

EXPLORING NEXT-GENERATION ANTIMICROBIAL SOLUTIONS FOR SUSTAINABLE COATING SYSTEMS

—
JAMES RAPLEY
MICROBAN INTERNATIONAL, LTD.

EXPERT SPEAKER: *JAMES RAPLEY*

SPEAKER BIOGRAPHY

With nearly a decade's worth of experience in new product development, James Rapley oversees coating technology projects for a variety of substrates at Microban. James possesses a solid understanding of dispersion and formulation, in addition to polymer formulation containing pigments, dispersion agents, surfactants and binding agents for use in coatings. James has several published technologies in the Li ion battery coatings industry focusing on ultra-thin coatings, and he has applied this knowledge to creating novel antimicrobial coating technologies.

Prior to joining Microban, James worked as a research scientist for a leading manufacturer of high-performance membrane separators, with a focus on ceramic coatings development. James holds Bachelor of Science and Master of Science degrees in Chemistry.



AGENDA

- 01 THE MISSION:** Creating sustainable coatings
- 02 THE PROBLEM:** Microbial attack on coatings
- 03 THE SOLUTION:** Antimicrobial solutions for coatings
- 04 THE INNOVATION:** Novel antimicrobials for coatings



THE MISSION: **CREATING SUSTAINABLE COATINGS**

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FACTORS FOR SUSTAINABLE COATING DEVELOPMENT

Antimicrobial technologies not only need to protect products against microbial attack but to do so in a way that is safe for consumers, sustainable for manufacturers, and friendly towards the environment.

