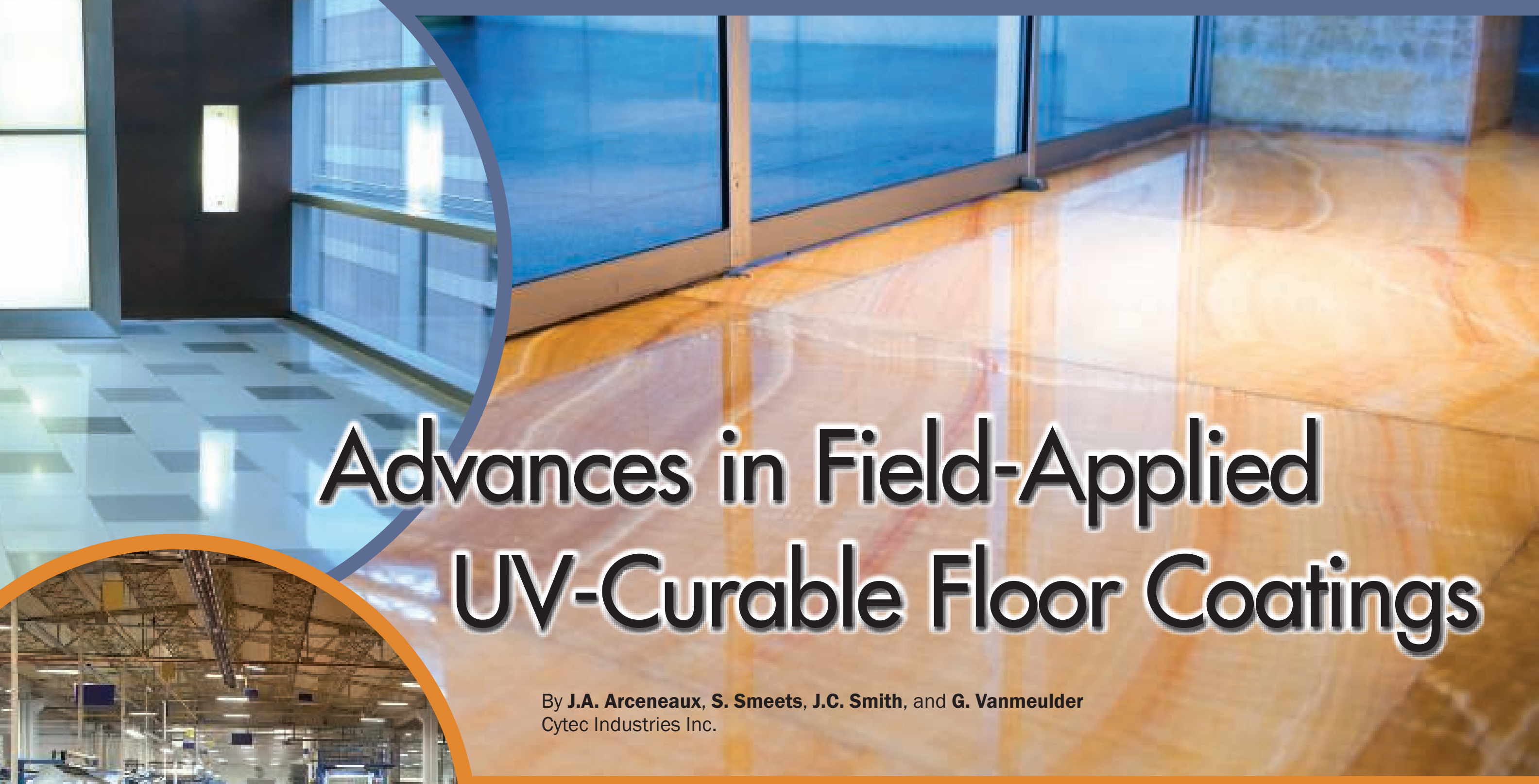

Advances in Field-Applied UV-Curable Floor Coatings

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Field-applied, UV-curable floor coatings were first introduced around the turn of the century. These floor coatings provide value to the end-user through fast return to service and improved coating properties that are fully developed immediately after cure. This value serves to minimize downtime, post-coat defects, and maintenance, thereby providing cost savings to the end-user.

