REVOLUTIONIZING COATINGS WITH ADVANCED MULTIFUNCTIONAL TECHNOLOGY

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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

In this session we will cover:

01 Functionality Wheel

02 Key Considerations

03 Functional Coatings designed for Interior Applications

04 Functional Coatings designed for Exterior Applications

05 Miscellaneous Functionalities and Combinations

FUNCTIONALITY WHEEL

REGULATORY PRESSURES

- PFAS-Free
- Heavy-Metal Free
- Low-VOCs
- Bio-Based

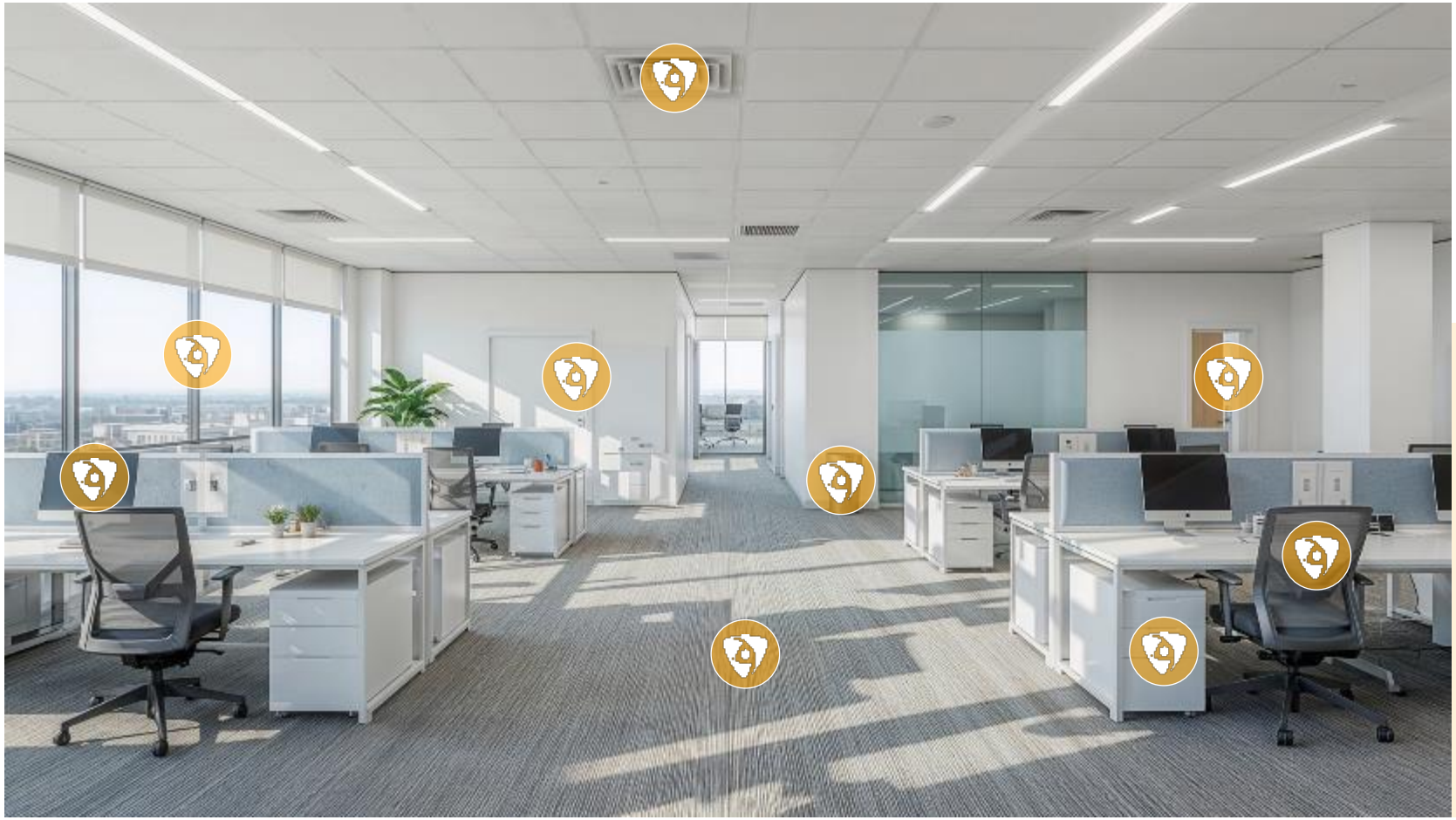
TEST METHODS

- Abrasion
- Hardness
- Tensile
- Contact Angle
- Odor Control
- Anti-microbial

KEY CONSIDERATIONS

- End Use: What application will the product be used for
- Substrate Properties: How will the substrate impact the coating’s ability to perform?
- Formulation Compatibilities: Are all components stable
- Manufacturing Considerations: Process Temps, Application Methods, Regulations, etc.
- Test Methods: Test Methods designed to meet specs and/or show functional performance

