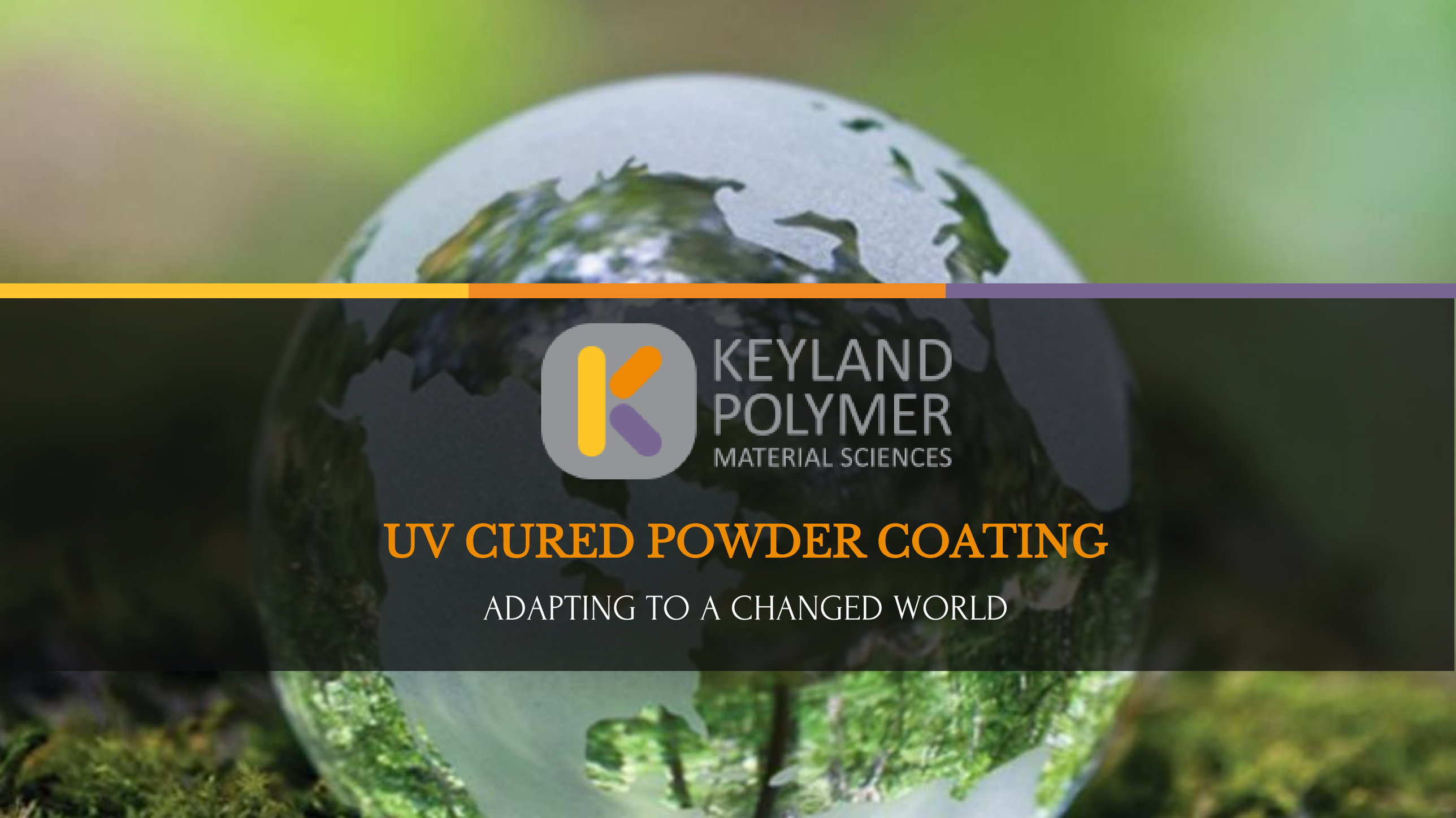
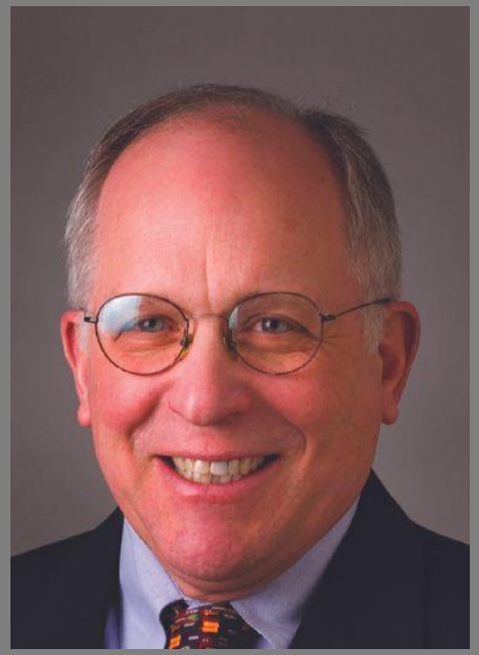


