



EBECRYL[®] 893 Resin for Field Applied UV Curable VCT Floor Coatings

In the early to mid 2000's, commercial UV curing moved out of the factory and into the field, with numerous improvements in UV curing equipment pushing this transformation. Floor coatings are one of the main applications for field applied UV cured coatings. Today, these field applied or on site floor coatings for wood, vinyl, tile, and concrete are all in some phase of commercialization.

The benefits of UV cured field applied floor coatings are similar to factory applied floor coatings: increased productivity and performance. In addition, the immediate cure aspect provides cost savings to the end user through immediate use, and added benefits of quality, since the finish will not be damaged once it is cured.

VCT

Conventional VCT (vinyl composition tile) coatings are typically based on waterborne acrylic copolymers. These coatings are short-lived due to low durability, and require frequent polishing/renovation. They can be classified as low, medium, or high maintenance depending on the frequency of required burnishing, which can be from one to five times per week. Additionally, these coatings are frequently stripped and reapplied. Thus, the maintenance costs and down times associated with these coatings can be quite high.

UV curable coatings can address many of the issues associated with conventional VCT coatings. They are durable and stain resistant, resulting in a low maintenance coating with reduced aggregate costs and down times. The properties of UV curable coatings are also fully developed immediately after UV cure, providing immediate return to service with floors that are resistant to damage. Table 1 summarizes the comparison of UV and conventional VCT coatings. The data for this comparison were obtained from manufacturer data sheets and brochures.

EBECRYL 893

EBECRYL 893 is a modified polyester acrylate specifically developed for UV curable field applied VCT floor coatings. EBECRYL 893 is low in viscosity, providing latitude in formulating for these low viscosity applications. It also provides resistance to yellowing upon cure and over its lifetime. VCT coatings based on EBECRYL 893 provide a good balance of properties such as cure speed, adhesion, hardness, and scratch resistance. Good chemical and solvent resistance and high gloss are also obtained with VCT coatings based on EBECRYL 893.

Table 2 gives a starting point formulation (SPF) for VCT floor coatings. It is recommended that these coatings be applied over sealed substrate to provide improved appearance. Table 3 gives a SPF for a UV curable sealer based on UCECOAT[®] resins, but conventional sealers can also be used. For optimized topcoat performance towards yellowing resistance, the use of UCECOAT 7689 or UCECOAT 7631 is advised. The performance properties of the EBECRYL 893 topcoat/UCECOAT 7578 sealer combinations are given in Table 4. High gloss, excellent adhesion and black heel mark resistance, and outstanding chemical and solvent resistance are demonstrated by the UV curable coating. Table 4 also shows the substantial improvement in scratch resistance (steel wool double rubs) that is achievable through the addition of EBECRYL 154, a functionalized nanocomposite acrylate. (In the SPF, replace 15% EBECRYL 893 with EBECRYL 154.)



TABLE 1. Comparison of Conventional and UV Curable VCT Coatings

PROPERTY	UV CURABLE COATING	CONVENTIONAL COATING
Number of coats (average recommendation)	1	4-5
Application Time (relative)	x	4-5 x
Total Dry Time (hours)	0.5 (flow/level)	2-2.5
UV Cure Time (relative)	x	0
Time to Fully Developed Properties (days)	immediately after UV cure	4
Maintenance Time (relative)	low	high
Lifetime (relative)	4-10 x	x
Coverage (sq ft/gallon)	500	2000-3000
Aggregate Cost (Equipment and Coatings)	+	-
Strippability (relative)	+/-	+

The yellowing of EBECRYL 893 was tested through exposure to a 300 watt Osram light bulb, at a distance of 40 cm. The Osram light bulb simulates sunlight, and is recommended for industrial material testing. After 4 days exposure, the EBECRYL 893 diluted with 21% EBECRYL 160 (TMPEOTA), photoinitiated with 4% Darocur[®] MBF, and coated at 100 microns on a white MDF back panel, gave a delta b of 1.4 compared to an unexposed sample. This very low yellowing value indicates suitability of use for coating VCT tiles.

Table 5 compares the performance of the UV curable EBECRYL 893 topcoat/UCESCOAT 7578 sealer combination on VCT to that of two commercially available VCT floor finishes. Adhesion and scratch and solvent resistance are much improved for the UV curable coating, and the UV curable coating shows much better chemical/stain resistance for all twelve of the chemicals that were tested. The gloss of the UV curable coating is also higher. These evaluations were performed immediately after UV cure for the UV curable coating, and 24 hours after the last coat had dried for the conventional coatings. As shown in Table 4, the addition of EBECRYL 154 to the UV curable coating can provide even more scratch resistance (from 25 to 100 steel wool double rubs) with little change in other properties. (EBECRYL 154 is a functionalized nanocomposite acrylate.)



