Expanding the Universe of Low Cure Powder Coating

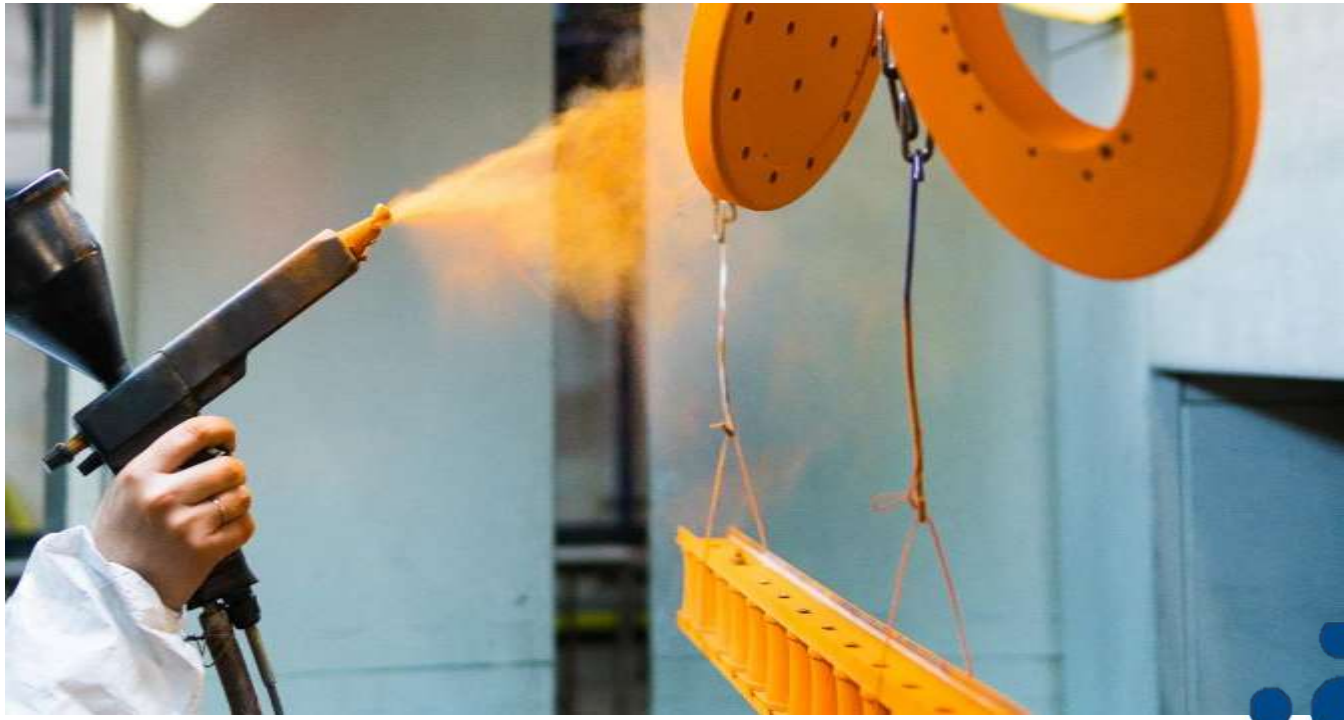
Powder Coating Summit | September 9, 2022

Dr. Robert G. Duan, Vice President, The ChemQuest Group

ChemQuest®

Agenda

- Why low-cure powder coating?
- Expanding the low-cure powder coating universe
- Low-cure powder technologies
- Summary
- Acknowledgements



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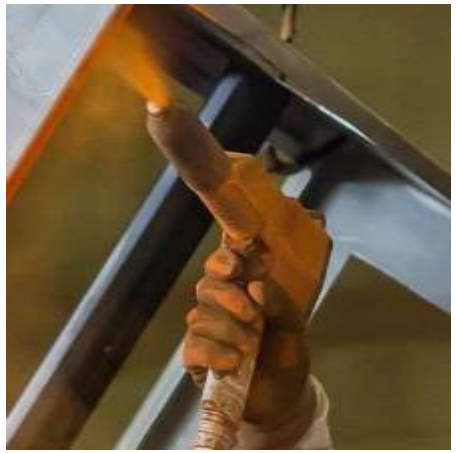
Global Industrial Coatings Innovation Drivers