KEYLAND POLYMER
MATERIAL SCIENCES

UV CURED POWDER COATING

ADAPTING TO A CHANGED WORLD



Michael Knoblauch

President

Keyland Polymer Material Sciences, LLC

Keyland Polymer Material Sciences is a global innovation leader that develops, manufactures, and applies solid polymer coatings and materials cured by Ultraviolet Light (UV) and Electron Beam Energy (EB). Keyland develops and brings to market safe, sustainable, and carbon reducing polymer chemistries and application systems.

Company Overview

DVUV
Wood Powder Coating

Since 2005, DVUV has been producing commercial and industrial medium density fiberboard (MDF) furniture products finished with UVMax® powder coatings. Customers include; major retail stores, office and healthcare firms.

KEYLAND POLYMER
UV POWDER

In 2006 Keyland Polymer UV Powder began developing, formulating and manufacturing UV Cured Powder coatings., sold under the UVMax® brand. UV Cured Powder coatings are an ideal finish for heat sensitive materials and have the smallest total carbon footprint of any industrial coating material, 80% smaller than solventbourne liquid coatings (DSM Life Cycle Assessment 2011)

KEYLAND POLYMER
UV RESINS

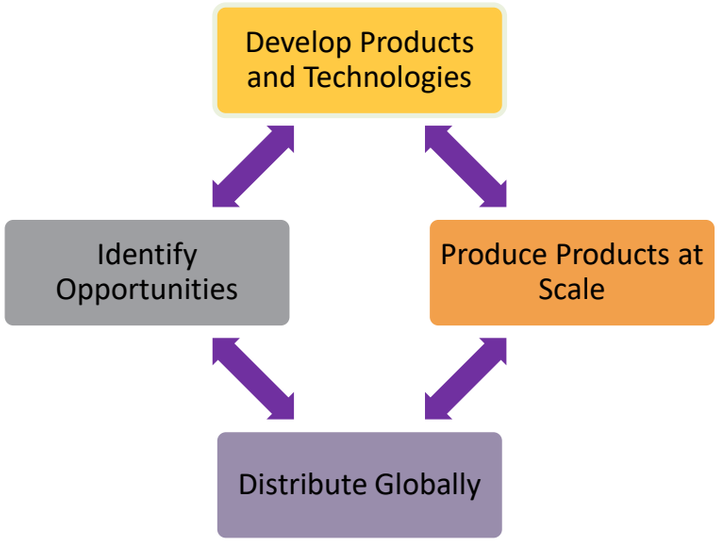
Keyland started developing its proprietary resins in 2009, collaborating with a Barcelona based resin chemist. The first production resin for commercial use was made in 2014. Keyland's resins are used in powder coating and as additives in UV or EB cured materials. Keyland's resins eliminate or reduce the use of hydrocarbon solvents and water-based chemistries.

KEYLAND POLYMER
UV MATERIALS SPAIN

In 2017 Keyland established a resin R&D laboratory in Alava, Spain. Keyland Spain and has a manufacturing partnership for production of resins. Keyland Spain supplies Keyland Powder and are sold in Europe and Asia by DKSH the Swiss marketing, sales, and distribution group.

KEYLAND POLYMER
UV APPLICATION TECHNOLOGY

Keyland has more than 15 years of UV powder application experience on heat sensitive substrates. Keyland offers system, engineering, design, installation and operating consulting assistance to firms building UV & EB cured powder and additive material application systems.



