Converting to UV with a Sustainable Approach

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Why is this topic so important?

- I get several cold calls a week wanting to know more about converting to UV
- Many companies have sustainability goals and it's hard to know even where to get started
- Digging into all the realities of converting to UV can be scary and overwhelming!

What you've probably already heard

UV process has faster:

- Line speed
- Cure time

UV technologies require less:

- Floor space
- Work-in-process
- Energy consumption
- Maintenance costs

UV technology is "green" with:

- Zero volatile organic compounds (VOCs)
- No hazardous air pollutants (HAPs)
- Improved health and safety

UV coatings have:

- Increased performance characteristics
- Higher crosslink density over thermal coatings
  - Scratch & abrasion resistance, chemical resistance, corrosion resistance, sunscreen resistance, etc.

It’s all true!

But do you know how to get there??

What I'm covering today

- The Players you need to consider
  - The roles of the Substrate Supplier, Formulator, Equipment Supplier, System Integrator, etc…
- Types of UV chemistry
  - High solids, solventborne, waterborne
- Equipment
  - What you might need based on chemistry, part, etc.
- Processing 101
  - How you need to cure it and how you can be sure it's cured
  - Substrate & Part design (and why this is listed last)
- The Cost of conversion

The Formulator

- Takes your specifications and uses those to develop a coating that works on your substrate
- Works with raw material suppliers to optimize formulation
- Can formulate using “green” materials, such as renewable raw materials
- Often can make substrate recommendations
- Can help establish contact with Equipment Suppliers and System Integrators

Equipment Suppliers

- Works with the Formulator to establish the equipment needed to paint the part and cure the coating
- Designs custom lines based on part design

Where are you going to paint parts?

- In-House
  - System Integrators
    - Plans and builds the line to fit your facility
    - Conveyors, part handling systems, air handling systems, masking, robotics, etc…
- Job Shop
  - Potentially a good way to begin initial conversion

Types of UV Chemistry

- 100% solids – no solvents or water
- High solids – small amount of solvent or water that needs to be flashed off
- Solventborne – contains VOC's, solvent type can be adjusted based on process
- Waterborne

Be aware that solvent & water can often open process windows which may reduce scrap

Tradeoffs in Formulation

- To get more complex properties, usually need a more complex formula
  - Weatherability
  - Abrasion, scratch, moisture, and chemical resistance
- Higher complexity in formulation can drive more complexity in processing parameters.

Equipment Selection

- Cycle time / through put
- Required preventative maintenance
  - Bulb rotation, thorough cleaning, etc.
- Cost of investment
- Customer service

Substrate & Part Design

- This is just now being discussed because typically the part is already designed by the time it is determined a coating is needed.

Processing – Substrate

- Has the substrate already been decided?
  - Often the formulator can tell you which substrates they've already had success with
  - Using similar substrates can help predict/shorten spec testing.
  - Substrate Suppliers may be able to recommend a Formulator based on previous experience
- Are there any substrates that are more difficult to work with than others
  - Of course, which is why it's good to identify the substrate early

Processing - Part Design

- Must consider part *paintability*
  - Sharp edges, deep recesses, and location of parting lines can affect optimization of application
  - 3D complexity
  - Size of part
  - Masking
  - Part fixtures

Processing – Application Methods

- Typical application methods
  - Dip
  - Roll Coat
  - Vacuum Coat
  - Spray
  - Rotary Bell
  - Flowcoat

Processing: UV Clear vs. Pigmented

UV Clear

- Fairly easy to cure
- Line of sight
- High degree of transparency
- Degree of cure depends on:
  - Light sensitivity of coating
  - UV Exposure

Pigmented UV

- More of a challenge to cure
- Many additional considerations
  - Color, type of pigment, loading level, coating thickness

Processing - Flash

- Temperature, Time, and Method
  - Ambient or Heated
  - IR, Convection, Combination
- Flash drives out solvent/water and allows for the coating to level properly
  - 2 - 3 minutes of infrared only, Low air movement
  - 8 - 10 minutes of heated air, High air movement
  - 2 – 3 minutes combination infrared and heated air, Medium air movement
- Time & Temperature are dependent on substrate's ability to withstand heat.