**REDUCE
TOXICITY**

**IMPROVE
STABILITY**

**IMPROVE
PROCESS
EFFICIENCY**

**REDUCE VOC
EMISSIONS**

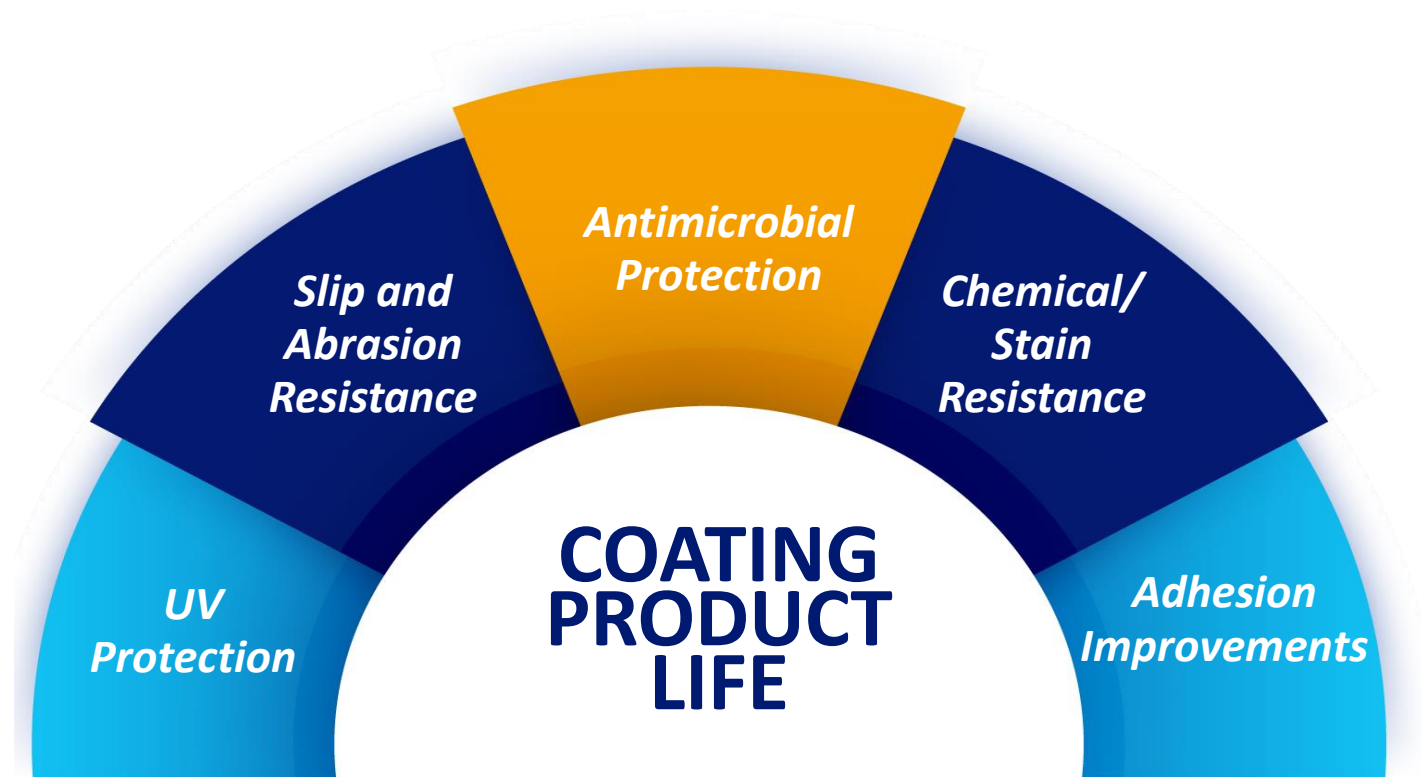
**REDUCE
WASTE
GENERATION**

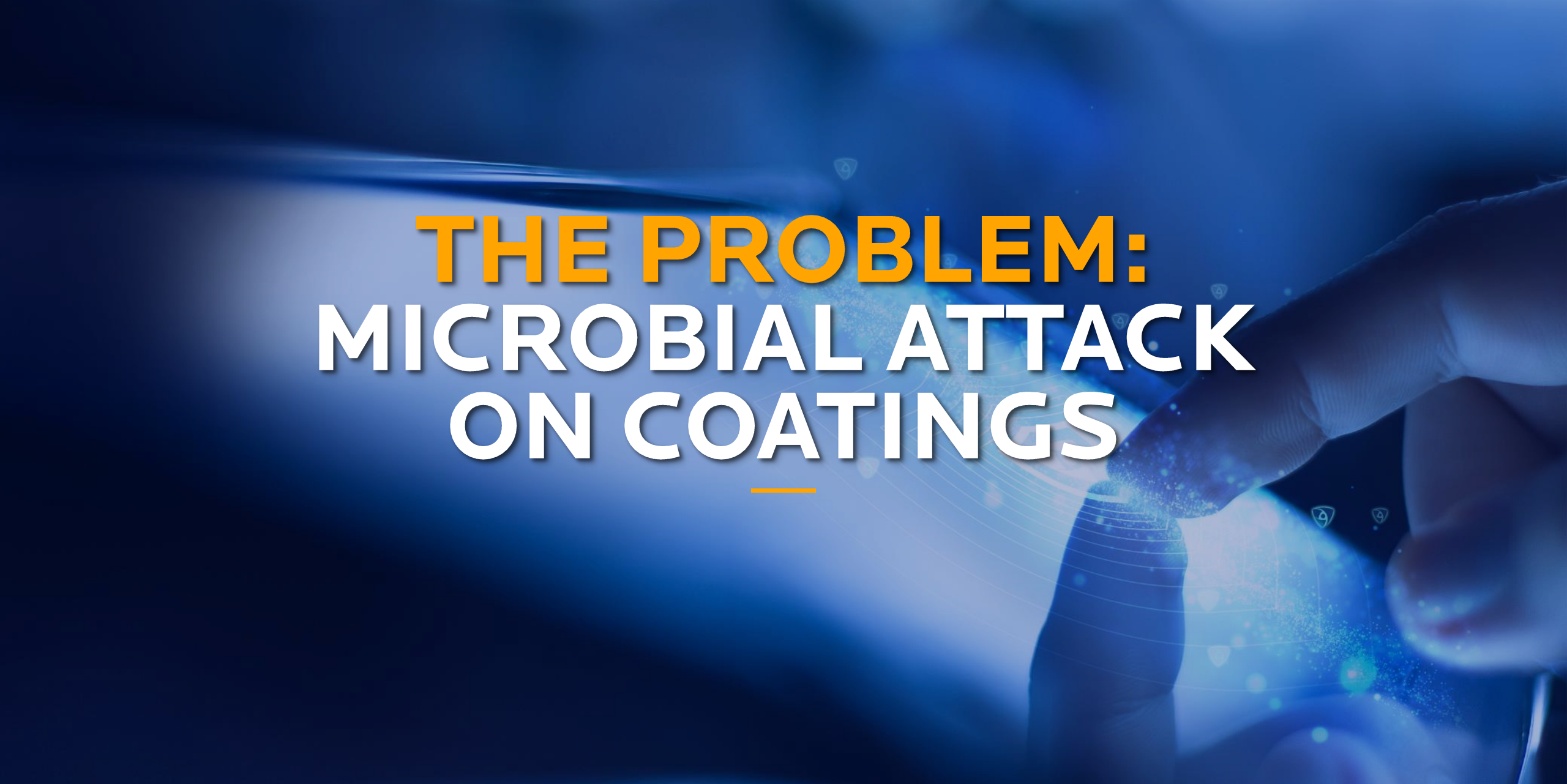
**EXTEND
PRODUCT
LIFETIME/
PERFORMANCE
PROPERTIES**

**Sustainable coating formulations + coatings that
create more sustainable finished products**

CURRENT EFFORTS FOR SUSTAINABLE COATING DEVELOPMENT

There are multiple approaches that exist to create more sustainable coatings formulations and extend the product life of the coating.





THE PROBLEM: MICROBIAL ATTACK ON COATINGS

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TYPES OF MICROORGANISMS



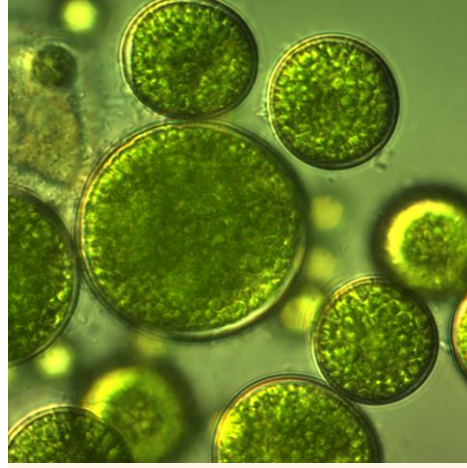
BACTERIA

Cells are simple and can multiply easily. Populations can increase quickly on surfaces



MOLD

Produce large numbers of spores that are spread through the air and then land on surfaces



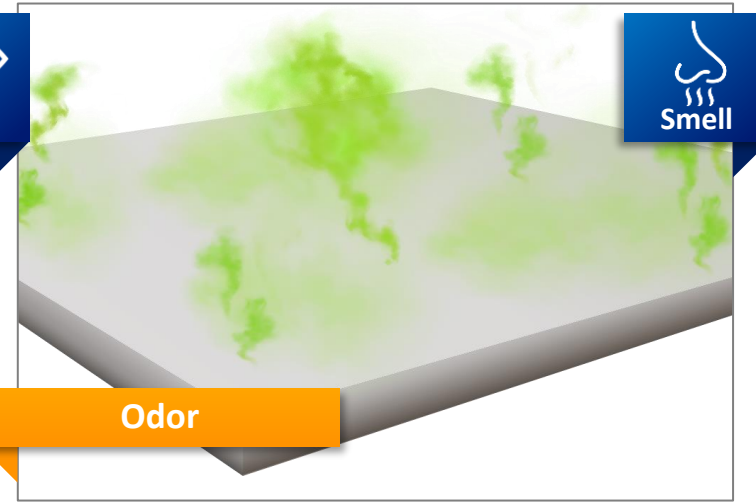
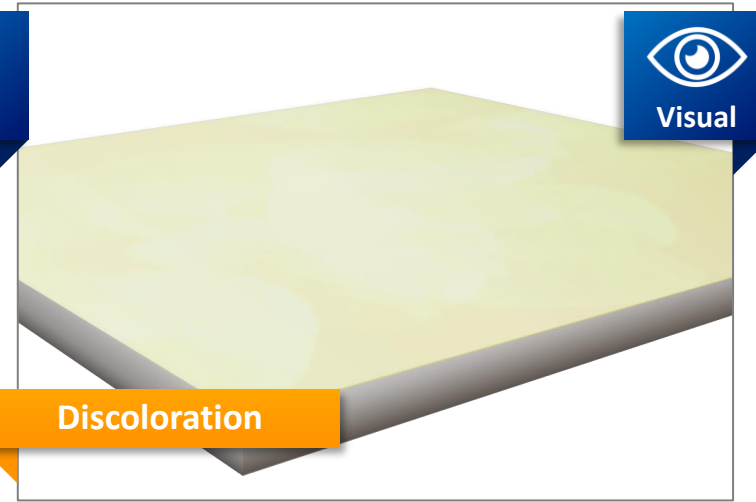
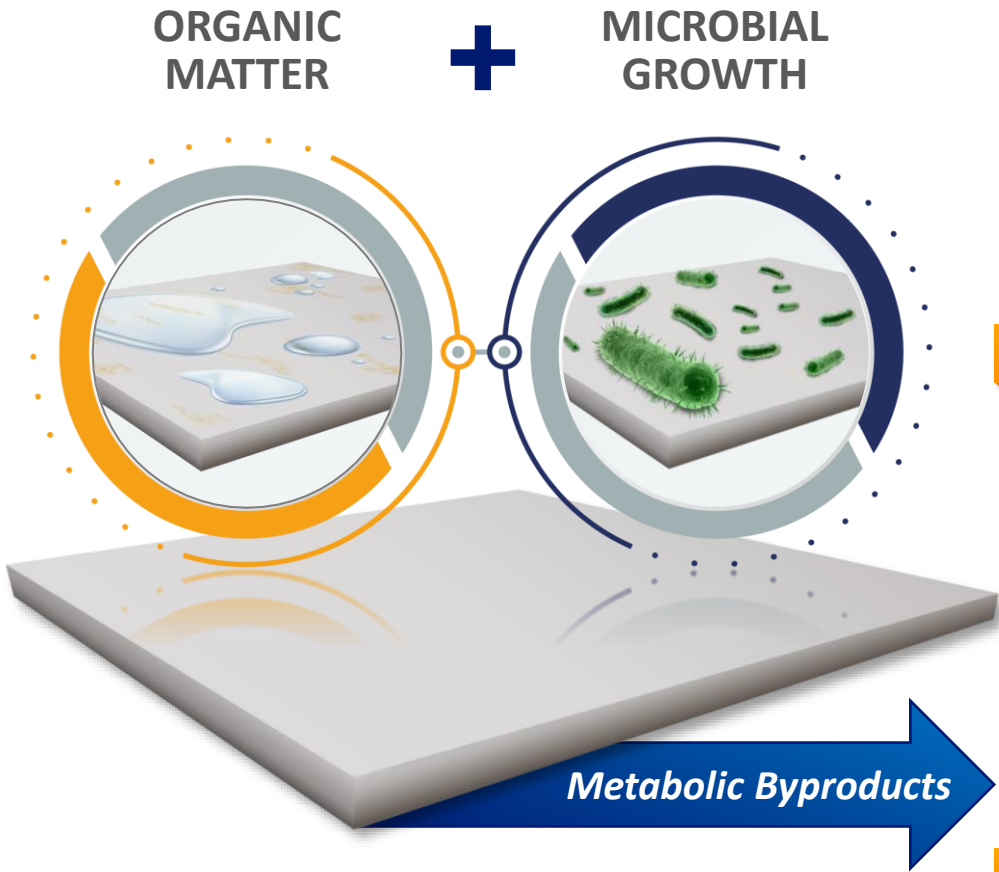
ALGAE