Green & Environmentally Responsible

Improved Surface Protection



Improved Application Efficiency

Custom Design

Cost Reduction

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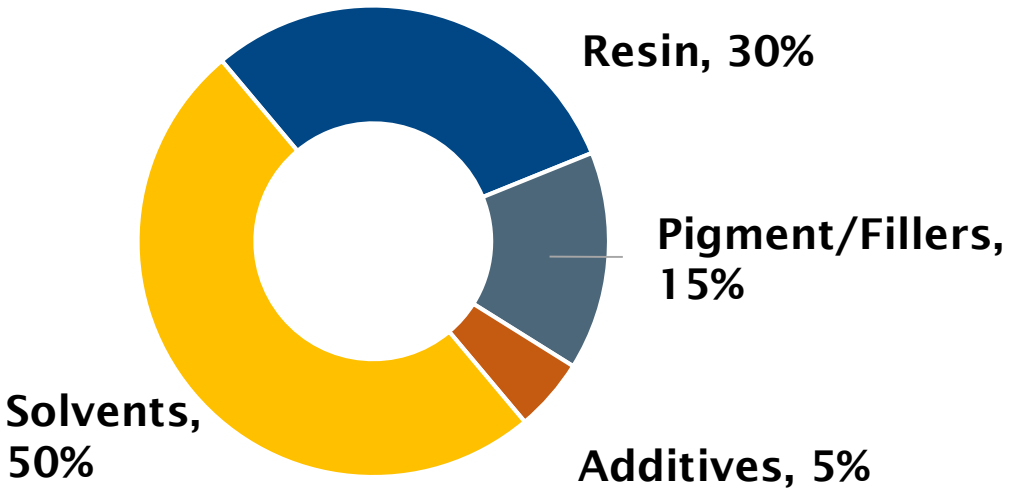
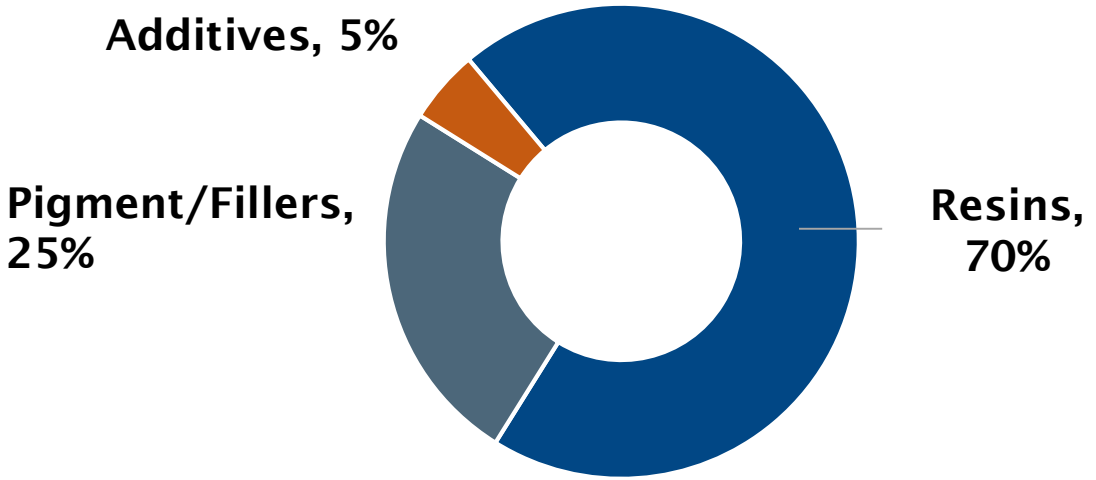
Liquid Coating vs. Powder Coating