UV Resins

UV Resin Development

UV Resin Manufacturing

Resin Markets:
- Coatings
- Inks
- Additive Manufacturing

Commercial Products:
UVP1300
UVE5100

UV Powder Coatings

UV Powder Development

UV Powder Manufacturing

Substrates:
- MDF and Wood
- Carbon Fiber
- Composites
- Plastics
- Ferrous Metals
- Non-Ferrous Metals

Commercial Products:
UVMax™

Application Technologies

Powder Coating Application Development

System Design and Installation

Coatings Markets:
- Industrial
- Furniture
- Aerospace
- Automotive
- Sports Recreation

Commercial Products:
UVDURAPRESS™

Material Distribution

Business Development

Global Resin and Powder Sales

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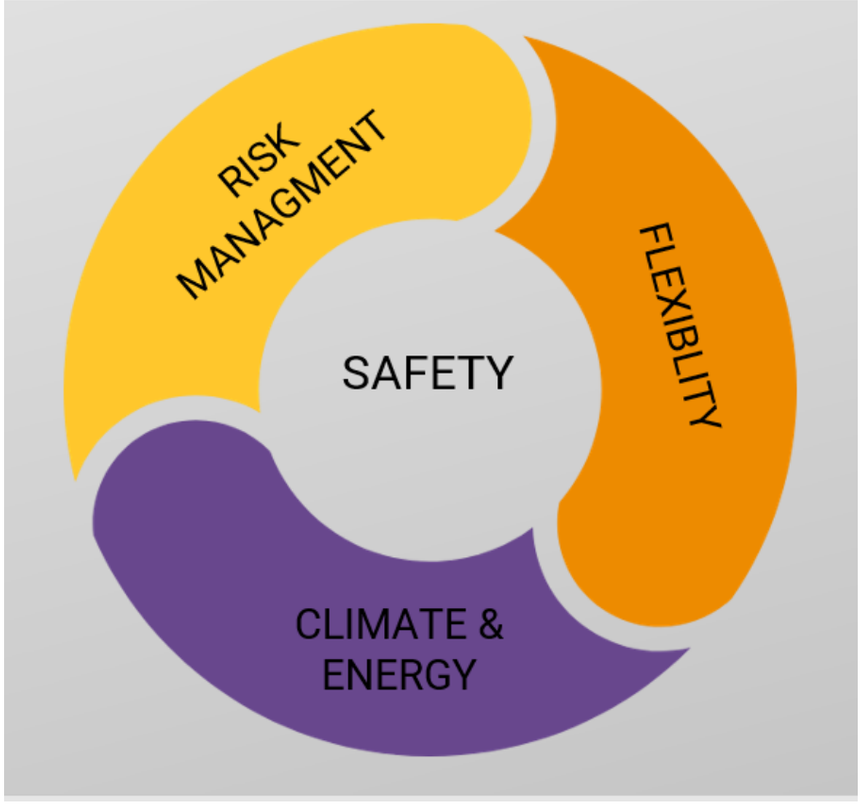
MATERIAL SCIENCES

Presentation



Covid has changed everything, “what was, is no longer.” We are experiencing changes in how and where we work, ways we communicate, how we measure and evaluate business risks, and make purchasing decisions. This has created exceptional and, in many cases, permanent changes to global supply chains and forced diversification of our material and supplier portfolios. Safety, security, flexibility are new measures of business evaluation criteria.

The demands of responding to the consequences of Covid has only added to the challenges of addressing the already significant impacts of climatic conditions and constraints.

This presentation will focus on safety, and the addition of an antimicrobial additive to UV cured powder coatings that are used to finish materials and products we touch.