Commonly found on exterior surfaces where there is moisture and soil

REAL-WORLD SOAP DISPENSER



EFFECTS OF MICROBIAL ATTACK ON COATED SURFACES





THE SOLUTION: **ANTIMICROBIAL SOLUTIONS** **FOR COATINGS**

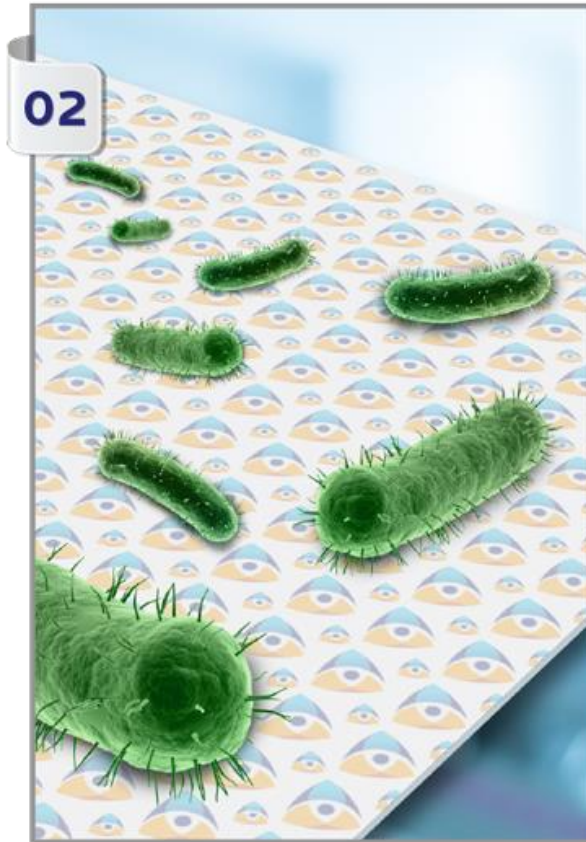
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HOW DO ANTIMICROBIALS WORK IN COATINGS?



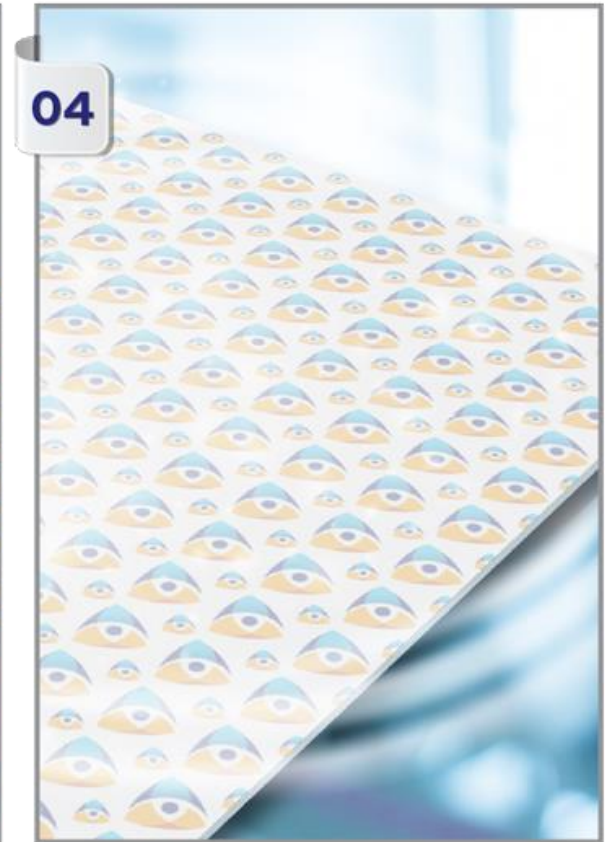
**TECHNOLOGY
COATING APPLIED**



**SURFACE
CONTAMINATION**

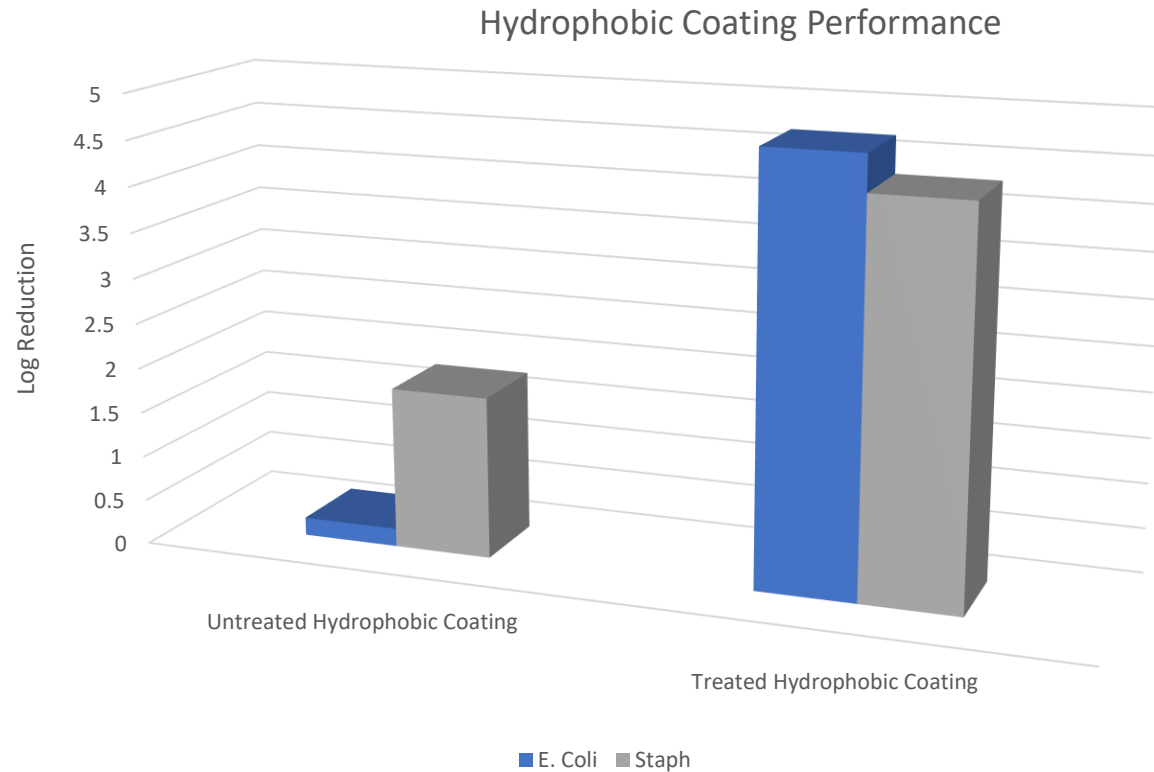


**TECHNOLOGY
AT WORK**



**UP TO 99.9% CLEANER
SURFACE**

DO CERTAIN COATINGS ALREADY HAVE ANTIMICROBIAL PROPERTIES?