The performance of the floor coatings has been improved since their first introduction. However, there is still a need for even stronger functionality, such as increased scratch and abrasion resistance, improved chemical resistance, and better appearance. This article discusses recent improvements in resin and formulation design that allow for enhanced coating performance in UV-curable concrete, wood, and vinyl composition tile (VCT) floor coatings.

INTRODUCTION

Coatings have been UV cured in industrial settings since the 1960s. The graphics industry was one of the first to adopt this technology, with a high-gloss coating on cards. Today, there are numerous industrial applications that utilize UV curing as the method of drying or polymerizing the coatings or inks.

The concrete tile industry has been growing its use of UV coatings as a way to increase both productivity and performance, and to meet environmental regulations. All conventional concrete coatings are multi-component systems, and the two-component epoxy/amine and urethane (isocyanate/polyol) are the most common. These epoxy and urethane coatings require more than one day before return to service. Faster curing systems include polyaspartic and methyl methacrylate coatings, which can be returned to service in hours instead of days. However, the pot life of these fast-curing systems dramatically compromises the open time necessary for proper application, and can result in wasted product and deficiencies in appearance and product performance. The rate of cure of multi-component systems is also limited by temperature, and is often unacceptable for refrigerated end-uses or cold weather application. Other disadvantages of conventional concrete coatings include high volatile organic content (VOC) and odor, as well as a lack of exterior durability, ease of cleaning, and abrasion resistance.

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UV-curable concrete coatings can address many of the shortcomings of these conventional concrete coatings.

The wood coating industry initially embraced UV-curing technology as a way to increase both productivity and performance. More recently, energy savings and environmental regulations have also become incentives for switching to UV-curing technology. Initially, all applications were based on 100% solids UV-curable products, coating mainly flat panels by roller coater. During the 1990s, UV-curable polyurethane dispersions in water (UV PUD) were developed, and PVC floor coatings were the first industrial application. The flexibility, adhesion, and stain resistance of these coatings made this new technology very successful. The low viscosity and the very low VOC of these dispersions also made them very attractive for spray, curtain, and vacuum applications onto wood.

Until recently, field-applied wood floor coatings have required conventional curing. Polyurethanes are the leading type of field-applied floor coatings; others include conversion varnishes, oils, and waxes. Today, there are several UV-curable wood floor coatings in varying stages of commercial development, including 100% solids and waterborne coatings.

Conventional vinyl composition tile (VCT) 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 downtime 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 downtime. 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.

UV—FROM FACTORY-APPLIED TO FIELD-APPLIED COATING

Applying and curing a coating in a factory is a well-controlled process. Moving this process to the field introduces many uncontrolled variables, which means that a robust coating and cure process is needed.

Substrate variations are more common in the field, where floor composition, surface treatment, roughness, porosity, and contamination are all potential challenges. Also, unlike in the factory, the substrate is larger than the UV-cure unit.

UV leakage at the sides of the curing equipment can prematurely cure the coating at the edges of the cure path. This may cause changes in the surface appearance in this area. Also, care must be taken to insure complete cure of all areas. Overlap criteria for the UV-curing unit are typically provided by the coating supplier to assist in achieving complete cure.

Field-applied UV-curable coatings are applied like conventional floor coatings using a squeegee, roller, or T-bar applicator. These application methods can result in coating thickness variations.