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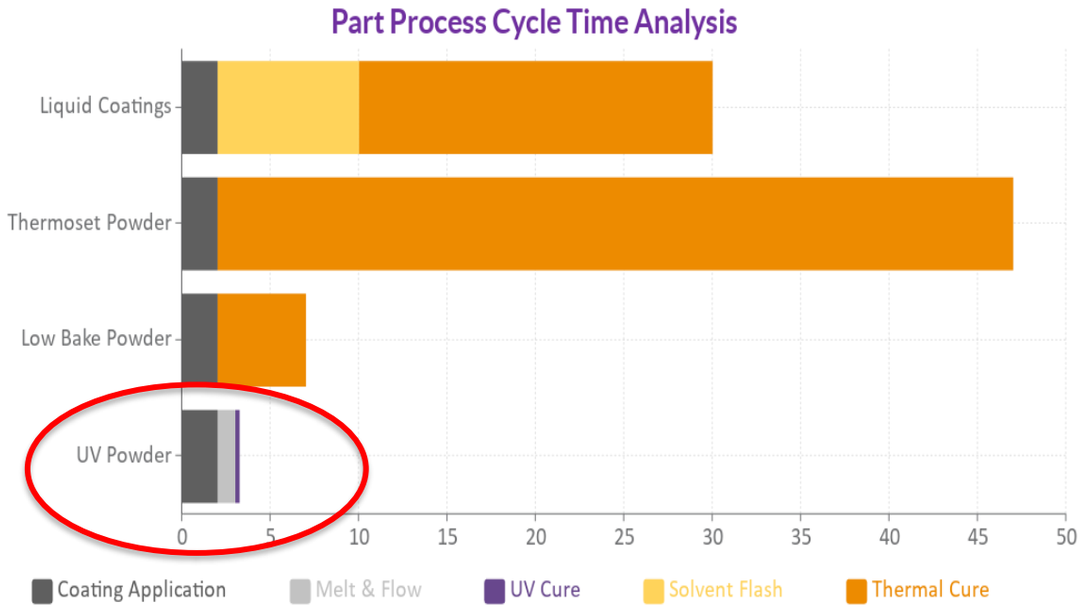
UV Cured Powder Coating

Performance Values
Speed
Durability
Low cost of quality

Safety
REACH compliant
Antimicrobial

Sustainability Values
Small carbon footprint
Low total applied cost
Low life cycle impact



Faster - 3.5 to 10 times
Meets KCMA and other standards
More productive – 6% - 30%
Higher profits per hour – 5% - >20%

Uses less energy – 25% to 90%
Smaller plant footprint – 40%
100% solid – no solvents or water

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Definitions

- Sanitize - to reduce or eliminate pathogenic agents (such as bacteria) on the surfaces of (something) **:** to make (something) sanitary (as by cleaning or disinfecting)
- Disinfect - to cleanse (a surface, a device, a supply of water, etc.) by destroying, inactivating, or significantly reducing the concentration of pathogenic agents (such as bacteria, viruses, and fungi) **:** to treat (something) with a disinfectant (such as chlorine, hydrogen peroxide, or sodium hypochlorite)
- Biocide - a substance (such as an algicide or fungicide) that destroys or inhibits the growth or activity of living organisms
- Antimicrobial - destroying or inhibiting the growth of microorganisms and especially pathogenic microorganisms

Source – Marriam Webster https://www.merriam-webster.com/dictionary

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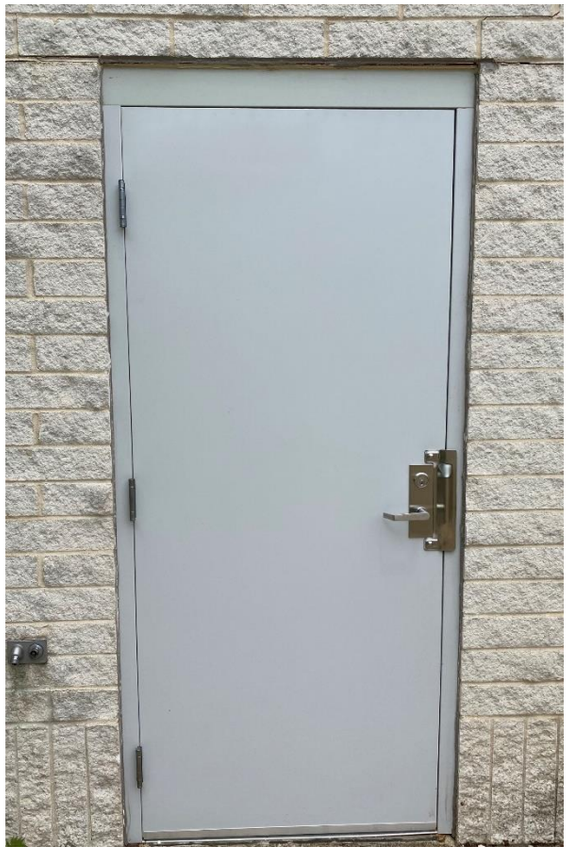

High Contact UV Cured Powder Coated Surfaces

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How often are these surfaces cleaned?

Are they being cleaned properly?

