

# Sustainable, Safe and High Quality UV-Cure Powder Coating for Wood Substrates

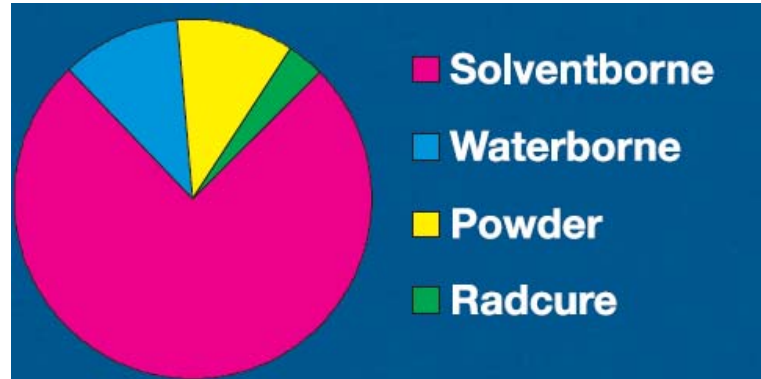


**5TH WOOD COATINGS AND SUBSTRATES CONFERENCE  
SEPTEMBER 20 – 21, 2012**

**THE UNIVERSITY OF NORTH CAROLINA  
AT GREENSBORO**

**ANDREW WALTON  
KEYLAND POLYMER, LTD.**

# Coating Industry Today



- **Paints and coatings market\***

- Global coatings market to reach 8.7 billion gallons and US\$107 billion by 2017
- Solventborne liquid coatings 75 – 80% of market
- Global powder coating market US\$5.4 billion

- **UV-curable coating market\***

- Consumption of UV-curable coatings from 2009-2017 will grow at a 6.65% rate to 1210.
- Producing 66 metric tons of product.

\* Global Industry Analysts, Inc.

# Coating Industry Tomorrow

UV-Curable coating technology is increasingly being seen as the future technology in the area of industrial coatings. The technology represents one of the rapidly growing segments in the coatings industry, and is arguably emerging as the answer to the rising environmental concerns and stringent regulations.

UV-Curable coating ranks among the fastest coating chemistries available in the present context. Curing of one-component UV-Curable coating takes few seconds to minutes, which makes it more ideal for use in applications that require faster turnaround time.

Global Industry Analysts, Inc. March 2012

# UV-Curable Powder Coating

4

## **ABOUT UV-CURABLE POWDER COATING**

# Powder Coating

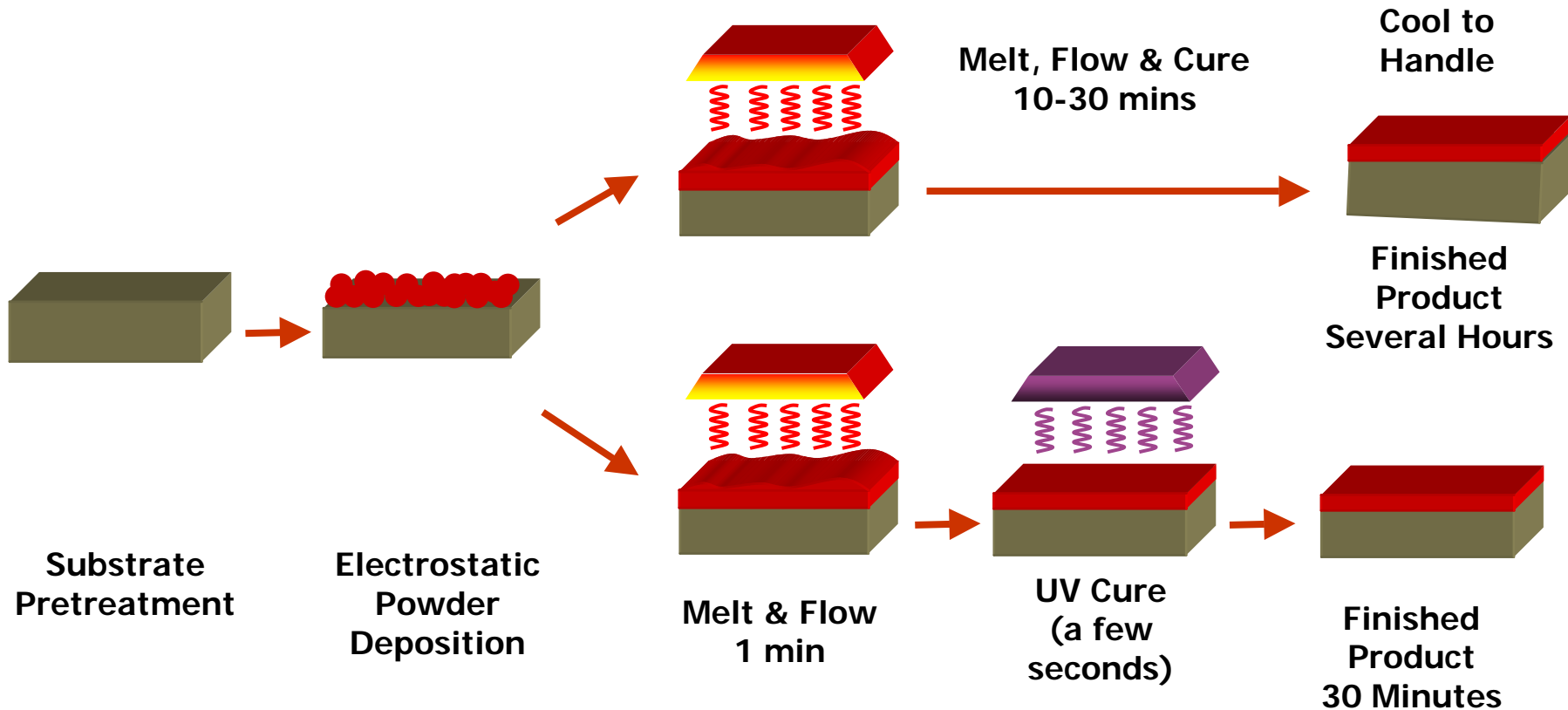
- Thermoset or thermally cured powder coatings were developed in the 1960s as functional coatings and have been adapted and developed for a variety of applications
  - Powder coatings give superior wear resistance, barrier properties, and cost effectiveness
  - Products include home appliances, industrial equipment, automotive primer, top coat
  - Powder coatings have no volatile organic compounds or hazardous air particulates.
  - Metal substrates are ideal for electrostatic powder application
  - Thermal cure cycle for powder coating ranges from 20 to 60 minutes depending on chemistry and part geometry

