

Technical Challenges in Formulating Field-Applied UV-curable Coatings

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The Formulation Process

- Substrate selection
- Market segment selection
- UV Source selection
- Formulation
- Testing
- Marketing & Sales

Not all substrates are created equal!

- No coating will work on all of the principal substrates
- Concrete- first commercial applications of field-applied UV curable coatings.
 - Substrate is extremely variable
- Resilient vinyl flooring- largest potential market segment
 - Adhesion and wear are key.
- Wood flooring
 - Many different woods are used.
 - Gloss must be controlled and uniform over several levels



Choose a Market Segment

- Each substrate has multiple markets.
 - Commercial
 - Institutional
 - Government
 - Education
 - Health care
 - Residential

Know your (UV) source

- Type of lamp
 - Medium pressure mercury arc- requires a shutter, runs hot
 - Continuous wave argon- no shutter required, fast start
 - Pulsed Xenon- no shutter required, fast start
 - LED- in your dreams!
- Voltage required
 - 110V is most convenient, but 220V provides higher power, faster cure
- Source optics- never ideal



Now you're ready to formulate!

- Select a base oligomer
 - Major effect on mechanical properties
- Diluents- must be low odor, low irritancy
 - 100% solids coatings will incorporate one or more monomers to reduce viscosity, improve adhesion and flow.
 - Water-borne coatings will have fewer monomers because water will reduce viscosity.

Additive package

- Photoinitiator(s)
 - Must be matched to spectral output of the lamp.
 - Have to balance cure speed versus ambient light sensitivity.
- Air release aids
- Flow and leveling aids
- Anti-slip aids

Laboratory Testing

- Laboratory tests- on test panels
 - Cure speed- easier with a conveyor and a radiometer than on the floor.
 - Adhesion
 - Hardness and abrasion resistance
 - Coefficient of friction. Target is 0.5 minimum for OSHA, 0.6 for ADA guidelines.
 - Gloss



Laboratory Testing (continued)

- QUV or Sunlight Tests for yellowing- This is a critical test!
- Stain resistance
- Scrub testing
- VOC content



Field Testing

- Site selection is key.
 - Find an early adopter who will provide a beta test site.
 - Substrate preparation is critical, depends on type of substrate.
 - Monitor site and watch for sabotage.
- Application rates, flow and leveling times and cure rates will differ in the field from the lab.



Field Testing (continued)

- Application tools must be evaluated and selected.
- Power supply to the cure equipment must be worked out.
- Field tests of coefficient of friction may differ from laboratory tests.

Case Study- QuantumCure™ VCT Sealant

- Developed by PhotoKinetic Coatings & Adhesives, LLC for commercial and institutional markets.
- First beta tests in October 2008.
- First commercial application in 2011.
- 100% solids coating designed for new installations and recoating of existing VCT floors.

Technical Specifications

Property	Test Method	Result
Abrasion Resistance, Falling Sand	ASTM D968-05e1	4-10X better than conventional sealant
Stain Resistance Betadine Bleach Tea Nail polish remover	ASTM D1308-02	No effect No effect No effect No effect
Solvent Resistance, Acetone Double Rubs	ASTM D5402-06	> 200 double rubs with no effect
Crosshatch Adhesion	ASTM D3359-08	100% after 3 pulls
Coefficient of Friction	ASTM D2047	0.62



Market Introduction

- It always takes longer than you plan!
- Early adopters are key. Work with them to correct flaws before you try to roll the product out more widely.
- Start local- it makes it easier to provide service.
- Train your applicators well.



Conclusions

- There is no one perfect coating for all substrates.
- You must provide an entire system solution, including coating, cure system and application method.
- You will need to partner with the UV equipment supplier and your raw materials suppliers to be successful.