Finally, the UV-cure unit is mobile and moves over the substrate. The distance from the UV-cure unit to the substrate and the speed of the UV-cure unit may both vary during the UV-curing process. The equipment for field-applied applications has undergone many modifications and upgrades over the last few years. There are at least seven manufacturers, each of which has a unique construct for their machines. Some of the recent improvements to UV-curing equipment are shown in *Table* 1. Many of these improvements address safety issues or process reproducibility. In general, however, it is the coating formulation that must be robust enough to overcome all of these challenges.

Feature	Purpose
Shutters: manual control or tied to movement of machine Instant on/off feature: tied to movement of machine Tip detectors	Reduce accidental UV exposure if machine is lifted or moved
Heat sensors	Reduce possibility of floor damage
Speed control: self-propelled or speed gauge for manual propulsion	Improve process reproducibility
Retractable handles	Better clearance
Light weight	Maneuverability
Power supply 110, 230, or 380 V	Fit local energy supply
Emergency shutoff on handle	Safety
Shielding Mandatory use of UV protective eye wear Use of clothing and creams to protect skin from stray UV light Cordoning off work areas Warning lights	Decrease eye and skin exposure

Table 1—Improvements in Mobile UV-Curing Equipment

Table 2—Starting Point Formulation for Clear Concrete Topcoat

Product	%
Polyester Acrylate A	75.5
Diluting monomer (di- or tri-acrylate)	20.0
Methylbenzoylformate (photoinitiator)	3.8
Defoamer	0.2
Wetting agent	0.5
	100.0
Viscosity (cP @ 25°C)	385
1-2 coats for 150–175 µm (6–7 mils) total coat weight on sealed concrete	
UV-cure exposure for partial or gel cure (mJ/cm²)	390
UV-cure exposure for full cure (mJ/cm²)	580

Table 3—Starting Point Formulation for Pigmented Concrete Topcoat

Product	%
Polyester Acrylate A	67.34
TMPEOTA (ethoxylated trimethylolpropane triacrylate)	17.9
Methylbenzoylformate (photoinitiator)	1.7
phosphine oxide, phenyl bis (2,4,6-trimethyl benzoyl) (photoinitiator)	0.85
2,4,6-trimethylbenzoyl diphenyl phosphine oxide (photoinitiator)	1.7
Defoamer	0.43
Defoamer	0.43
Black pigment	0.26
White pigment paste	8.53
Flow/leveling agent	0.43
Rheology modifier	0.43
	100.0
Viscosity (cP @ 25°C)	400
2 coats for 100–150 µm (4–6 mils) total coat weight on sealed concrete	
UV cure exposure for partial or gel cure (mJ/cm²)	580
UV cure exposure for full cure (mJ/cm²)	830

UV FIELD-APPLIED CONCRETE COATINGS

Concrete coatings can be used on floors that are exposed to various and sometimes severe conditions, such as strong chemicals in factories, pickle juice in grocery stores, shopping cart traffic in retail stores, and hot tires in garages and warehouses. Even under these conditions, the coating is expected to maintain a good appearance and performance. Ideally, the coating also should not yellow during cure or use. These properties are needed in both clear and pigmented concrete floor coatings.

A second-generation UV-curable resin—Polyester Acrylate A—has been developed to address many of the previously mentioned requirements for concrete floor coatings. To meet the scratch and abrasion resistance needed for floors in retail stores, a functionalized nano-composite acrylate—Polyester Acrylate B—can be used to replace 15% of Polyester Acrylate A. *Table* 2 provides a starting point formulation for a clear concrete floor coating that is based on Polyester Acrylate A. The pigmented starting point formulation is shown in *Table* 3. *Table* 4 details the performance of a clear concrete floor coating with and without the addition of Polyester Acrylate B. The performance of a pigmented concrete floor coating is shown in *Table* 5. All of the starting point formulations exhibit excellent stain, solvent, and chemical resistance, including pickle juice for the clear floor coatings. The formulation containing Polyester Acrylate B shows a substantial increase in steel wool double rubs versus the formulation without it, making it more appropriate for retail stores with shopping cart traffic.