# History of UV-Curable Powder Coating

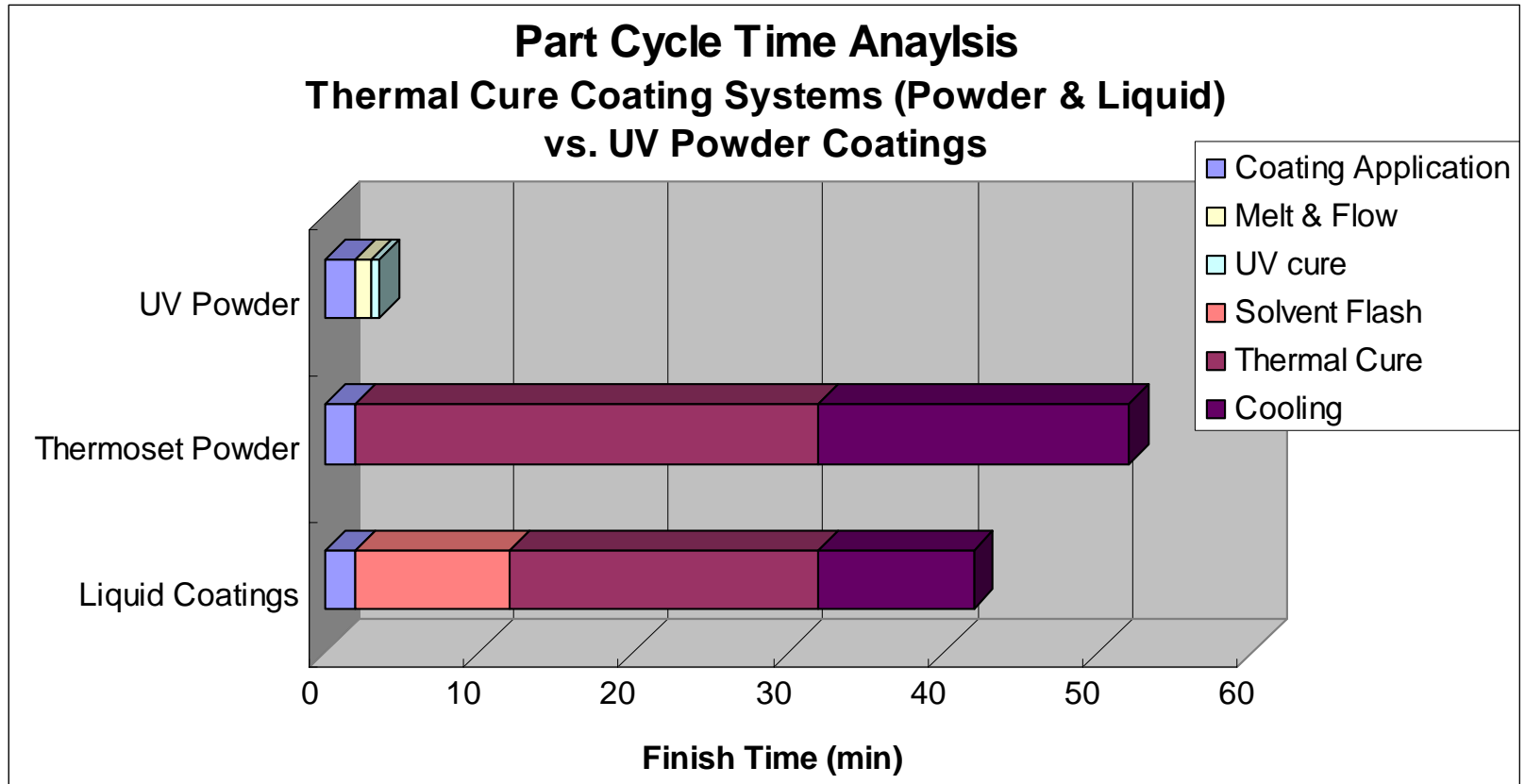
- 1998 – 2000s: 1<sup>st</sup> commercial applications in U.S.
  - Automotive radiator
  - Industrial motor
- 2001: Decorative Veneer built the 1st N. American UV-cure coating facility in Plainwell, MI USA
- Application facilities built in Europe for MDF and PVC cushion floor
- 2005: Decorative Veneer system moved to Cleveland, OH and DVUV formed
  - Key markets: Retail – Healthcare – Education & Office furniture – specialty applications
- 2006: Keyland Polymer, Ltd. formed to develop, formulate, and manufacture UV-curable powder coatings for DVUV and other customers