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Cleanability of UV Cured Powder Coating Surfaces

Method for Evaluation of Three UV Cured Powder Coatings - Resistance to Common Household and Commercial Liquid Cleaning Products

Reagent #	Product	Active Ingredient	Details
1	Water	N/A	Tap water to act as standard
2	Bleach solution (2% v/v)	Sodium Hypochlorite	Check the label to see bleach is intended for disinfection. Centers for Disease Control and Prevention (CDC) recommends 5 tablespoons bleach per gallon of tap water (at least 1000ppm sodium hypochlorite).
3	Isopropanol solution (70% v/v)	Isopropyl Alcohol	CDC recommends isopropyl alcohol solutions contain at minimum 70% alcohol for disinfecting cleaners.
4	Clorox Commercial Solutions® Formula 409®	n-Alkyl (40% C12, 50% C14, 10% C16) dimethyl benzyl ammonium chloride, (Quaternary Ammonium)	
5	Ethanol solution (70% v/v)	Ethyl Alcohol	CDC recommends ethyl alcohol solutions contain at minimum 60% alcohol for disinfecting cleaners.
6	Troy Chemical Incorporated, Troy 1609®	Alkyl (60% C14, 30% C16, 5% C12, 5% C18) dimethyl benzyl ammonium chloride & Alkyl (68% C12, 32% C14) dimethyl ethylbenzyl ammonium chloride, (Quaternary Ammonium)	

https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cleaning-disinfection.html
https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2

NEMA LD 3-2000 method 3.4 Cleanability/ Stain Resistance, 3.4.5 and 25 cycles are considered one cleaning for the purpose of this test procedure

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Evaluation of Coating Resistance to Common Household and Commercial Liquid Cleaning Products Scrub Test, 10 Cleanings						
Reagent	1	2	3	4	5	6
Test Specimen ID	ZP19L06R1	ZP19L06R1	ZP19L06R1	ZP19L06R1	ZP19L06R1	ZP19L06R1
Coating Description	Textured white UV powder coating	Textured white UV powder coating	Textured white UV powder coating	Textured white UV powder coating	Textured white UV powder coating	Textured white UV powder coating
*Initial Film Thickness, mils	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5
*Final Film Thickness, mils	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5
*Initial Gloss, 60° GU	10-12	10-12	10-12	11-12	11-12	12-13
*Final Gloss, 60° GU	10-12	10-12	11-12	11-12	11-12	12-13
*Initial Pencil Hardness	2H	2H	2H	2H	2H	2H
*Final Pencil Hardness	2H	2H	2H	2H	2H	2H
Color Transfer to Cotton Cloth, yes/no	No	No	No	No	No	No
Coating Appearance Comments After Testing	No observable change	No observable change	No observable change	No observable change	No observable change	No observable change

*In the area where test will be/was conducted.

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MATERIAL SCIENCES

Evaluation of Coating Resistance to Common Household and Commercial Liquid Cleaning Products Scrub Test, 10 Cleanings						
Reagent	1	2	3	4	5	6
Test Specimen ID	ZP18L04R1	ZP18L04R1	ZP18L04R1	ZP18L04R1	ZP18L04R1	ZP18L04R1
Coating Description	Smooth white UV powder coating	Smooth white UV powder coating	Smooth white UV powder coating	Smooth white UV powder coating	Smooth white UV powder coating	Smooth white UV powder coating
*Initial Film Thickness, mils	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5
*Final Film Thickness, mils	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5
*Initial Gloss, 60° GU	85-90	86-90	88-90	86-90	88-90	86-90
*Final Gloss, 60° GU	86-90	86-90	88-90	85-90	89-90	86-90
*Initial Pencil Hardness	H	H	H	H	H	H
*Final Pencil Hardness	H	H	H	H	H	H
Color Transfer to Cotton Cloth, yes/no	No	No	No	No	No	No
Coating Appearance Comments After Testing	No observable change	No observable change	No observable change	No observable change	No observable change	No observable change

*In the area where test will be/was conducted.