Typical Liquid Paint



Typical Powder Coating



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Liquid Coating vs. Powder Coating

Typical Liquid Paint

Advantages:

- ▲ Smooth paint
- ▲ Faster formulation changes
- ▲ Greater choices of finishing styles and appearances

Disadvantages:

- ▼ Multi-step processes (time consuming, energy intensive, labor intensive)
- ▼ Regulatory pressure on VOC and solvent
- ▼ Lower paint transfer efficiency (in general)
- ▼ More space requirements for finishing lines

Typical Powder Coating

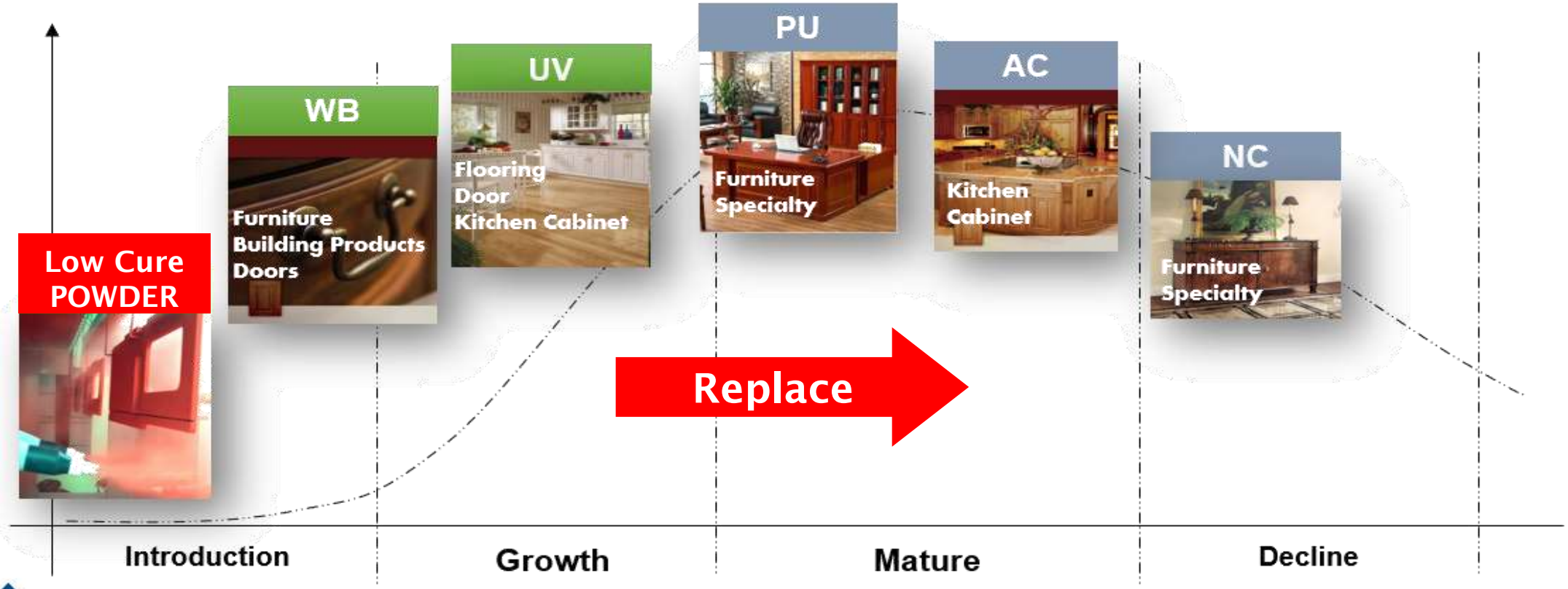
Advantages:

- ▲ One-step process (save time, energy, labor, and space)
- ▲ Green and zero-VOC
- ▲ Highly durable for indoor applications
- ▲ Lower space requirements for finishing lines
- ▲ Vast improvements in paint transfer efficiencies
- ▲ Recycling plastics