# UV Powder Coating

- Differentiating UV-Curing from Thermal-Curing

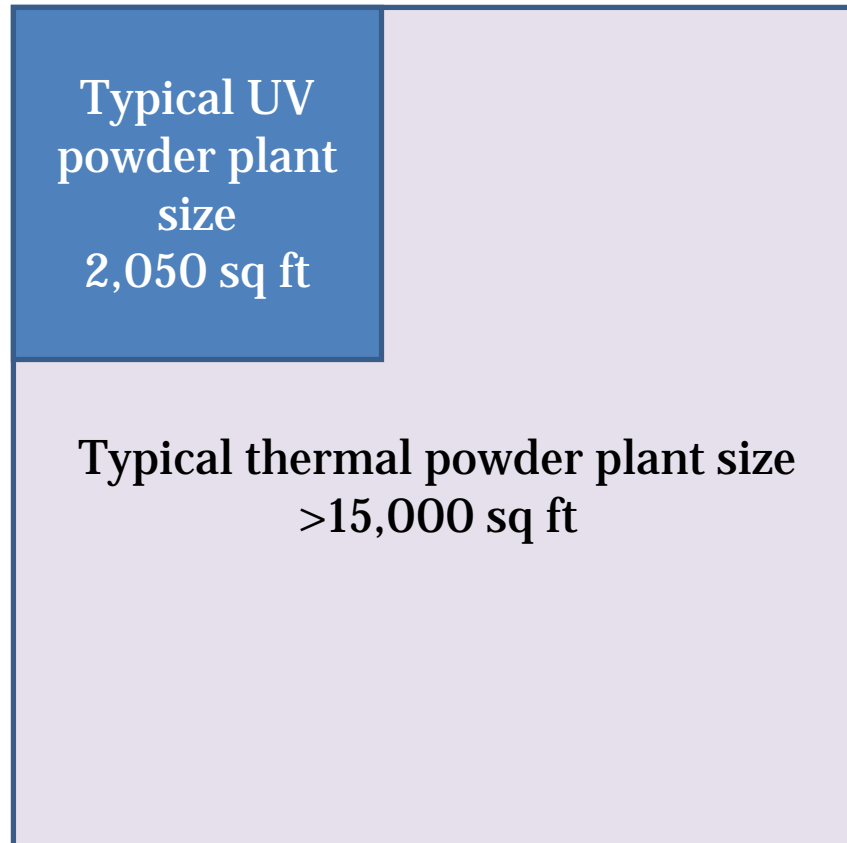


# Operational Efficiencies





# Reduced Manufacturing Footprint



**Keyland Polymer Ltd.**

*Manufacturer of UV-Curable Powder Coatings*

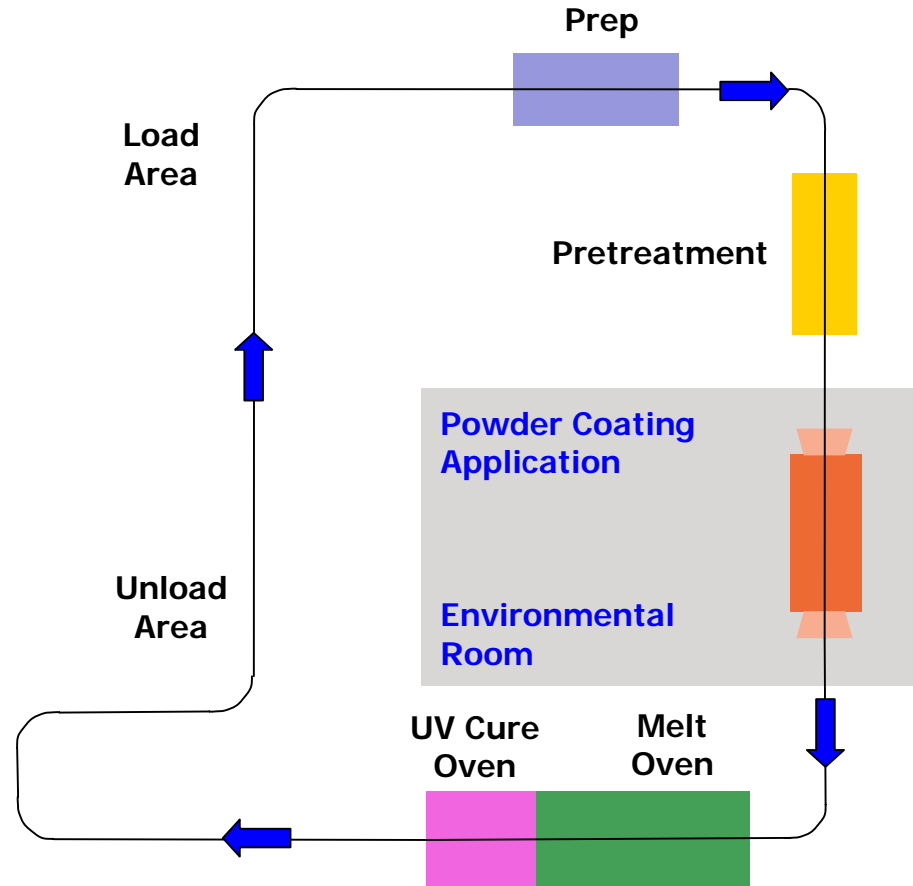
5th Wood Coatings and Substrates Conference

# UV Powder Application System

- A UV powder application system

- Parts are loaded and prepared
- Pretreatment
- Electrostatic powder application
- Flow/Melt oven
- UV Cure oven

200 foot line – cycle 20 minutes



**Keyland Polymer Ltd.**

Manufacturer of UV-Curable Powder Coatings

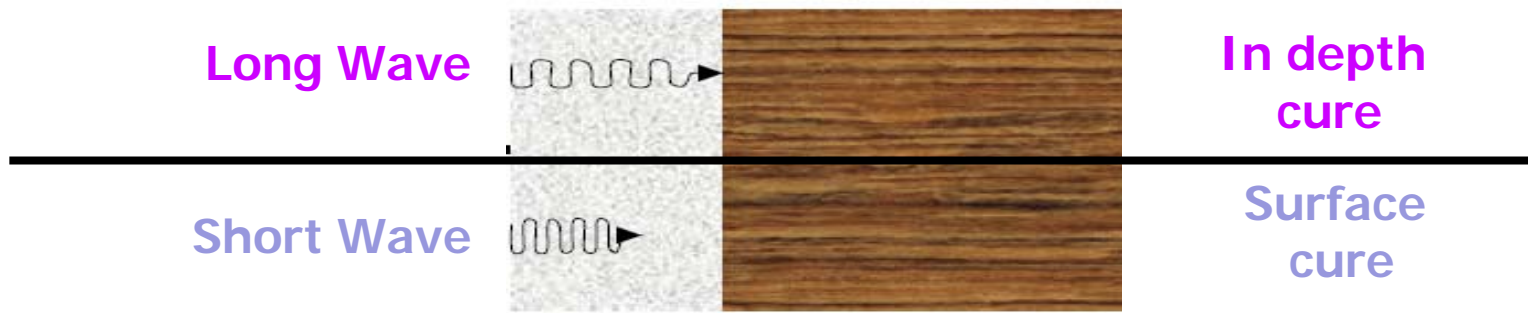
5th Wood Coatings and Substrates Conference

# UV Powder Chemical Composition

Resin – Unsaturated	60 – 95 wt %
Photo Initiator	0.5 – 3.0 wt %
Flow Control Agent	0.5 – 2.0 wt %
Degassing	0.5 – 4.0 wt %
Pigments	0.1 – 20 wt %
Filler/Extender	0 – 35 wt %
Additives	0.25 – 1 wt %

# UV Curing Parameters

- **Intensity** - Power or density of UV energy
  - Typical 1000 - 3000 mW/cm<sup>2</sup> UV V
  - Ideal conditions - high intensity over short time
- **Exposure** - Total energy received at coating surface
  - Typical 1000 - 3000 mJ/cm<sup>2</sup> UV V
  - Intensity (mW/cm<sup>2</sup>) X time (secs) = Exposure (mJ/cm<sup>2</sup>)
- **UV Spectrum required for different applications**
  - Clear/Tints -Mercury
  - Opaque - Iron additive and Gallium additive Mercury



# Application Process Advantages

- **Powder Coating Advantages**
  - Easier to blend, process and control during application
  - Easily to clean up with an industrial vacuum
- **Polymer can be reclaimed and re-sprayed yielding up to 98% material utilization.**
- **Color changes do not require purging materials or solvents. Accomplished in minutes rather than hours.**



# Finishes and Color Matching

✘ S:\DVUV Marketing File\Images\Solid Surface\solidsurfacepeeps from holly's outlined images copy.jpg