INTERIOR MULTIFUNCTIONAL COATINGS



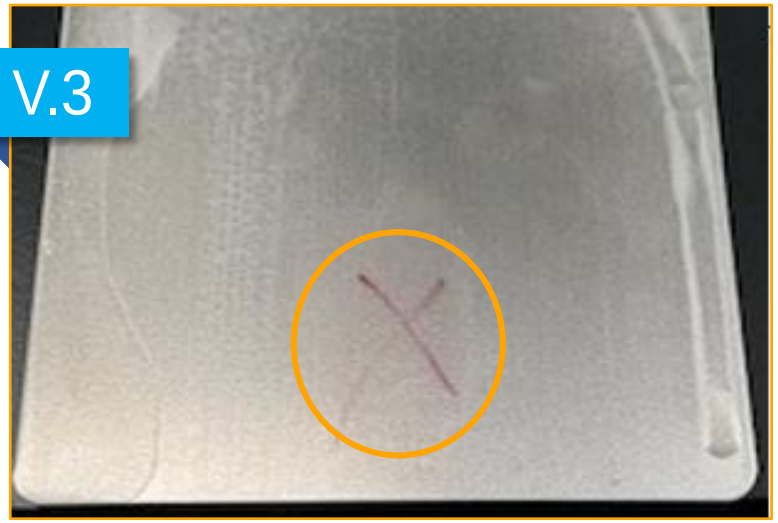
- Many surfaces are covered with protective coatings
- Interior coatings need to operate well after multiple touches, abrasions, and improve overall consumer experience

FLUORINE FREE OMNIPHOBIC COATING

- End Use: Protecting High Touch Surfaces
- Substrate Properties: Non-porous, metal, ceramic
- Test Methods: Contact Angle, X-Test, ISO 22196, ASTM 30 pt. III

FLUORINE FREE OMNIPHOBIC COATING

Repellency	Contact Angle Measurements		
	Formulations		
	V.1	V.2	V.3
N-Hexadecane	33.27	27.4	30.11
Water	109.69	118.04	109.03