Disadvantages:

- ▼ Capital investments on new application line
- ▼ Application challenges (substrate variation, line control, repair)
- ▼ Lower smoothness
- ▼ Low temperature transportation and storage
- ▼ Limited choices of resins/additives

Wood Coating Technology Trends



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Change in Consumer Preferences – Powder Coatings Well Positioned

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Low Cure Powder – Some Examples of Early Successes

- Office furniture
- Garage furniture
- Bathroom furniture
- Youth furniture
- Shelving
- Kitchen cabinet
- Baseball bats

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⚠ *However:* Slow Low Cure Powder Market Penetration

- High application **equipment investments** ($500K~$2M)
- Limitations of **resin technology**:
  - Manufacturing difficulties
  - Limited choice of finishes
  - Limited outdoor durability data
- **Substrate sensitive**:
  - MDF quality and consistencies
- Lack of **turn-key systems**
- No clear **value proposition**

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Disruptive Technology Requires Different Approaches to Penetrate the Market

Apple: from Computer to iPhone

60% >$400 market share

Sony: from TV to Digital Camera

22% market share

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The Introduction of the iPhone

Technology Integrator

- Touch refinement screen

Turn-Key Solution Provider

- iOs mobile OS
- Appl ecosystem
- iTurn

Demonstration of Value

Expanding the Low Cure Powder Coating Universe

Low Cure Powder

Composite

Gypsum board

Replace melamine & foil laminates

Plastics

Large metal pieces

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Laminate and Foil Value Chain

Base Paper Production → **Printing** → **Coating or Impregnation** → **Lamination** → **Furniture, Cabinets, Flooring …**

Decorative Paper with high resin absorption capacity and high opacity
30 to 100g/m

Solid Colors
Wood Grains
Stone Patterns

Impregnation:
- Melamine Formaldehyde
- Urea Formaldehyde
- Acrylic

Coating: WB/AC; UV; EBeam

Lamination with adhesives to chipboard or MDF. Adhesives are PVAc or hot melt

laminate flooring structure

Could be easily replaced by powder coating lines

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Low Cure Powder Coating Advantages over Laminate:

- Efficient **one-step** process
- No need to use **adhesives**
- No need to perform the **lamination steps**
- **Full coverage:** front and back
- **Multiple textures** and varying smooth level possible
- Different **gloss** levels
- Clear or solid **color** or other color effects
- **Moisture resistance**
- Possible to **repair**
- Possible to coat **non-flat objects**

Powder Coated MDF

Laminated Particle Board

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Opportunities in Pre-Coat Building Materials

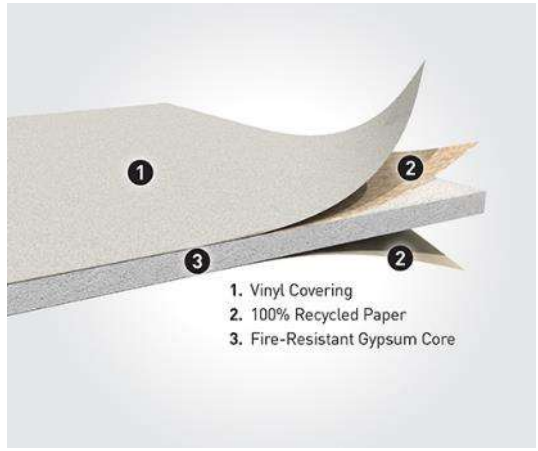
Interior/Exterior Prefinished Doors

MASONITE
DOORS THAT DO MORE.