Hot-tire pickup resistance is important for garage and warehouse applications. Coatings without this resistance are softened by the heat and water from tires on automobiles or forklifts. Then, under pressure from the weight of the vehicles, the plasticizers in the tires bond the tire to the coating. The end result is coating removal,

Table 4—Performance Properties of a Clear Concrete Topcoat Based on Polyester Acrylate A, With and Without the Addition of Polyester Acrylate B

Property	Topcoat	Topcoat + Polyester Acrylate B
Substrate	Concrete tiles	Concrete tiles
Sealer and coat weight	UV PUD 2 x 50 µm dry (2 x 2 mils dry)	UV PUD 2 x 50 µm dry (2 x 2 mils dry)
Topcoat and coat weight	Polyester Acrylate A 1 x 150 µm (6 mils)	Polyester Acrylate A + B 1 x 150 µm (6 mils)
Monomer dilution in topcoat	15% Propoxylated neopentylglycol diacrylate and 30% dipropyleneglycol diacrylate	15% Propoxylated neopentylglycol diacrylate and 30% dipropyleneglycol diacrylate
UV-cure exposure	1 x 410 mJ/cm^2	1 x 410 mJ/cm^2
Gloss (60°)	92	90
Appearance	High clarity; No surface defects	High clarity; No surface defects
X-cut adhesion (3M 610 tape)	4A	4A
Coin test	Very slight burnish	Very slight burnish
Pencil hardness	5B	4B
MEK double rubs	200+	200+
Steel wool (0000) double rubs	25	135
Chemical resistance (24-hr spot test, with cottonball, covered)		
Mustard	Slight stain (no stain at 30 min)	Slight stain (no stain at 30 min)
Betadine	Slight stain (no stain at 30 min)	Slight stain (no stain at 30 min)
RIT® dye (navy, undiluted)	Slight stain (no stain at 30 min)	Slight stain (no stain at 30 min)
Xylene	No effect	No effect
Olive oil	No effect	No effect
Formula 409®	No effect	No effect
Vinegar	No effect	No effect
Water	No effect	No effect
Ethanol (50%)	Slight distortion	Slight distortion
Isopropanol (70%)	No effect	No effect
Windex®	No effect	No effect
Pickle juice	No effect	No effect
Brake fluid	No effect	No effect
Transmission fluid	No effect	No effect

RIT is a registered trademark of Phoenix Brands LLC; Windex is a registered trademark of S.C. Johnson & Son, Inc.; Formula 409 is a registered trademark of The Clorox Company.

and/or black tire marks on the coating. Coatings with higher crosslink density tend to perform better in these applications than coatings that are less crosslinked.

There is no standard lab method of testing for hot-tire pickup resistance of concrete coatings. Cytec has developed an internal method to perform this testing in a laboratory environment. The results from this method should not be compared to those from other methods unless correlations have been completed.

Both dry and wet hot-tire pickup testing were performed on the Polyester Acrylate A-based pigmented concrete coating. The coatings were applied to sealed fiber cement panels. All of the coatings passed the tests. The tires did not stick to the coatings, and were removed remarkably easily. The dry tire left no marks. The wet tire left a mark, which was much reduced, but still slightly visible after cleaning. Earlier work with clear concrete coatings based on the first-generation polyester acrylate resin showed no marks with the dry tire test, and the slight marks left by the wet tire test were easily and completely cleaned. These results, shown in *Figures* 1–3, are better than those typically seen for 2K water-based epoxy coatings.