	Untreated Hydrophobic Coating	Treated Hydrophobic Coating
■ E. Coli	0.2	4.7
■ Staph	1.8	4.3
■ Contact Angle (H ₂ O)	110	110

EXAMPLES:

Surface energy modification
(hydrophobicity/hydrophilicity)

CONS:

Do not guarantee broad-spectrum protection against a variety of microorganisms

Cannot be sold with any customer-facing antimicrobial claims

DO CERTAIN COATINGS ALREADY HAVE ANTIMICROBIAL PROPERTIES?

Sample Description	Antibacterial	
	<i>E. coli</i>	<i>S. aureus</i>
Untreated Solvent-Based Coating	<90%	<90%
Treated Solvent-Based Coating	>99.99%	>99.99%

EXAMPLES:

Solvent-based coatings

CONS:

While solvent-based coatings do not need antimicrobial protection in the wet state, once dry there is no guarantee of protection against microbial growth

Cannot be sold with any customer-facing antimicrobial claims

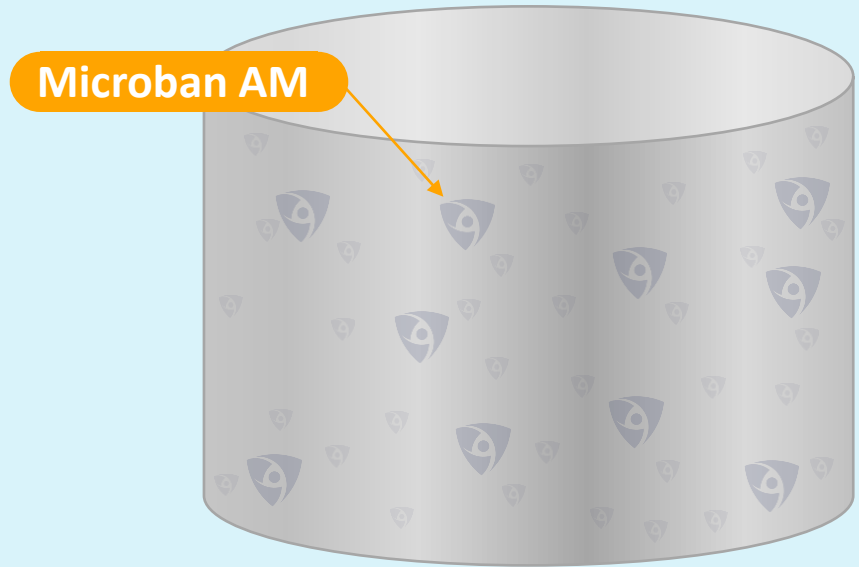
DRY FILM PRESERVATION VS. IN-CAN PRESERVATION

DRY-FILM PRESERVATION



- ❖ Requires more additive
- ❖ Extends the lifetime of finished coating product
- ❖ Can qualify for treated article claims

IN-CAN PRESERVATION



- ❖ Requires minimal additive
- ❖ Protects the wet-state formulation only
- ❖ Does not extend the lifetime of finished coating product
- ❖ Does not qualify for treated article claims



INNOVATIONS FOR **WATER-BASED** COATINGS

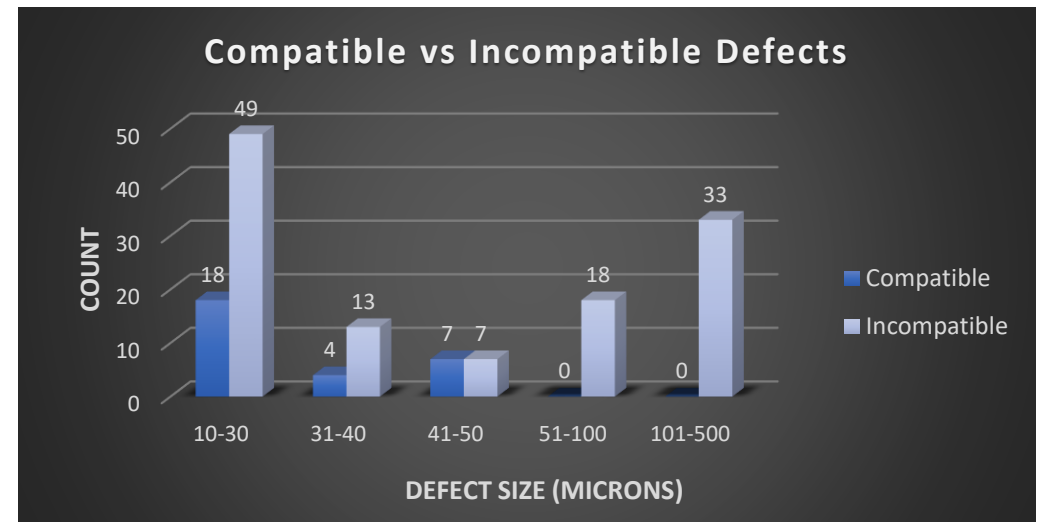
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THE CHALLENGES OF TRADITIONAL ANTIMICROBIALS IN WATER-BASED COATINGS



- ❖ Presence of emulsifiers and dispersing agents in coatings make the latexes and suspensions susceptible to destabilisation if ionic charge or pH is not acceptable
- ❖ Require thorough mixing during production to avoid aggregation and sedimentation
- ❖ Prone to clumping, non-uniformity, clouding, speckling and coating defects
- ❖ Hygroscopic, significantly reducing their life shelf and, ultimately, leading to more production waste

