coatings based on all the resin systems show no blistering or change in colour for the hours. The panels immersed for 72 hours in solvent, but no cracking, blistering or change in colour was observed which indicates that all the systems have excellent solvent resistance.

Acid and Alkali Resistance

The coated panels dipped in 2% acid and 2% alkali solution for 72 hours show that all the panels were unaffected up to 48 hours was observed, after which possibilities of change in colour. The observations reveal that on exposing the coated panels to 2% NaOH and 2% H₂SO₄, no substantial loss in gloss or change in appearance were observed indicating excellent adhesion as well as good resistance to acid, alkali and organic solvents.

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