TABLE 2. Starting Point Formulation for EBECRYL 893 Based Topcoat

CYTEC PRODUCT	%	PURPOSE / PROPERTY
EBECRYL 893	50.00	Coating Performance
NPG(PO) ₂ DA [®] or EBECRYL 145	14.96	Viscosity Reduction
DPGDA [®]	30.00	Viscosity Reduction
Darocur [®] MBF ⁽¹⁾	5.00	Photoinitiator
BYK [®] A-500 ⁽²⁾	0.04	Defoamer
	100.00	
Viscosity (cP @ 25° C)	75	
Coat at 2 mils (50 µm) on sealed VCT		Sealer improves aesthetics
UV cure at exposure necessary to get a mar free surface (mJ/cm ²)	410 typical	Crosslinked polymer for resistance properties and aesthetics

⁽¹⁾Product of Ciba

⁽²⁾Product of BYK Additives & Instruments

TABLE 3. Starting Point Formulation for UV Curable Sealer Based on UCECOAT Resins

CYTEC PRODUCT	%	PURPOSE / PROPERTY
UCECOAT [®] Resins 7578, 7689, or 7733 (US) 7578, 7631, or 7733 (EU)	92.3	Coating Performance
ADDITOL [®] VXW 4973	0.5	Defoamer
ADDITOL VXW 6503	0.2	Flow & Leveling
Isopropanol	5.0	Coalescent
ADDITOL BCPK	2.0	Photoinitiator
	100.0	
Viscosity (cP @ 25° C)	20	
Coat at 5-7 mils (125-175 µm) wet on VCT; 2 mils (50 µm) dry film thickness (DFT)		Sealer improves aesthetics
Sealer should be dried before re-coating, but does not need an intermediate UV cure. UV cure one time after the topcoat has been applied, or partially cure (gel cure) the sealer to insure intercoat adhesion.		

See the Featured Product Sheet “UCECOAT Resins for UV Curable Sealers for Concrete & Vinyl Composition Tile (VCT)”



TABLE 4. Performance Properties of Topcoat/Sealer Combinations with and without the Addition of EBECRYL 154

PROPERTY	TOPCOAT ON SEALED VCT	TOPCOAT + EBECRYL 154 ON SEALED VCT
Gloss (60°)	90	88
Appearance	High clarity; No surface defects	High clarity; No surface defects
Crosscut Adhesion (3M 610 tape)	5B	5B
Coin Test	Very slight burnish	Very slight burnish
Black Heel Mark Resistance (BHMR)	No marking	No marking
Pencil Hardness	4B	4B
MEK Double Rubs	200+	200+
Steel Wool (0000) Double Rubs	25	100
Chemical Resistance (24 hour spot test, with cottonball, covered)		
Mustard	Slight stain (no stain at 30 minutes)	Slight stain (no stain at 30 minutes)
Betadine	Slight stain (no stain at 30 minutes)	Slight stain (no stain at 30 minutes)
RIT® Dye (navy, undiluted)	Slight stain (no stain at 30 minutes)	Slight stain (no stain at 30 minutes)
Xylene	Slight distortion	Slight distortion
Olive Oil	No effect	No effect
Formula 409®	No effect	No effect
Vinegar	Slight stain	Slight stain
Water	No effect	No effect
Ethanol (50%)	Slight distortion	Slight distortion
Isopropanol (70%)	No effect	No effect
Windex®	No effect	Slight distortion
Pickle Juice	No effect	No effect

TABLE 5. Comparison of UV Curable and Conventional VCT Coatings

PROPERTY	UV COATING (1 coat: 2 mils or 50 µm DFT)	CONVENTIONAL COATINGS (4 coats: 1 mil or 25 µm DFT)	
	EBECRYL 893 SPF (over 1 seal coat)	MEDIUM MAINTENANCE FINISH	LOW-MEDIUM MAINTENANCE FINISH
Gloss (60°)	90	78	70
Crosscut Adhesion (610 tape)	5B	0B	0B
Pencil Hardness	4B	4B	4B
MEK Double Rubs	200+	10	10
Steel Wool (0000) Double Rubs	25	1	1
With 15% EBECRYL 154	100		
Chemical Resistance (24 hour spot test, with cottonball, covered)			
Mustard	Slight Stain	Moderate Stain/Dist	Moderate Stain/Dist
Betadine	Slight Stain	Severe Stain	Severe Stain
RIT Dye (navy, undiluted)	Slight Stain	Moderate Stain	Moderate Stain
Xylene	Slight Distortion	Severe Lift	Severe Lift
Olive Oil	No Effect	No Effect	Moderate Distortion
Formula 409	No Effect	Severe Lift	Severe Lift
Vinegar	Slight Stain	Severe Distortion	Severe Distortion
Water	No Effect	Slight Distortion	Moderate Distortion
Ethanol (50%)	Slight Distortion	Severe Lift	Severe Lift
Isopropanol (99%)	No Effect	Severe Lift	Severe Lift
Isopropanol (70%)	No Effect	Moderate Lift	Moderate Lift
Windex	No Effect	Severe Lift	Severe Lift
Coin Test	Slight Distortion	Severe Lift	Severe Lift
Black Heel Mark Resistance	No Marking	No Marking	No Marking

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