Processing - Suggestions for Implementation

- Process controls to consider
  - Standardized work practices (UV cure parameters, system maintenance, etc.)
  - Clean rooms
  - High quality mold / tools
  - Special part handling

Processing - Radiometers

- All radiometers are not created equal:
  - Different wavelength ranges
  - Different light filters
- Different Radiometer Models:
  - IL390 (Compact Radiometer) [240-400nm]
  - Diskure 365 [240-400nm]
  - PowerMap [250-445nm]
  - UVIMAP [320-390nm]
  - UV Puck [250-445nm]
  - Microcure [320-390nm]

UV Band Wavelengths
UVA: 320 – 390nm
UVB: 280 – 320nm
UVC: 250 – 280nm
UVV: 395 – 445nm

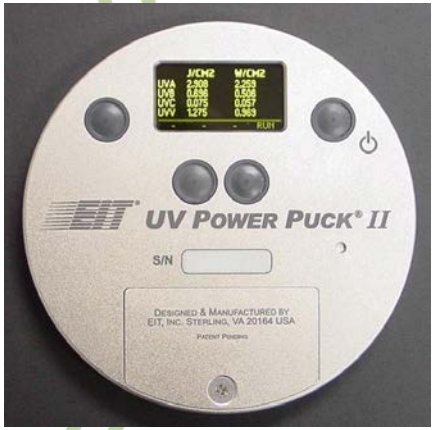
Processing - Radiometers

UV Power Map

MicroCure

IL390B

Diskure 365



Power Puck II

Processing - Radiometer Readings

IL390 Energy			PowerMAP UVA		Puck UVA
	Diskure 365	UVIMAP		Microcure	
mJ/cm	mJ/cm	J/cm	mJ/cm	J/cm	J/cm
5000	4550.2	3086.9	3274.44	2.44743	3.8586
5250	4780.2	3241.2	3428.40	2.56593	4.0561
5500	5010.2	3395.4	3582.36	2.68443	4.2536
5750	5240.1	3549.7	3736.32	2.80293	4.4510
6000	5470.1	3703.9	3890.28	2.92143	4.6485
6250	5700.1	3858.2	4044.24	3.03993	4.8460
6500	5930.1	4012.4	4198.20	3.15843	5.0435
6750	6160.1	4166.7	4352.17	3.27694	5.2410
7000	6390.0	4320.9	4506.13	3.39544	5.4385
7250	6620.0	4475.2	4660.09	3.51394	5.6360
7500	6850.0	4629.4	4814.05	3.63244	5.8334
7750	7080.0	4783.7	4968.01	3.75094	6.0309
8000	7309.9	4937.9	5121.97	3.86944	6.2284
8250	7539.9	5092.2	5275.93	3.98794	6.4259
8500	7769.9	5246.4	5429.90	4.10644	6.6234
8750	7999.9	5400.7	5583.86	4.22494	6.8209
9000	8229.9	5554.9	5737.82	4.34344	7.0184

The Cost of Conversion

- Always the BIG question:

What are my cost savings??

- My answer:

It depends! Each specific situation is different. In general, UV coatings cost more per gallon and equipment costs may be more up front, but film builds are lower and cost to run equipment is less over time.

Generic Cost Comparison

Standard 2K Thermal Cure Clearcoat											
Sq. Ft. Area of Part	%TE	DFT	Volume Solids	Clearcoat Gallons	Avg. Pricing	Clearcoat Cost	1K or 2K	Hardener Gals.	Hardener Pricing	Hardener Cost	Total Paint Costs
1000	30	1.0	0.38	546.9	$50.00	$27,344	2	195	$55.00	$10,742	$38,086.18

Standard 45% Solids UV Cure Clearcoat - Spray to Waste											
Sq. Ft. Area of Part	%TE	DFT	Volume Solids	Clearcoat Gallons	Avg. Pricing	Clearcoat Cost	1K or 2K	Hardener Gals.	Hardener Pricing	Hardener Cost	Total Paint Costs
1000	30	0.7	0.38	387.6	$100.00	$38,755	1				$38,755.16

High Solids 2K UV Cure Clearcoat											
Sq. Ft. Area of Part	%TE	DFT	Volume Solids	Clearcoat Gallons	Avg. Pricing	Clearcoat Cost	1K or 2K	Hardener Gals.	Hardener Pricing	Hardener Cost	Total Paint Costs
1000	30	1.0	0.68	305.6	$100.00	$30,561	2	61	$55.00	$3,362	$33,922.55

High Solids 1K UV Cure Clearcoat											
Sq. Ft. Area of Part	%TE	DFT	Volume Solids	Clearcoat Gallons	Avg. Pricing	Clearcoat Cost	1K or 2K	Hardener Gals.	Hardener Pricing	Hardener Cost	Total Paint Costs
1000	30	0.7	0.68	216.6	$150.00	$32,486	1				$32,485.95

Standard 45% Solids UV Cure Clearcoat - With Reclaim											
Sq. Ft. Area of Part	%TE	DFT	Volume Solids	Clearcoat Gallons	Avg. Pricing	Clearcoat Cost	1K or 2K	Hardener Gals.	Hardener Pricing	Hardener Cost	Total Paint Costs
1000	70	0.7	0.38	166.1	$150.00	$24,914	1				$24,914.03

Note: Assumes 100% Yield

Thank You!