The yellowing of Polyester Acrylate A 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 four days of exposure, the Polyester Acrylate A diluted with 21% TMPEOTA, photoinitiated with 4% methylbenzoyl formate, and coated at 100 microns on a white MDF back panel, gave a delta b of 1.4, compared

Table 5—Performance Properties of Pigmented Concrete Topcoat Based on Polyester Acrylate A

Property	Value
Substrate	Fiber cement panels
Sealer and coat weight	UV PUD 1 x 50 µm dry (2 mils dry)
Topcoat and coat weight	Polyester Acrylate A 2 x 75 µm (2 x 3 mils)
Monomer dilution in topcoat	20% Trimethylolpropane triacrylate
UV-cure exposure	Air dry sealer: <3% moisture content 1 x 580 mJ/cm^2 first topcoat 1 x 830 mJ/cm^2 second topcoat
Gloss (60°)	84
X-cut adhesion (Tesa 4104 tape)	5A
Pencil hardness	3H
Water double rubs	200+
Isopropanol double rubs	200+
Chemical resistance	
(24-hr spot test, with cottonball, covered)	
Ketchup	No stain
Mustard	Slight stain; No stain at 4 hr
Coffee	No stain
Arachide oil (vegetable oil)	No stain
Ethanol (50%)	No stain
NaOH (10%)	No stain
NH_3 (10%)	No stain
Acetic acid (7%)	No stain
Javel (sodium hypochlorite) (9%)	No stain
Eosin (red dye) (2%)	Moderate stain
Hot-tire pickup resistance	
Dry	No coating pickup; No marks; No impression
Wet	No coating pickup; Very slight marks; No impression

with an unexposed sample. This very low yellowing value indicates suitability of use for concrete coatings.

In summary, concrete coatings based on Polyester Acrylate A have:

- Excellent stain, solvent, and chemical resistance (including pickle juice);
- Excellent scratch and abrasion resistance when formulated with 15% Polyester Acrylate B;
- Superior hot-tire pickup resistance;
- Very low yellowing values

ZIPPERING IN UV FIELD-APPLIED CONCRETE COATINGS

One of the drawbacks of using UV-curable field-applied coatings for concrete is an appearance aberration called "zippering." As *Figure* 4 shows, this aberration has the appearance of a zipper. This is due to the UV light leakage from the edges of the UV curing equipment, and to the differential in shrinkage of the UV-curable coating at the surface and in the depth. When the UV light leaks from the edges of the equipment, it prematurely cures the surface of the coating at the edges. Upon fully curing this section of the coating, the surface and the depth of the coating have differences in shrinkage, and the zippering occurs.

There are several approaches to minimize or eliminate zippering, and some of these are given in *Table* 6. Equipment choice is very important, and it is critical to test the coating with the equipment that will be used in the field. Equipment manufacturers have made recent advances, including the use of flexible shielding to block light leakage. Proprietary improvements in lamp design have also been made, and have shown better performance. Coating properties such as thickness, viscosity, and shrinkage affect the formation of zippers, and should be controlled. The choice of monomers, oligomers, photoinitiators, and additives all impact these coating properties, and also should be controlled. Pigmented systems can be even more challenging, because the photoinitiator choice is impacted by the UV absorbance of the pigments.

The photoinitiator package plays a major role in eliminating zippering. However, not only zippering must be considered when designing the photoinitiator package. Other performance parameters affected by photoinitiator choice are surface cure so that there are no wheel marks; depth of cure so that adhesion and performance are adequate; the number of times that an overlap cure can occur without affecting intercoat adhesion; and the open time of the uncured coating. The starting point formulations given in *Table*s 7 and 8 use a photoinitiator package that addresses all of these concerns, and also gives a coating that does not zipper. Each of the three components of the photoinitiator package is used at four parts by weight (pbw) in the total formulation.

A totally different approach to eliminating the zipper effect is the use of texturing to hide/prevent the zippers. Fillers, particles, etc. that are transparent to UV light can be added to the coating to provide a textured surface, which does not show zippering. Aluminum oxide and sand are two examples of fillers that can be used. These fillers can also be utilized to adjust the coefficient of friction (COF) of the coating.