KEYLAND POLYMER
MATERIAL SCIENCES

Evaluation of Coating Resistance to Common Household and Commercial Liquid Cleaning Products Scrub Test, 10 Cleanings						
Reagent	1	2	3	4	5	6
Test Specimen ID	ZP20B13R1	ZP20B13R1	ZP20B13R1	ZP20B13R1	ZP20B13R1	ZP20B13R1
Coating Description	Textured black UV powder coating	Textured black UV powder coating	Textured black UV powder coating	Textured black UV powder coating	Textured black UV powder coating	Textured black UV powder coating
*Initial Film Thickness, mils	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5
*Final Film Thickness, mils	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5	3-3.5
*Initial Gloss, 60° GU	16-20	16-18	16-19	16-17	16-18	15-16
*Final Gloss, 60° GU	16-20	16-18	16-18	16-18	16-18	14-16
*Initial Pencil Hardness	2H	2H	2H	2H	2H	2H
*Final Pencil Hardness	2H	2H	2H	2H	2H	2H
Color Transfer to Cotton Cloth, yes/no	No	No	No	No	No	No
Coating Appearance Comments After Testing	No observable change	No observable change	No observable change	No observable change	Very subtle lightening of surface	No observable change

*In the area where test will be/was conducted.

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Antimicrobial Additive in UV Cured Powder Coatings

It’s in There!

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ISO 22196

COMPLIANT

(antibacterial activity on non-porous surfaces)

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Company name:	Keyland Polymer UV Powder, LLC
Report language: *(Spanish or English)*	English

Sample data:

Sample						Additive	
N°	**Reference**	**Reference to be included in the report** *(if different from Ref. sample)*	**Number of specimens**	**Maximum temperature**	**Material**	**Name**	**%**
1	PB17-20L11T4 (STANDARD)		2	230C	UV powder over Al	N/A	
2	PB17-20L11T1		12	230C	UV powder over Al	BactiBlock 101 R1.47	0.8
3	PB17-20L11T2		12	230C	UV powder over Al	BactiBlock 101 R1.47	1.0
4	PB17-20L11T3		12	230C	UV powder over Al	BactiBlock 101 R1.47	1.5
5							

Other details about the samples:

UV-cured powder coating over standard aluminium panels (panels reduced from full sized panels purchased from Q-Lab)

Type of study:
(Check the box or fill in the "Other" box)

X	**JIS Z 2801 (ISO 22196)**		**JIS L 1902 (ISO 20743)**		**ASTM E2149**		**Other**

Company name:	Keyland Polymer UV Powder, LLC
Report language: *(Spanish or English)*	English

Sample data:

Sample						Additive	
N°	**Reference**	**Reference to be included in the report** *(if different from Ref. sample)*	**Number of specimens**	**Maximum temperature**	**Material**	**Name**	**%**
1	ZT21A20R1 (STANDARD)		12	230C	UV Powder over Al	N/A	
2	ZT21B01R1		12	230C	UV Powder over Al	Bactiblock 101 R1.47	0.3
3	ZT21B01R2		12	230C	UV Powder over Al	Bactiblock 101 R1.47	0.5
4	ZT21B01R3		12	230C	UV Powder over Al	Bactiblock 101 R1.47	0.7
5							

Other details about the samples:

UV-cured powder coating over standard aluminium panels (panels reduced from full sized panels purchased from Q-Lab)

Type of study:
(Check the box or fill in the "Other" box)

X	**JIS Z 2801 (ISO 22196)**		**JIS L 1902 (ISO 20743)**		**ASTM E2149**		**Other**

KEYLAND POLYMER
MATERIAL SCIENCES

Informe de análisis / *Analysis Report*

ID: 21022401

Empresa / *Company*	Keyland Polymer UV Powder, LLC	
Fecha de emisión del informe / *Date of issue*	24/02/2021	
Proyecto / *Project*	C671	
Fecha recepción muestras / *Reception date*	16/02/2021	
Fecha ensayo / *Test date*	**Fecha inicio** / *Start date*:	22/02/2021
	Fecha fin / *End date*:	24/02/2021
Actividad / *Activity*	Actividad antimicrobiana en superficies no porosas / *Antimicrobial activity on non-porous surfaces*	