**Multi- Component**

✘ 3colorb.jpg

**Metallic**



**RAL – Pantone – PMS systems**

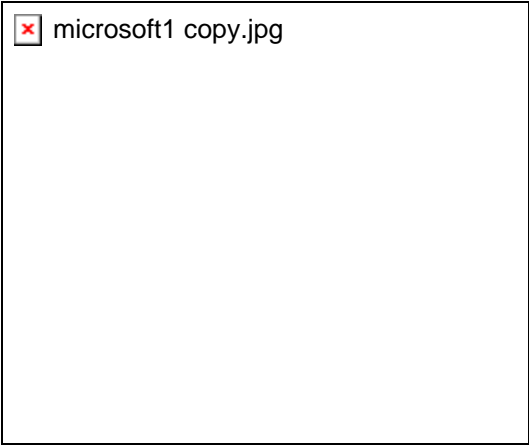
✘ 006editCMYK

**Opaque**

# Finished Products



POP Display



Interactive Retail Display



Educational Lectern



Healthcare Component



Architectural Element

**Keyland Polymer Ltd.**

*Manufacturer of UV-Curable Powder Coatings*

5th Wood Coatings and Substrates Conference

# UV-Curable Powder Coating

16

## **PERFORMANCE CHARACTERISTICS**



# UV-Curable Powder for MDF Substrates

Test Standard	Category	Test Description	UV-W06-SS2	UV-W06A-SS2
ASTM D4138 Method A	Film Thickness	Tooke Gauge - Destructive	3-4 mils	3-5 mils
ASTM D4060	Abrasion Resistance	Taber Abrasion Test - CS-17 Wheel 500gm, 500 cycles	32.4 mg loss	29.1 mg loss
ASTM D3363-05	Scratch Resistance – Pencil Hardness	Hardness – Wolff-Wilborn 300 gm load, 45° / no scratch	2H	3H
ASTM D523	Gloss Measurement	60° NOVO-GLOSS meter	22-25 units	16-20 units
NEMA LD3-1995	Impact Resistance	224 g steel ball (1/2 lb) 1 1/2" dia.	No cracking at 55"	No cracking at 35"
NEMA LD3 - 2005 3.4	Cleanability / Stain Resistance	Reagents: 10% citric acid, vegetable oil, coffee, milk, catsup, mustard, vinegar, red lipstick, grape juice, black permanent marker, water washable black marker, and # 2 pencil	No permanent effect on sample surface	No permanent effect on sample surface
	Cure	MEK swap - 50 double rubs	No softening or color loss	No softening or color loss
NEMA LD3 - 2005 3.4	Hot water	Pool of boiling water placed on surface, pot placed in water for 20 minutes	No blistering	No blistering
ASTM D3359 Method B	Adhesion	Cross Hatch Adhesion – MDF must be present on piece of coating removed	No loss of adhesion	No loss of adhesion

**Keyland Polymer Ltd.**

*Manufacturer of UV-Curable Powder Coatings*

5th Wood Coatings and Substrates Conference

# Chemical Resistance

- Test Duration – 24 hours
- Reagents uncovered for duration of test
- Inspection after 24 hours shows no damage or impaired surface

Reagent	Effect
Engine oil	no effect
Gearbox oil	no effect
Hydraulic oil	no effect
Brake fluid	Slight gloss loss
Antifreeze	no effect
Cold cleaner	no effect
Inert cleaner	no effect
E95	no effect
Unleaded gas	Slight/moderate gloss loss (a ring)
Diesel fuel	no effect
Battery fluid	no effect

# UV-Curable Powder Coating

19

**OPERATIONAL  
EFFICIENCIES**

# UV Powder Finishing Advantages

- **Fast**
  - Instant cure
  - Completed parts in 20 minutes or less
  - One coat
- **Clean**
  - No harmful chemicals, monomers or additives
  - Safe to use – no special safety gear
  - Easy material handling and clean up
- **Green**
  - Smallest carbon footprint of any coating material
  - No VOC's
  - Waste recycling or repurposing
  - No operating permits

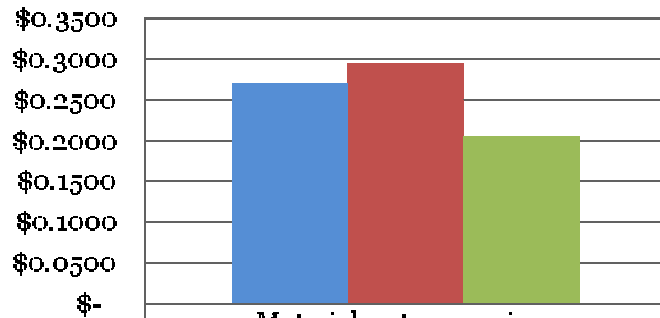


# UV Powder Process Benefits

- **Higher Quality Finished Products**
  - Reduces substrate thermal exposure stress deformation
  - Cross linked UV curing
  - Design and formulate coatings that are product specific
- **Lower Cost with Higher Quality**
  - Higher throughput
  - Reduced WIP
  - Fewer defects
- **Faster and Higher ROI**
  - Process more material in a shorter period of time
  - Lower total applied cost compared to other finishing systems