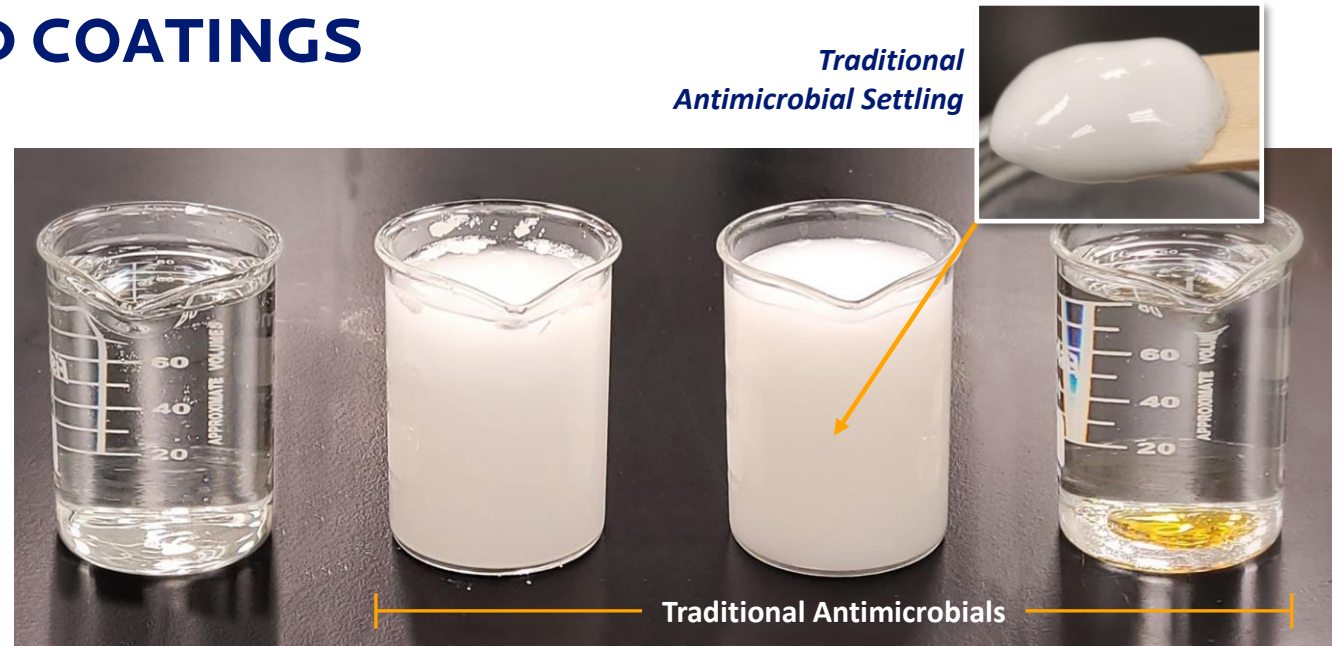


INNOVATIONS FOR WATER-BASED COATINGS

KEY ATTRIBUTES

- ❖ Heavy-metal-free solution with improved quality and stability for water-based coatings
- ❖ Eliminates the common struggles associated with aggregation and sedimentation during the mixing and dispersing process
- ❖ Inhibits bacterial growth by up to 99.99% and prevents mold and mildew growth on the treated surfaces
- ❖ Ideal for optimal clarity and thin coatings. Minimal impact on coating aesthetics

Traditional Antimicrobial Settling



NOVEL TECHNOLOGY	TRADITIONAL ANTIMICROBIALS
Clear and UV stable	May cause yellowing or other negative visual defects
Easy to incorporate, mix, and disperse	Difficult to incorporate, mix and disperse
Stability after incorporation	May phase separate or settle due to gravity

PERFORMANCE DATA

- 📍 Maintains color and clarity after prolonged UV exposure
- 📍 Superior shelf-life stability
- 📍 Thermal stability up to 150°C
- 📍 Minimal to no impact on clarity

CLEAR COATINGS (ON GLASS)

Sample	Avg. Haze (n=3)
Novel antimicrobial technology	0.23
Antimicrobial dispersions	34.57