The two starting point formulations are for a clear (*Table* 7) and a gray pigmented (*Table* 8) concrete coating. These coatings were applied to sealed concrete, and cured with a Bulldog 15-3000 from HID. The performances of these starting point formulations are essentially the same as those shown for Polyester Acrylate A in *Table*s 4 and 5.

WATERBORNE UV FIELD-APPLIED WOOD COATINGS

Waterborne UV systems are preferred for field-applied wood coatings because the conventional wood coatings are mostly waterborne. This allows the same application method to be used, along with the same drying times and sanding procedures. In addition to being similar to conventional wood coatings, the UV waterborne wood coating dries tack-free to the touch, making possible quick sanding and recoating. After the last wood coating has been applied, the UV-cure process gives a fully cured coating that can be put back into service immediately. These properties allow floor coatings to be completed in one day, eliminate many post-coat defects for the contractor, and minimize downtime for the floor owner.

Most floor owners request matte wood floor finishes, although there are some gloss finishes in selected markets. One of the problems with matte finishes is inconsistent matting, which is most noticeable in large open areas such as hallways. This matting problem has prevented the market acceptance of UV floor coatings, especially in the residential area.

The uneven matting is the result of the use of inorganic particles to provide the matte aspect, since the drying process can cause localized concentration gra-

Figure 1—Dry hot-tire pickup resistance.

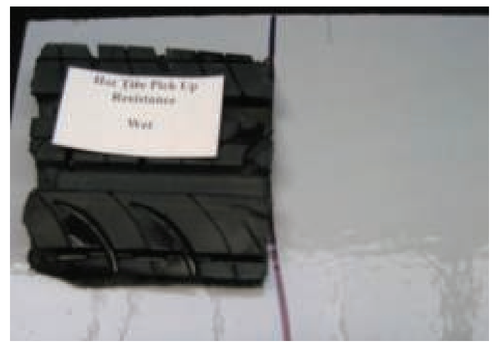

Figure 2—Wet hot-tire pickup resistance.

Figure 3—Wet hot-tire pickup resistance, cleaned.

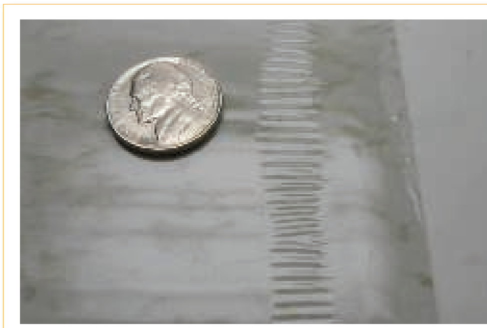

Figure 4—Zippering of a UV-curable coating.

Table 6—Approaches to Eliminate Zippering in UV-Curable Concrete Coatings

Property	Approach
Light leakage from equipment	Use of shielding; improved lamp design
Time between first cure (light leakage) and second cure (full cure)	Minimize time between cures; Appropriate design of coating/curing plan
Cure speed or energy	Slower cure speeds (higher UV energy) give better results
Coating thickness	Use thinner coatings; thicknesses below 10 mils (250 μ) recommended
Coating viscosity	Formulate for higher viscosity; Target 1000–2000 cP (mPas)
Coating flow/leveling/defoaming	At higher formulation viscosity, additive selection becomes more important
Photoinitiator package	Photoinitiator blends should be chosen to enable both surface cure and in depth cure
Coating shrinkage	Minimize shrinkage through monomer and oligomer choice; however, basic coating properties must be maintained

Table 7—Starting Point Formulation for a Clear Concrete Topcoat that Cures Without Zippering