Interior/Exterior Prefinished Trims

James Hardie®
Building Products

Interior Prefinished Sheetrock



National Gypsum

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Working with the Right Partners

Resin & Additive Suppliers

Equipment Suppliers

Coatings Formulators, Application Developers, System Integrators

Substrate or Finished Goods Manufacturers

- Wood
- Composites
- Gypsum board
- Replace melamine and foil laminates
- Plastics
- Large metal pieces

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ChemQuest Powder Coating Research

ChemQuest
POWDER COATING RESEARCH

- Raw Materials
- Collaborative Innovation
- Testing, Evaluation & Validation
- Formula Optimization
- Education & Publishing
- Market Data, Trends & Drivers

Unmatched in powder coating technical capabilities by any other consulting experts in the world

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Low Cure Powder Coating Technology

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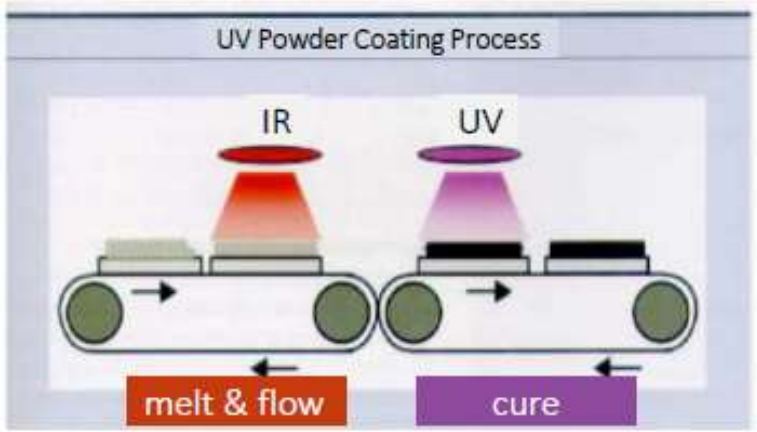
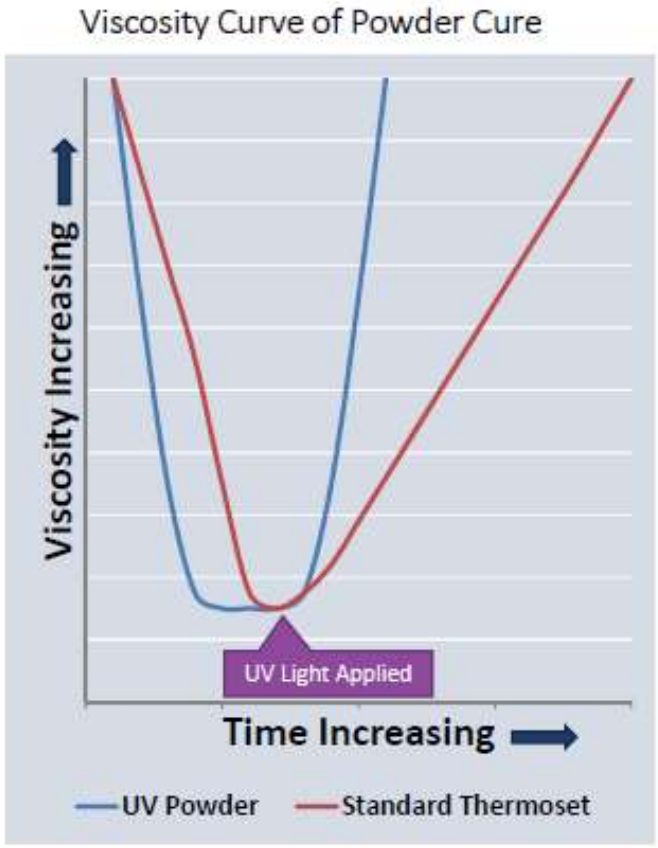
IR Powder vs. UV Powder