Novel technology

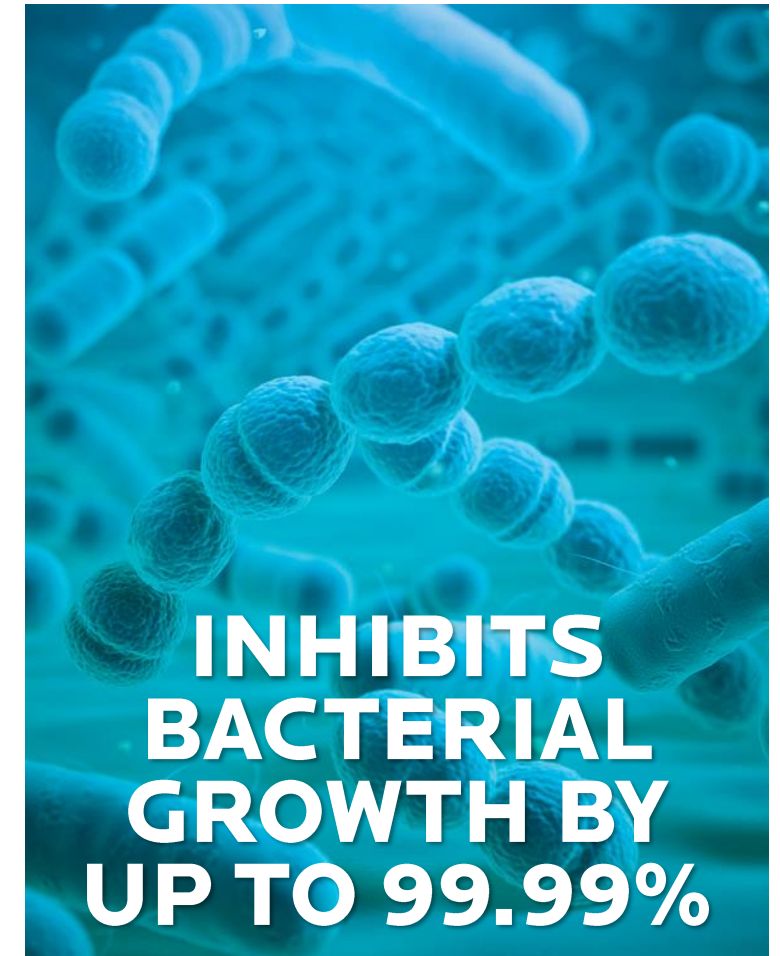


Dispersion



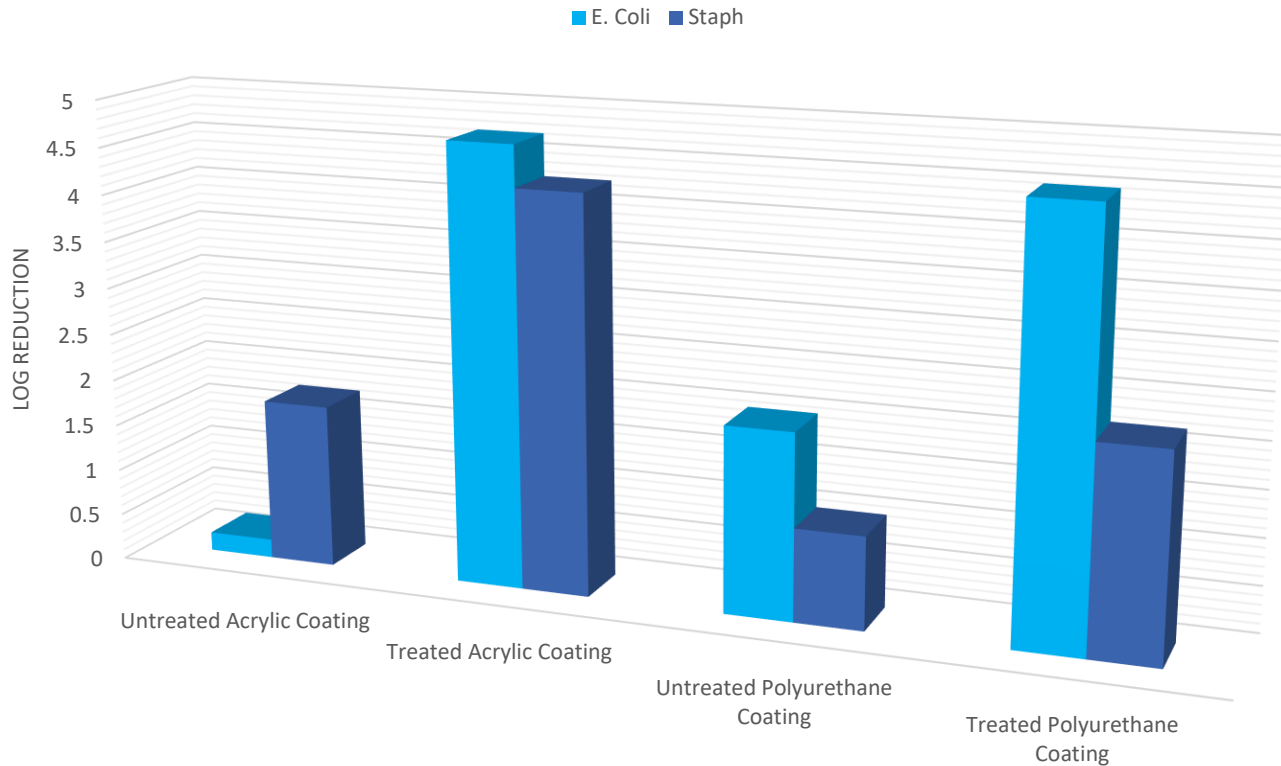
PERFORMANCE DATA: **ACRYLIC AND POLYURETHANE COATINGS**

Sample description	Antibacterial		Antifungal
	Ec	Sa	ASTM G21
Water-based acrylic coatings	>99.99%	>99.9%	Pass
Water-based polyurethane coatings	>99.99%	>99%	Pass

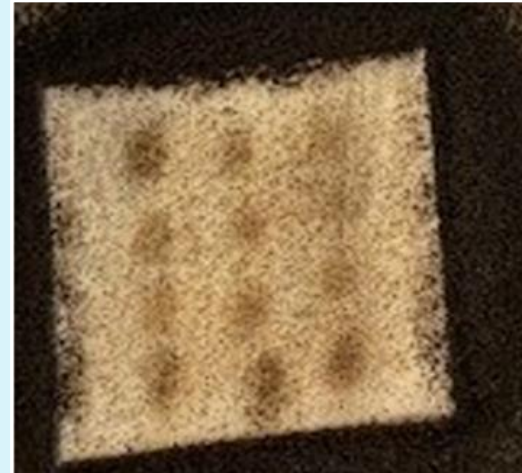


PERFORMANCE DATA: *TREATED vs. UNTREATED*

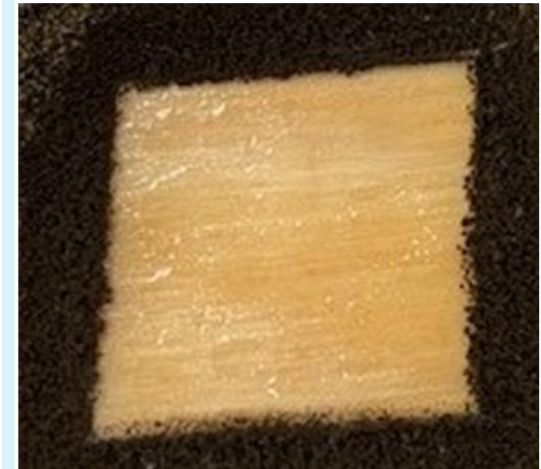
Antibacterial Efficacy



UNTREATED COATING



TREATED COATING

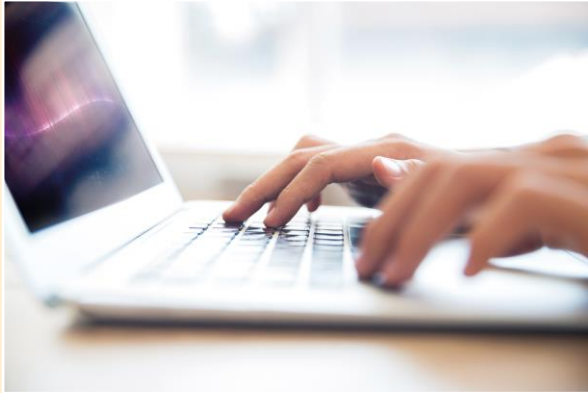


Untreated vs. treated coating on a wood substrate tested for fungal growth.

The antimicrobial performance of water-based acrylic and polyurethane coating surfaces with and without antimicrobial treatment.

SUITABLE APPLICATIONS

Suitable for use in water-based coatings and paints for application on:



Polymers



Wood



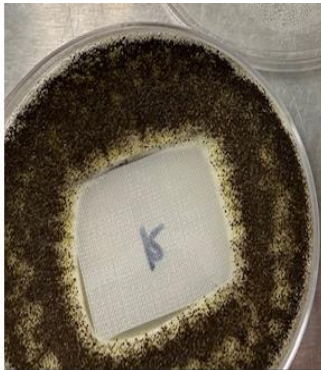
Metal



Glass...and more!



Untreated coating



Treated coating



Wood surface



Treated coating



Untreated coating



Treated coating

KEY FEATURES: WATER-BASED TECHNOLOGY



Easy-to-use - Optimized processing and manufacturing requirements allow for easy incorporation to water-based coating systems



Heavy-metal-free solution - The technology does not contain metal-based chemistries and is an effective alternative to metal-based antimicrobial additives



Broad-spectrum antimicrobial - Effective against not just bacteria but also the growth of fungi including mold and mildew



Improved quality - Improved stability with minimal impact on optical properties of water-based coatings, making it ideal for transparent and thin coatings



UV stable - Does not change color and maintains clarity after prolonged UV exposure



Long shelf-life - can be stored for later use, preventing unnecessary wastage and optimizing resources for more sustainable manufacturing.



24/7 protection - Effective against microbial growth 24/7 and for the expected life of coating products.



Global registration - The technology is registered with U.S. Environmental Protection Agency (EPA) and EU Biocidal Products Regulation (BPR)



INNOVATIONS FOR **SOLVENT-BASED** COATINGS

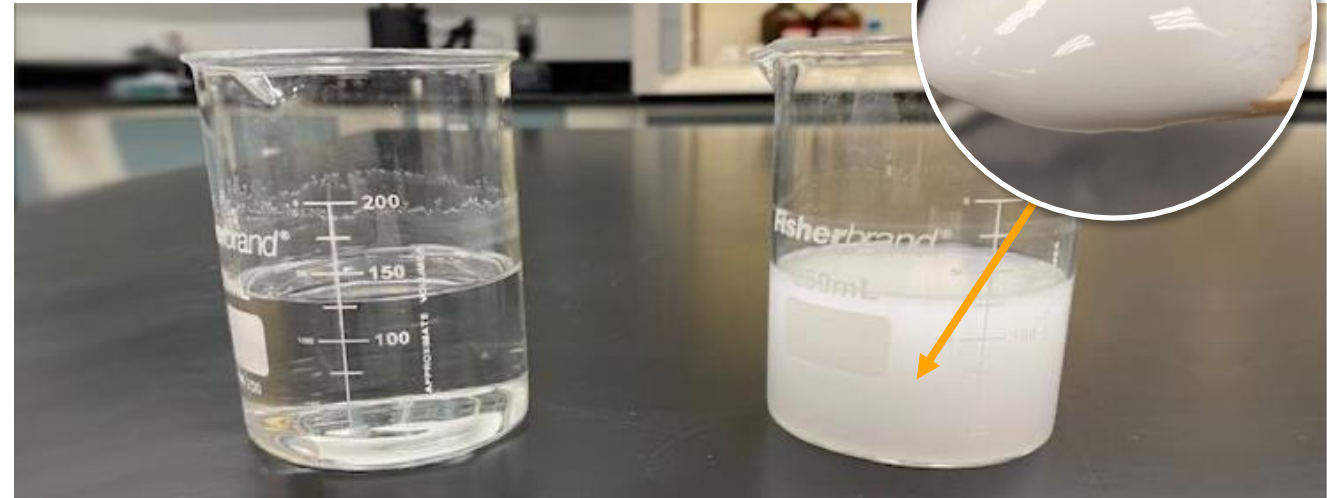
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INNOVATIONS FOR SOLVENT-BASED COATINGS