Product	Parts by Weight
Polyester Acrylate A	80.0
TMPEOTA (ethoxylated trimethylolpropane triacrylate)	20.0
Flow/leveling agent	0.5
Defoamer	1.0
Rheology modifier	0.5
Fumed silica	3.0
	100.0
50/50 Blend of benzophenone and 1-hydroxy-cyclohexylphenyl-ketone	4.0
2,4,6-Trimethylbenzoyl diphenyl phosphine oxide	4.0
Amine synergist	4.0
Viscosity (cP or mPas @ 25°C)	1000-2000
1 coat for 75–250 μm (3–10 mils) total coat weight on sealed concrete	
UV-cure speed with Bulldog 15-3000 from HID for full cure (fpm)	15–20
UV-cure exposure for full cure (mJ/cm²)	1300–1350

dients of the particles. The angle of light incidence also impacts the gloss, which can result in the appearance of uneven matting. Matting agents that are not particles, such as waxes, can be used, but do not give enough matting effect for the desired finishes.

Recent developments at Cytec have resulted in a new waterborne UV resin—UV PUD 1—which provides an initial 60° gloss of 21 on wood, with the capability to achieve a 60° gloss of 4 and an 85° gloss of 5 through the use of additives. The use of matting particles is eliminated, or is maximized at 2.4%, so the inconsistent matting problem is solved. The UV PUDs generally have an initial 60° gloss of 90. *Table* 9 shows the 20°, 60°, and 85° gloss levels for wood coatings based on the new resin with and without additives. Since the gloss levels at all three angles are similar, the appearance of a consistent gloss is greatly enhanced. The gloss values are also somewhat independent of coating thickness. The same gloss values are obtained for coating thicknesses of 15–50 μ, and similar gloss values for coating thicknesses of 10–100 μ.

An added benefit of the use of UV PUD 1 is that open times and wet edge times of the formulations based on the new resin are increased versus those based on previous waterborne UV resins. This enables easier application and touchup of the wood coatings. A further advantage is increased shelf life of the matte wood coating since there are no or very little inorganic particles to precipitate in the coating. The shelf life can be almost equal to that of the waterborne UV resin.

Product	Parts by weight
Polyester Acrylate A	59.3
TMPEOTA (ethoxylated trimethylolpropane triacrylate)	14.8
Flow/leveling agent	0.37
Defoamer	0.74
Rheology modifier	0.37
Fumed silica	2.22
Extender pigment	11.1
Gray pigment paste	11.1
	100.0
50/50 Blend of benzophenone and 1-hydroxy-cyclohexylphenyl-ketone	4.0
2,4,6-Trimethylbenzoyl diphenyl phosphine oxide	4.0
Amine synergist	4.0
Viscosity (cP or mPas @ 25°C)	1000–2000
2–3 coats for 100–125 µm (4–5 mils) total coat weight on sealed concrete	
UV-cure speed with Bulldog 15-3000 from HID for full cure and good intercoat adhesion (fpm)	15–20
UV-cure exposure for full cure and good intercoat adhesion (mJ/cm²)	1300–1350

Table 8—Starting Point Formulation for a Pigmented Concrete Topcoat that Cures Without Zippering

Formulation[a]	Gloss (20°)	Gloss (60°)	Gloss (85°)[b]
UV PUD 1	3	21	—
UV PUD 1 + 2.0% aqueous wax dispersion	2	17	—
UV PUD 1 + 3.0% aqueous wax dispersion	1	6	10
UV PUD 1 + 5.0% aqueous wax dispersion	1	5	9
UV PUD 1 + 2.0% aqueous wax dispersion 1.4% silica matting agent	2	10	—
UV PUD 1 + 2.0% aqueous wax dispersion 2.4% silica matting agent	1	4	5

(a) Three coats of matte formulation on oak or beech wood.
(b) Only reported for 60° gloss values <10, based on ASTM D523.

Table 9—Gloss Levels of Matte Wood Floor Coatings Based on the New UV Waterborne Resin

The performance properties of the wood coatings based on the new waterborne resin, UV PUD 1, are similar to those of wood coatings based on typical UV PUDs: excellent adhesion, chemical resistance, and scratch resistance.