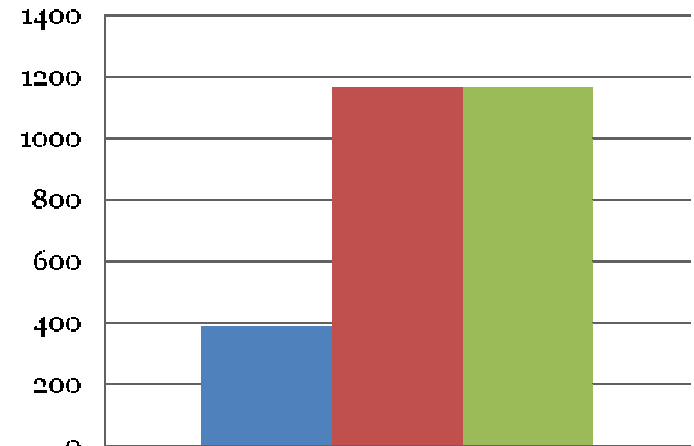
# Material Cost & Productivity

## Material Cost per Square Foot of Surface Finished



Material cost comparison \$/sqare foot - Liquid and UV cured powder	
■ Liquid 2 coat low VOC	\$0.2712
■ UV powder spray to waste	\$0.2940
■ UV powder spray to reclaim	\$0.2054

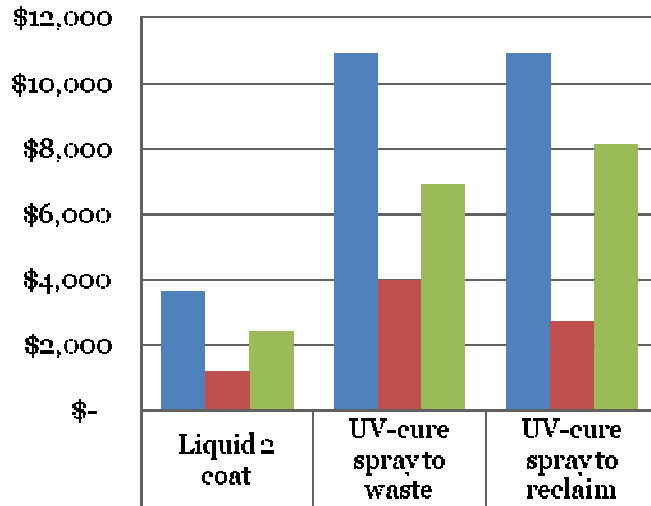
## Parts Produced per Day



Parts Produced per Day 8 hour Shift	
■ Liquid 2 coat low VOC	388
■ UV-cure powder spray to waste	1164
■ UV-cure powder spray to reclaim	1164

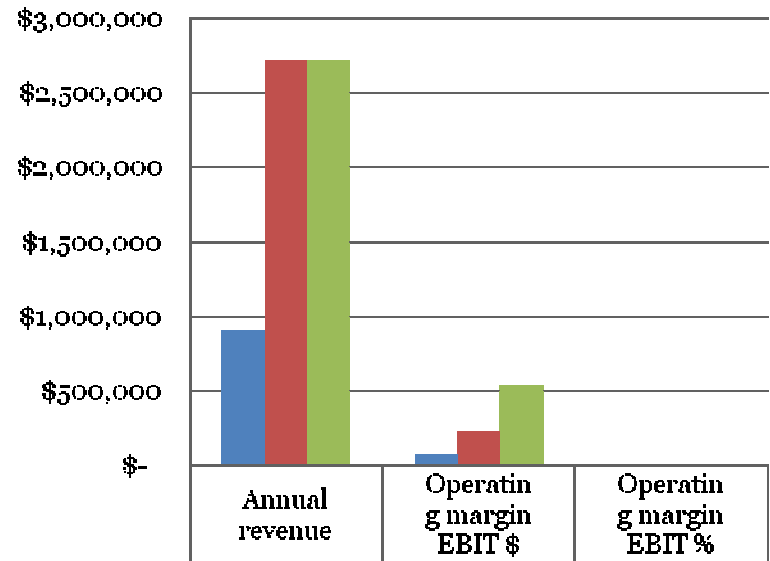
# Revenue and Operating Margin

## Daily Revenue, Material and Gross Margin



■ Total revenue/day	\$3,630	\$10,891	\$10,891
■ Total material/day	\$1,210	\$3,995	\$2,750
■ Gross margin/day = R-C	\$2,420	\$6,897	\$8,142

## Revenue & Operating Margin



■ Liquid 2 coat	\$907,621	\$77,692	8.56%
■ UV-cure spray to waste	\$2,722,863	\$233,077	8.56%
■ UV-cure spray to reclaim	\$2,722,863	\$544,302	19.99%

Operating margin data from [www.nyu.stern.edu](http://www.nyu.stern.edu)