Según norma de ensayo / *According to the standard*	JIS Z 2801:2010 (ISO 22196) – Productos antibacterianos - Prueba de actividad y eficacia antibacteriana (*ver Anexo I*) / *JIS Z 2801:2010 (ISO 22196) – Antibacterial products – Test for antibacterial activity and efficacy (see Annex I)*	
Referencia de las muestras / *Sample reference*	**Código** / *Code*	**Descripción** / *Description*
	C671/21021601	ZT21A20R1
	C671/21021602	ZT21B01R1
	C671/21021603	ZT21B01R2
	C671/21021604	ZT21B01R3
Microorganismos / *Microorganisms*	*Staphylococcus aureus* CECT 240, ATCC 6538P *Escherichia coli* CECT 516, ATCC 8739	
Inóculo / *Inoculum*	Diluyente / *Diluent*: Nutrient Broth 1/500	
	Volumen / *Volume*: 0,4 ml	
Neutralizante / *Neutralizing*	10 ml SCDLP	
Comentarios / *Comments*	Muestras curadas en estufa durante 72 h a 120 ºC / *Samples cured in oven for 72 h at 120 ºC*	

Resultados / *Results*

Microorganismo / *Microorganism*:	*Staphylococcus aureus* CECT 240, ATCC 6538P					
Inóculo - Tiempo 0 h (UFC/ml) / *Inoculum - Time 0 h (CFU/ml)*:	9,20E+05					
Tiempo 24 h / *Time 24 h*:						
Código / *Code*	**Descripción** / *Description*	**UFC** / *CFU*				**%Reducción** / **%Reduction**	**Valor actividad antimicrobiana (R)** / *Antimicrobial activity value*
		Réplica / *Replicate* 1	**Réplica** / *Replicate* 2	**Réplica** / *Replicate* 3	**Media** / *Average*		
C671/21021601	ZT21A20R1	4,40E+03	8,80E+03	9,68E+03	7,63E+03	-	-
C671/21021602	ZT21B01R1	1,00E+01	2,00E+01	1,00E+01	1,33E+01	99,83	2,76
C671/21021603	ZT21B01R2	1,00E+01	1,00E+01	1,00E+01	1,00E+01	99,87	2,88
C671/21021604	ZT21B01R3	1,00E+01	1,00E+01	1,00E+01	1,00E+01	99,87	2,88

% Reducción = $[(U_t - A_t)/ U_t]*100$; R= log U_t - log A_t; donde U_t es la media del número de células bacterianas viables sobre la muestra sin tratar tras 24 h de incubación, y A_t es la media del número de células bacterianas viables sobre la muestra tratada con el antimicrobiano tras 24 h de incubación.
% Reduction = $[(U_t - A_t)/ U_t]*100$; R= log U_t - log A_t; where U_t is the average of the number of viable cells of bacteria on the untreated piece after 24 h, and A_t is the average of the number of viable cells of bacteria on the antimicrobial treated piece after 24 h.

Cuando R ≥ 2.0, se considera que la muestra presenta propiedades antimicrobianas.
When R ≥ 2.0, the sample is considered to show antimicrobial properties.

Resultados / *Results*

Microorganismo / *Microorganism*:	*Escherichia coli* CECT 516, ATCC 8739					
Inóculo - Tiempo 0 h (UFC/ml) / *Inoculum - Time 0 h (CFU/ml)*:	9,67E+05					
Tiempo 24 h / *Time 24 h*:						
Código / *Code*	**Descripción** / *Description*	**UFC** / *CFU*				**%Reducción** / **%Reduction**	**Valor actividad antimicrobiana (R)** / *Antimicrobial activity value*
		Réplica / *Replicate* 1	**Réplica** / *Replicate* 2	**Réplica** / *Replicate* 3	**Media** / *Average*		
C671/21021601	ZT21A20R1	4,00E+06	4,40E+06	1,52E+07	7,87E+06	-	-
C671/21021602	ZT21B01R1	3,00E+01	1,00E+01	4,00E+01	2,67E+01	>99,99	5,47
C671/21021603	ZT21B01R2	1,00E+01	1,00E+01	1,00E+01	1,00E+01	>99,99	5,90
C671/21021604	ZT21B01R3	1,00E+01	1,00E+01	1,00E+01	1,00E+01	>99,99	5,90

% Reducción = $[(U_t - A_t)/ U_t]*100$; R= log U_t - log A_t; donde U_t es la media del número de células bacterianas viables sobre la muestra sin tratar tras 24 h de incubación, y A_t es la media del número de células bacterianas viables sobre la muestra tratada con el antimicrobiano tras 24 h de incubación.
% Reduction = $[(U_t - A_t)/ U_t]*100$; R= log U_t - log A_t; where U_t is the average of the number of viable cells of bacteria on the untreated piece after 24 h, and A_t is the average of the number of viable cells of bacteria on the antimicrobial treated piece after 24 h.