In summary, the benefits provided by using UV PUD 1 in a wood floor coating are:

- Uniform matte aspect;
- Ability to achieve very low gloss levels;
- Increased open and wet edge times;
- Improved shelf life; and
- Performance properties equal to coatings based on typical UV PUDs.

WATERBORNE UV FIELD-APPLIED VCT COATINGS

Today, UV-curable field-applied VCT coatings may be either waterborne or 100% solids. Waterborne may be preferred because of the similarity to conventional waterborne acrylics regarding handling and application techniques. Other benefits are decreased shrinkage, a tack-free state after dry but before UV cure, no zippering issues, and improved stain resistance. The advantages of 100% solids systems are no drying time before UV cure, and higher gloss levels.

Table 10—Starting Point Formulations for UV-Curable Waterborne Matte VCT Coatings

Coating Gloss Level (60°)	52	38	26	15	8
Product			%		
UV PUD 1	97	95	93	92.5	92
Defoamer	0.5	0.5	0.5	0.5	0.5
Flow/leveling agent	0.5	0.5	0.5	0.5	0.5
Aqueous wax dispersion	—	2	4	4	4
Silica matting agent	—	—	—	0.5	1.0
Photoinitiator	2	2	2	2	2
Percent Total	100	100	100	100	100
Deionized water	10	10	10	15	20
Solids (%, calculated)	30.7	30.8	30.8	29.8	28.8
Viscosity (DIN Flow Cup 53211; sec @ 20°C)			20–30		
Coat at 4-6 mils with a T-bar or flat pad applicator on VCT, and allow to dry (typically 2–4 hr)					
UV cure exposure necessary to get a mar free surface (mJ/cm²)			425 typical		

Table 11—Performance Properties of UV-Curable Waterborne Matte VCT Floor Coatings

Property	Value				
Gloss (60°)	52	38	26	15	8
Crosscut adhesion (610 tape)	5B	5B	5B	5B	5B
Pendulum hardness (Persoz, sec)	85	84	79	81	82
Pencil hardness	B	B	B	B	B
Coin test	4	4	4	4	4
MEK double rubs	200+	190	190	160	160
Chemical resistance (24-hr spot test, with cottonball, covered)					
Isopropanol 99%	5	5	5	5	5
Water	5	5	5	5	5
Formula 409®	5	5	5	5	5
Windex®	5	5	5	5	5
Vinegar	5	5	5	5	5
Olive Oil	5	5	5	5	5
Pickle Juice	5	5	5	5	5
Mustard	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)
Betadine	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)
Navy RIT® dye	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)	4; 5 (30 min)

Most VCT finishes applied today are high gloss, and are frequently burnished to maintain the high gloss. Because of the labor and aggregate costs associated with the maintenance of these high gloss VCT finishes, some VCT markets are now using lower gloss or matte coatings.

Like the matte wood coatings, the VCT matte coatings can also suffer from appearance aberrations and reduced formulation stability. The new waterborne UV resin, UV PUD 1, provides the same benefits in a VCT coating as in a wood coating. *Table* 10 provides starting point formulations for VCT coatings with 60° gloss levels from 52 to 8. Only 1% silica is required to obtain the 60° gloss of 8. *Table* 11 shows that these matte coatings give superior adhesion to VCT and excellent chemical and solvent resistance.

CONCLUSION

The commercial use of UV-curable field-applied floor coatings continues to grow, but has been slowed by some performance deficiencies. Recent product and formulation developments have addressed some of these deficiencies in concrete, wood, and VCT coatings. Specifically, Polyester Acrylate A provides a high performance concrete coating that does not yellow; Polyester Acrylate B brings excellent scratch and abrasion resistance properties to concrete coatings; a new photoinitiator package prevents zippering in concrete coatings based on Polyester Acrylate A; and UV PUD 1 addresses the need for uniform matting and improved formulation stability in wood and VCT coatings. CT

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