KEY ATTRIBUTES

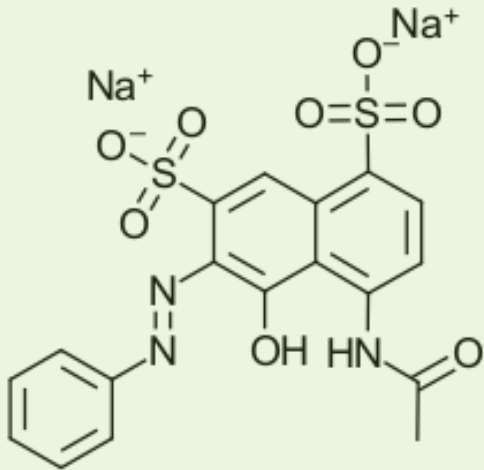
- Patent-pending, more environmentally friendly technology which eliminates heavy-metal-based chemistries from the formulation
- Provides clear advantages over traditional antimicrobial systems that are non-soluble, heavy, and difficult to keep suspended
- Inhibits bacterial growth by up to 99.99%
- Provides exceptional UV stability and is an ideal solution for thin and transparent coatings



NOVEL TECHNOLOGY	TRADITIONAL ANTIMICROBIALS
Clear and UV stable	May cause yellowing or other negative visual defects
Easy to incorporate, mix, and disperse	Difficult to incorporate, mix and disperse
Stability after incorporation	May phase separate or settle due to gravity

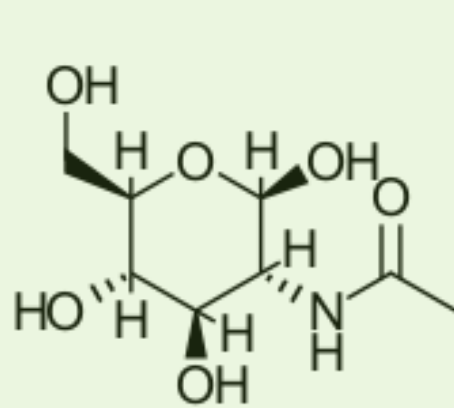
*The technology used in this product is similar to acids found in nature and is used in multiple consumer product applications.

LOOKING TOWARDS NATURE



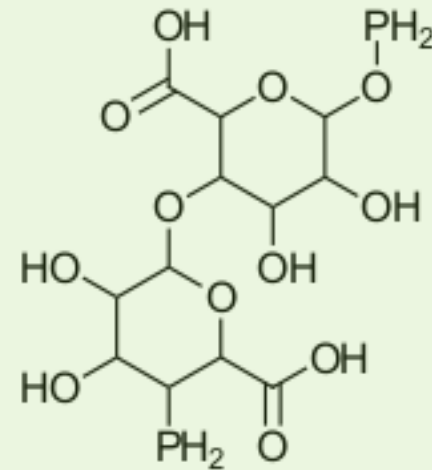
LIGNIN

- Used to create renewable binders
- Naturally occurring in plants, especially wood and bark



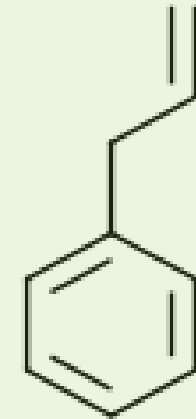
CHITIN

- Used to create films
- Naturally occurring in shells of crustaceans



ALGINATE

- Used to create fibers
- Naturally occurring in seaweed/algae



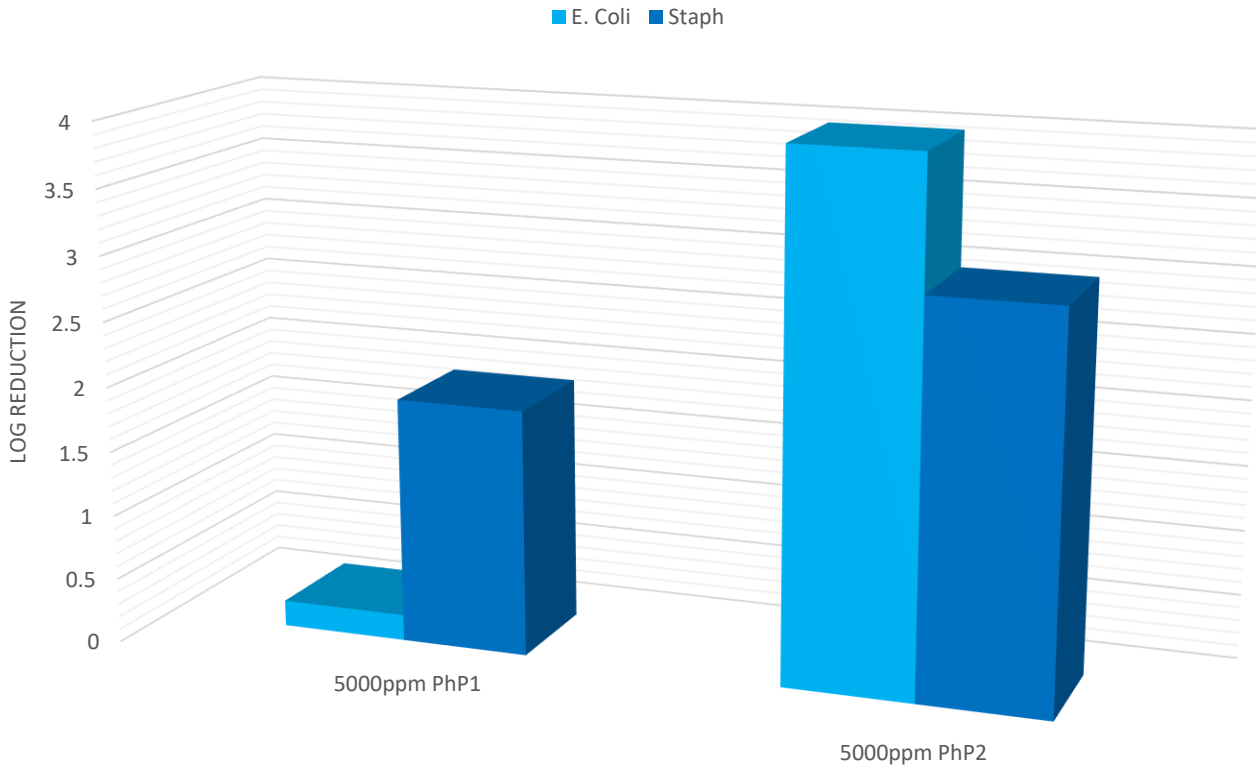
PHENYLPROPANOIDS

- Used in food preservatives
- Naturally occurring in plants



LOOKING TOWARDS NATURE

Performance of different Phenylpropanoid Antimicrobials(PhP)