# UV-Curable Powder Coating

24

**SUSTAINABILITY**



# Sustainability – Life Cycle Assessment

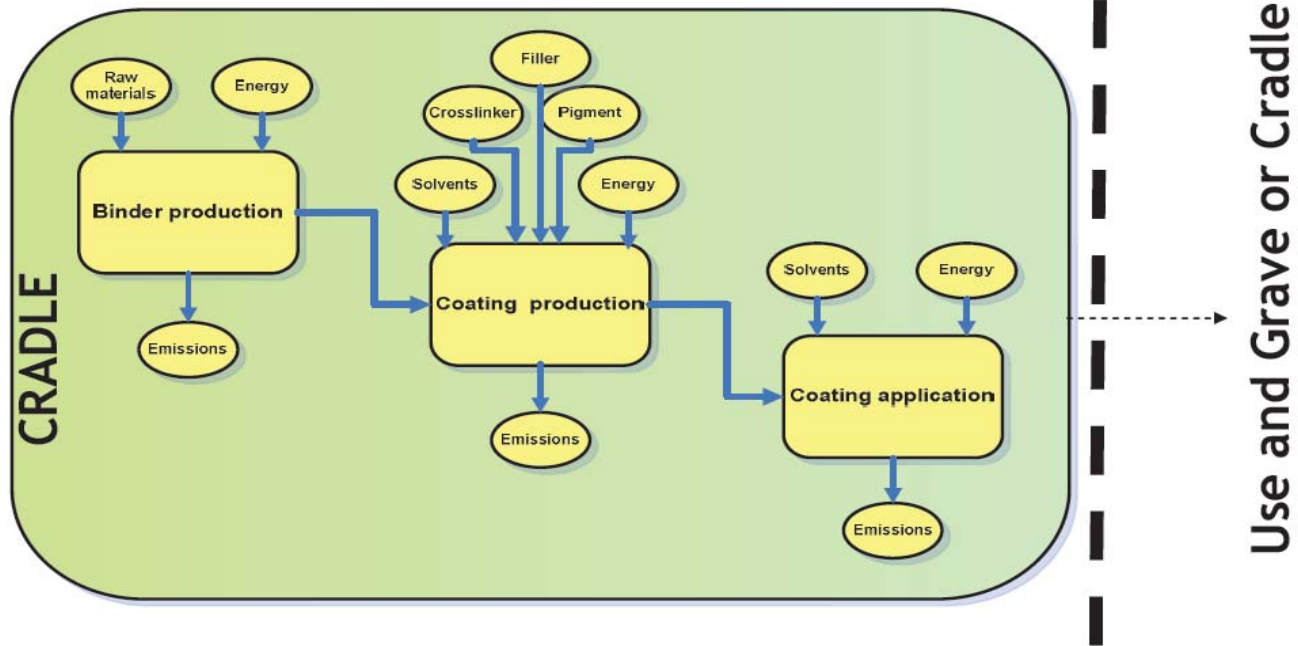
Assumptions for this Life Cycle Assessment	
Substrate	MDF, 19 mm
Average Surface Area	0.5 m <sup>2</sup> , coated both sides
Coating	TiO <sub>2</sub>
Pigment/Resin/Filler	20/60/20 for all (avg)
Solid Contents	100% all powders 50% for all 2-k systems 40% for waterborne UV
Layer Thickness	150 um (6 mils)
Curing Temperature	Depending on System
Sanding	Not factored
Utilization % (Transfer Efficiency)	95% Powder 90% Waterborne UV 60% 2k solventborne and waterborne
Solvent Treatment	Incineration
Durability, Functionality, End of Life	No differentiation

Collaboration with DSM Coating Resins, originally presented at 2011 Decorative Surface Conference Orlando, FL