Cuando R ≥ 2.0, se considera que la muestra presenta propiedades antimicrobianas.
When R ≥ 2.0, the sample is considered to show antimicrobial properties.

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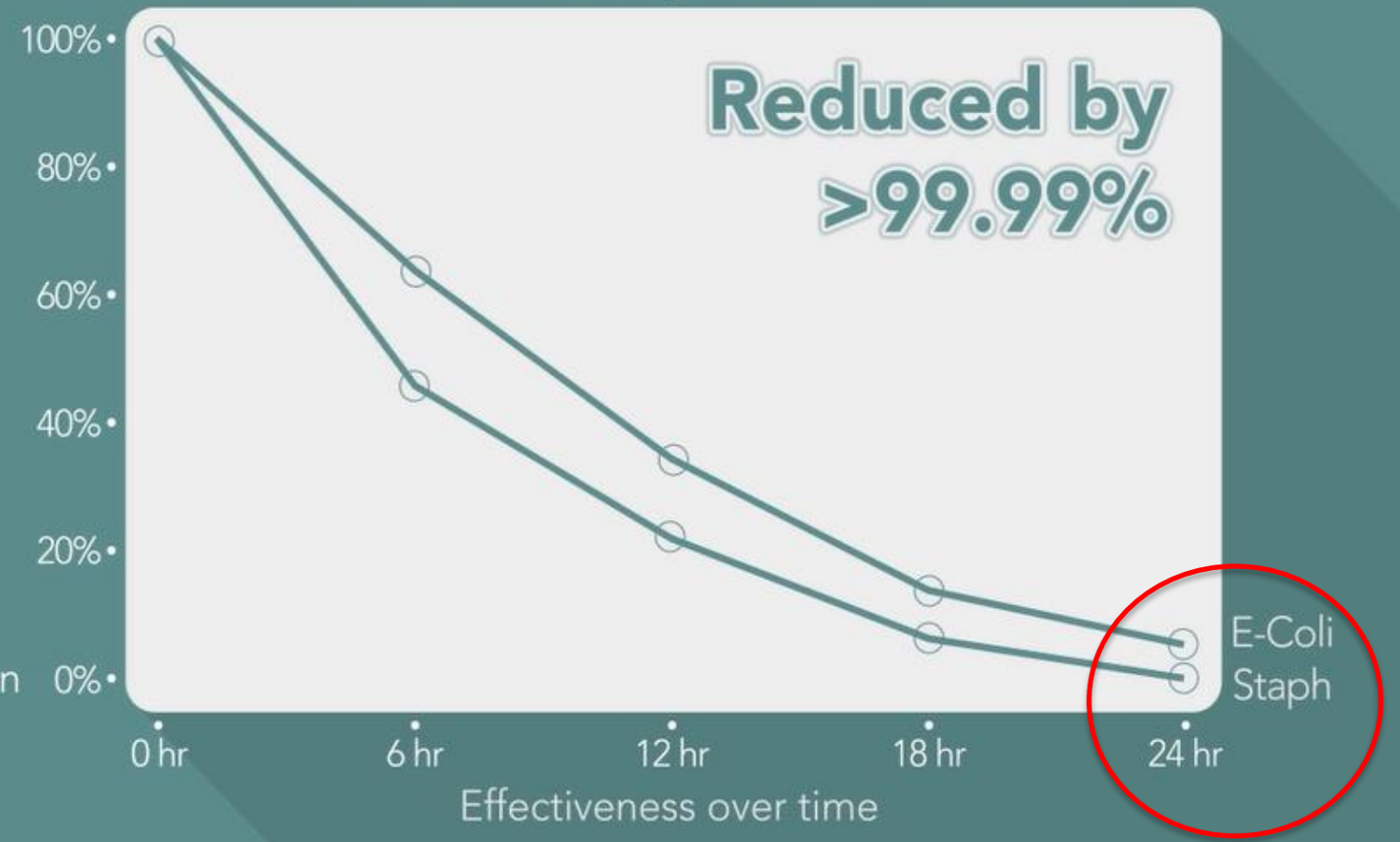
Microbe reproduction



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UV POWDER

UVMax™ DEFENDER

ANTIMICROBIAL COATINGS

UV Cured Powder Coatings

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THANK YOU!

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