Maintains color and clarity after prolonged UV exposure



Superior shelf-life stability



Inspired by nature



Minimal to no impact on clarity

SUITABLE APPLICATIONS

Suitable for use in solvent-based coatings and paints for application on:



Polymers



Wood



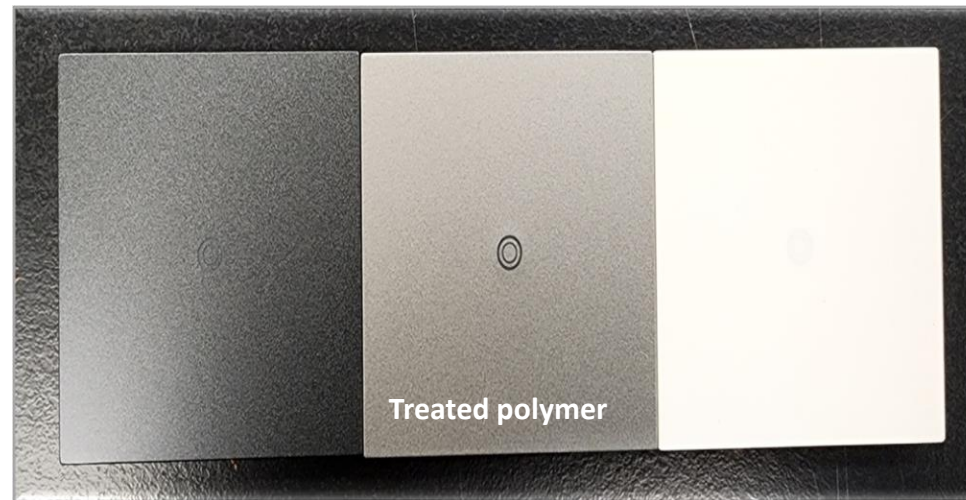
Metal



Glass...and more!



Treated polymer



Treated polymer



Treated glass

KEY FEATURES: SOLVENT-BASED TECHNOLOGY



Nature-Inspired - Industry groundbreaking technology with an ingredient inspired by nature



Compatible - Broad-spectrum antibacterial that integrates seamlessly into most commonly used formulation thinners



Heavy-metal-free solution - Effective alternative to metal-based antimicrobial additives



Easy to use - Optimized processing and manufacturing requirements allow for easy incorporation to a variety of solvent-based coatings systems



UV stable - Does not change color and maintains clarity after prolonged UV exposure



Improved quality - Improved stability with minimal impact on optical properties of solvent-based coatings, making it ideal for transparent and thin coatings

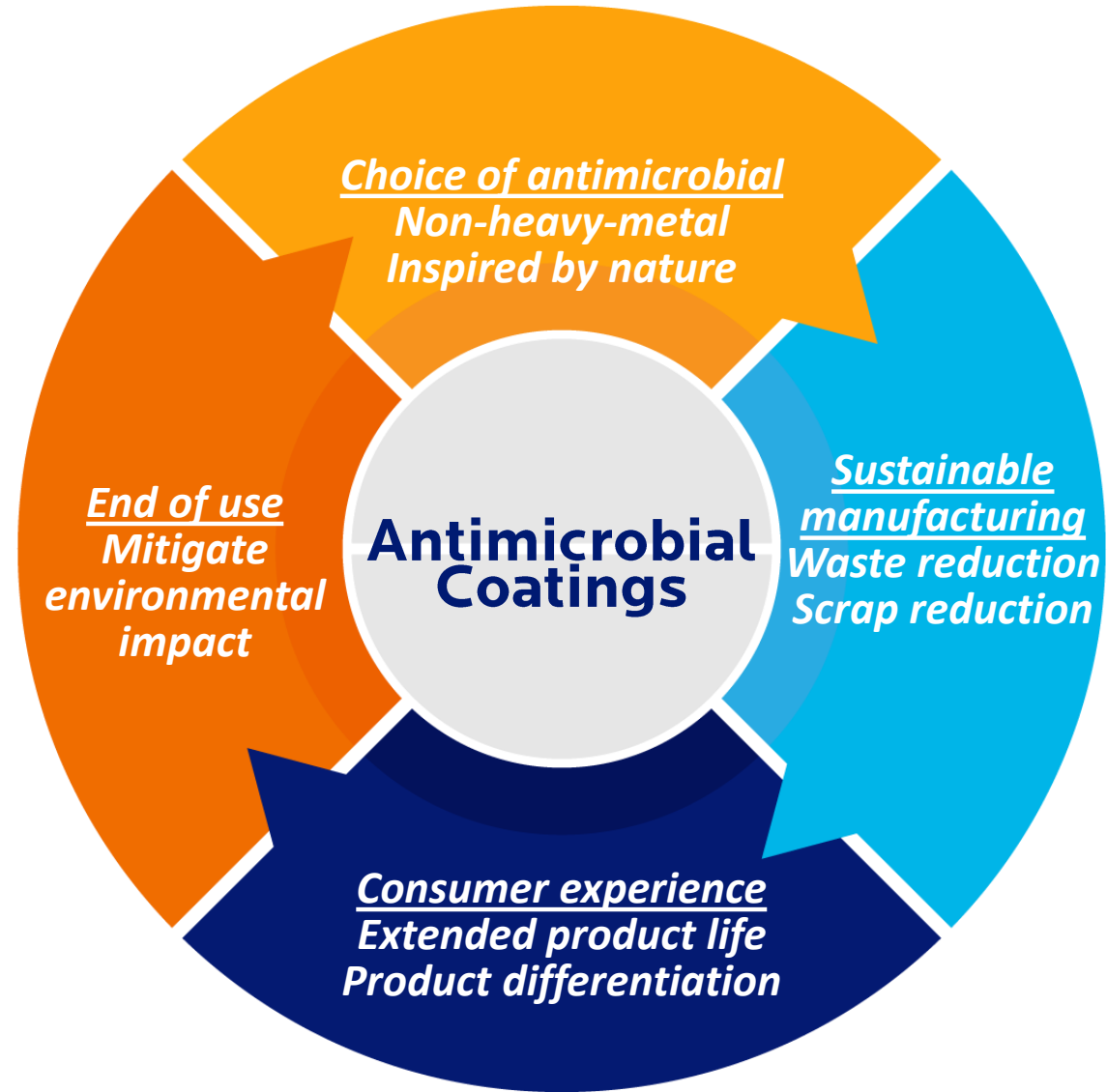


24/7 protection - Effective against bacterial growth 24/7 and for the expected life of coating products



Regulatory registrations - Registered with EU Biocidal Products Regulation (BPR). U.S. Environmental Protection Agency (EPA) registration is pending

OVERALL BENEFITS





**THANK YOU
FOR YOUR ATTENTION**

QUESTIONS ARE WELCOME