# Sustainability

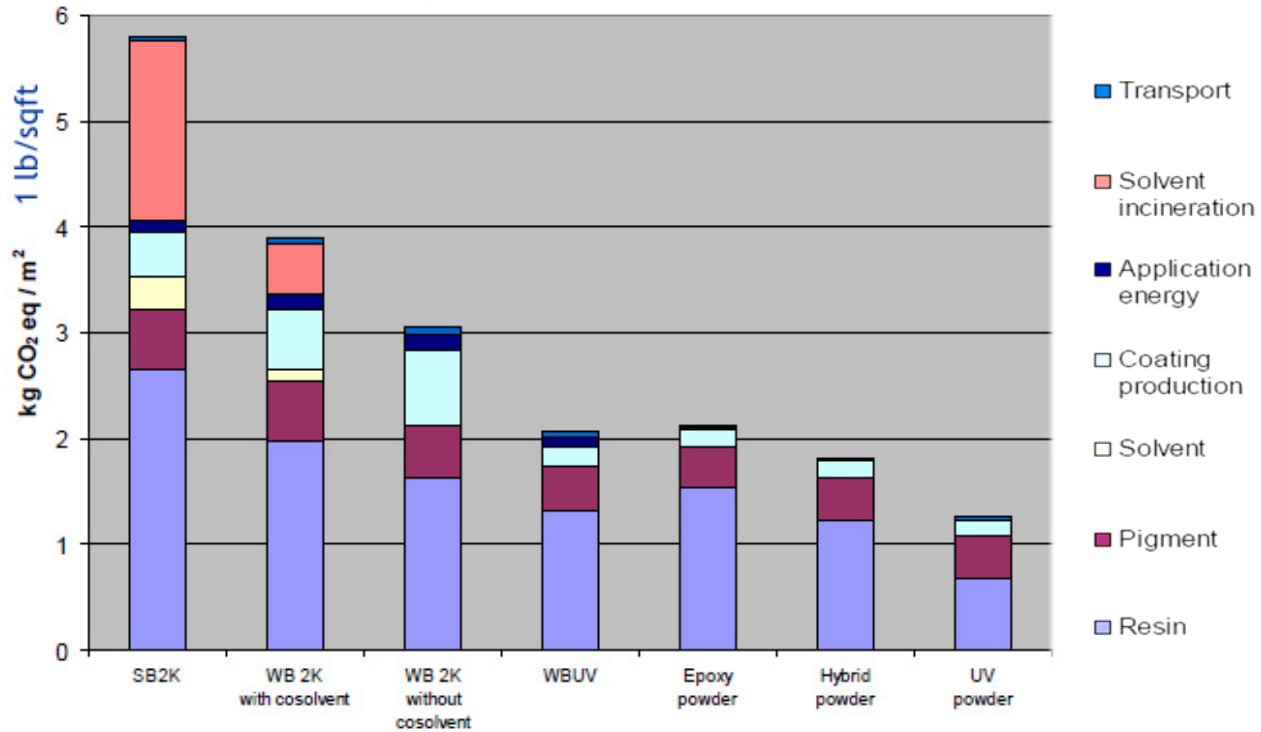
## Scope of LCA: Cradle to Gate

GATE



# Sustainability

## • Coatings Life Cycle Assessment



### Assumptions

Substrate : MDF 0.75" Thick Coating both sides Surface area – 5.4 sq ft	Solid Content	100% all powders 50% for all 2-k systems 40% for waterborne UV	Utilization % (Transfer Efficiency)	95% Powder 90% Waterborne UV 60% 2k solvent and waterborne
Pigment/Resin/Filler 20/60/20 for all (avg) TiO <sub>2</sub>				

# Sustainability – Findings

- Solvent-based coatings have the highest environmental footprint
  - High CFP to produce and dispose solvents
- Waterborne paints (conventional and UV 100% solids) have lower environmental impact
- UV-curable powder coatings have the lowest environmental impact of coating materials

Coating Technology Impact on Carbon Footprint

	Solventborne-2K	Waterborne-UV	UV Powder
Carbon Dioxide, CO <sub>2</sub> (kg/m <sup>2</sup> )	0.96 / mil of coating	0.35 / mil of coating	0.21 / mil of coating
Typical Coating Thickness	5 mils	2 mils	2 mils
Coating Carbon Footprint (CO <sub>2</sub> )	4.8 kg/m <sup>2</sup>	0.7 kg/m <sup>2</sup>	0.41 kg/m <sup>2</sup>

10 x More

Keyland Polymer Ltd.

Manufacturer of UV-Curable Powder Coatings

# UV-Curable Powder Coating

29

**FUTURE OF  
UV POWDER**

# Future of UV-Curable Powder Coating

- **Convergence of the macro market forces creates greater opportunity for UV-curable powder coating**
  - Population growth and migration to cities
  - Reduction of carbon consumption as a % of GDP & establishment of carbon targets
  - Continuing growth of transportation sector
  - Continuing growth rates in emerging economies
- **UV-curable powder coating opportunities**
  - Innovative chemistries and application technologies deliver more value at lower cost
  - Displacing existing finishing chemistries & application technologies
  - Develop and penetrate new markets and material applications

# Conclusion

- The coatings market will grow at or above aggregate global GDP.
  - The *market* offers better than average GPM and ROI opportunities to firms that bring into the market innovative chemistries and coatings that meet market specific needs.
    - Improved coating performance
    - Demonstrably sustainable, economically viable and have a reduced carbon footprint
    - Fast application time and fast cure response
- UV-Curable powder coatings are a viable but nascent finishing system.
  - The productive and economic capability of UV-curable application technology is clearly demonstrable and generates greater than market GPMs and higher ROIs.
  - More resources need to be expanded to meet the significant market opportunities.
  - UV-curable powder coating application technology and chemistry are poised to capture a significant and profitable market share of the Global Coatings Industry.

Fast – Clean & Green™

# UV-Curable Powder Coating

32

**THANK YOU  
&  
QUESTIONS**



# Keyland Polymer Ltd.

**ANDREW WALTON  
BUSINESS DEVELOPMENT MANAGER**

**4621 HINCKLEY IND PKY SUITE 8  
CLEVELAND, OH 44109  
216-741-7915**

**[awalton@keylandpolymer.com](mailto:awalton@keylandpolymer.com)  
[www.keylandpolymer.com](http://www.keylandpolymer.com)**