	IR Powder	UV Powder
Chemistry	Epoxy/polyester hybrid Polyester/TGIC/hydroxy alkyl amide Unsaturated polyester-vinylether	(Meth)acrylated polyester, (Meth)acrylated polyurethane, (Meth)acrylated polyester/epoxy hybrid
Curing Agent	Preoxide TGIC	Alpha-Hydroxy-Ketone (Surface Cure) Bis-Acrylphosphine Oxide (Deep Cure)
Application	130˚C; 10 min	110˚C; 5 min + UV
Substrate Temp.	80~100˚C	45~60˚C
Issues	• Substrate Sensitive • Outgassing • Powder heat sensitivity • Hard to scale up some type of powder manufacture	• Limited thickness – tio2 and carbon black • Limited choice of color – yellow and red would interfere with photo-initiators • Outdoor durability – long term outdoor durability is not proven

Advantage of UV-Powder for Heat Sensitive Substrates

- IR powder begins cure as the powder is melting
- For UV powder, the melt and cure phases are independent processes
- This allows for smoother films at lower temperatures because of longer open time after melting before curing
- Substrate temperature for UV-Powder is also greatly reduced





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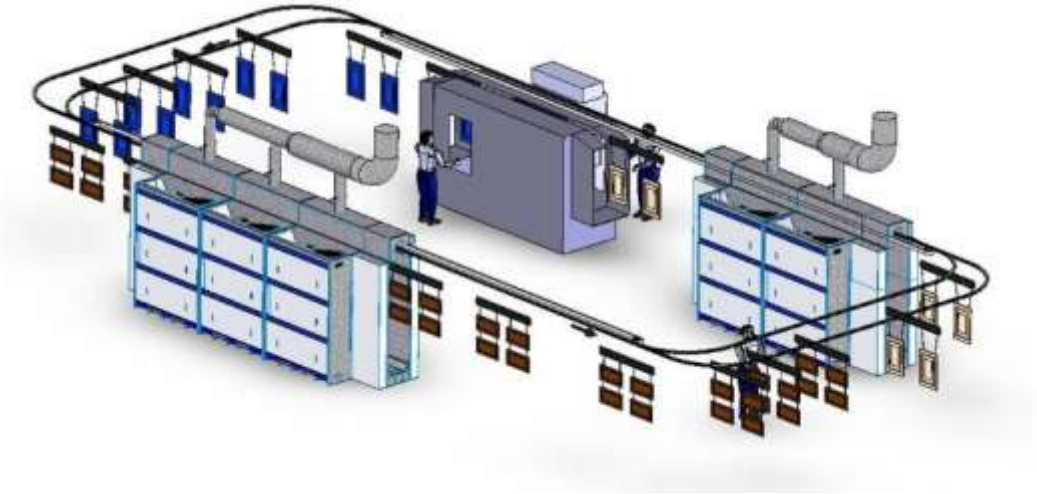
Powder vs. Liquid UV Line

Powder Line

Pre-Heat → Spray → Cure → Assemble



15~30 minutes

UV Line

Sand → Brush Stain → Heat /Cure → Sand → Spray Primer → Cure → Sand → Spray Topcoat → Cure → Assemble

60~150 minutes

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UV Powder vs. UV Liquid

- **Lower health risks and toxicity**, due to the use of higher MW materials. No skin irritation problems due to the elimination of reactive monomers
- **Higher film thickness**
  → one coat application
- **Better edge coverage**
  → uniform film thickness
- **Lower penetration on wood**
  → reduce coating usage
- **Better adhesion** over rigid substrates

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Innovation Trends

- **Ultra-Low Temperature IR-Powder**

  Cure Temperature below 100C in less than 5 minutes

- **Improved Outdoor Durability for UV-Powder**

  Comparable to liquid polyester coatings

- **Flat-line Application for UV-Powder**

  Enable faster throughput and productivity

- **LED Cure for UV-Powder**

  Reduce energy consumption and prolong the life of UV lamp

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Summary

- Low-cure powder is a **disruptive** coating technology that requires different approach to penetrate the market.
- UV-cure presents new opportunities to use **heat-sensitive substrates**.
- **Exterior coating** presents exciting opportunity.
- Development of **turn-key application technologies** is the key to mass adoption.

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Thank You

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