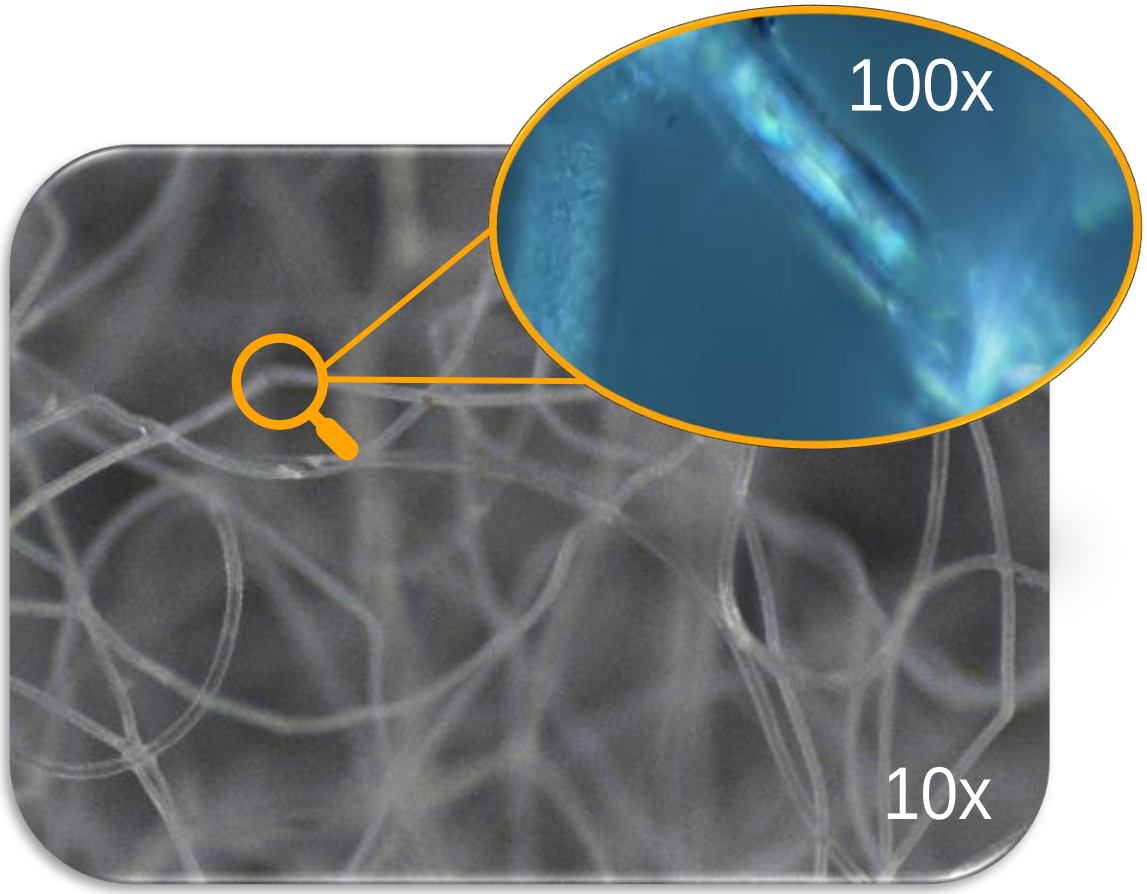
FLUORINE FREE OMNIPHOBIC COATING

Sample Description	Antibacterial	
	Ec	Sa
Untreated PFAS-Free Coating	No Reduction	90%
Treated PFAS-Free Coating	>99%	>99%

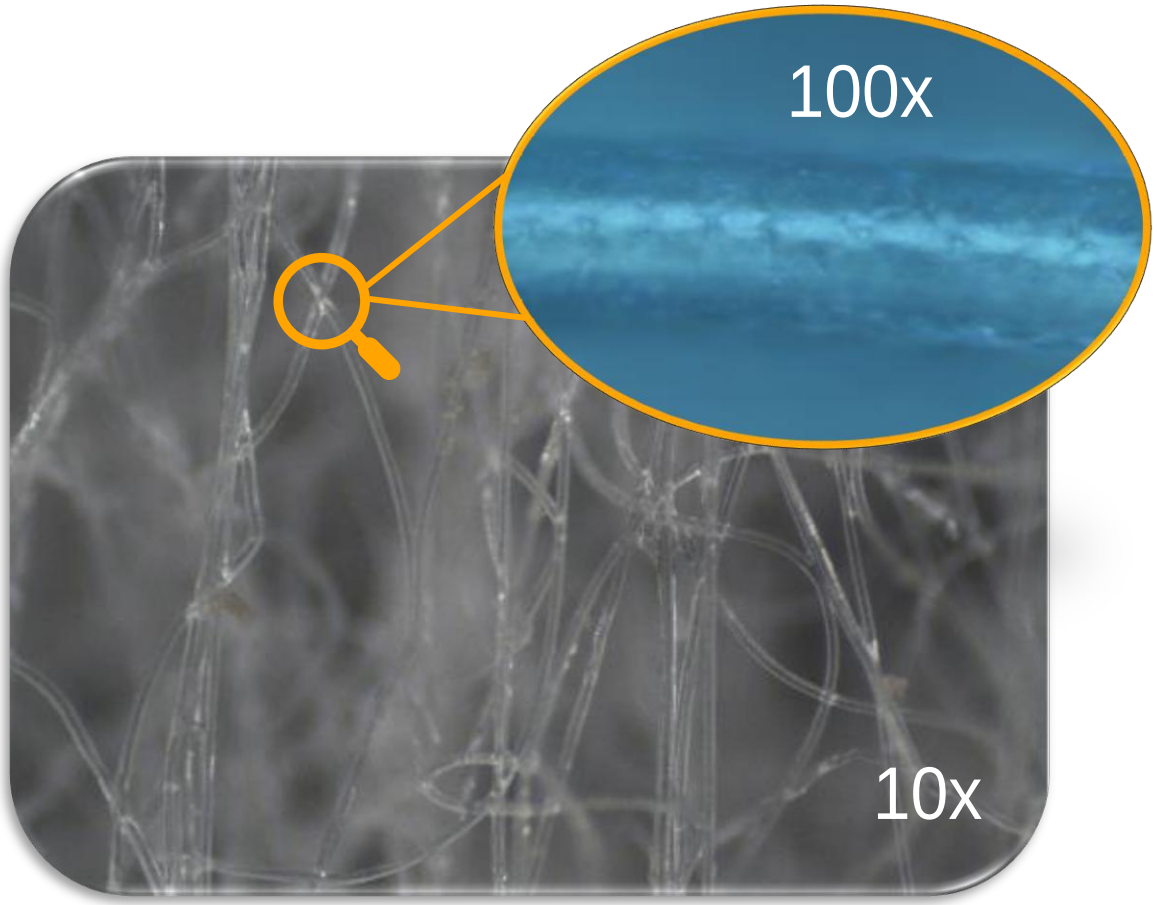
FLEXIBLE AND DURABLE ANTIMICROBIAL COATING (PET FIBERS)

- End Use: Filtration Media
- Substrate Properties: Porous PET Nonwovens
- Test Methods: ISO 22196, AATCC TM 100, ASTM E-2180, ASTM G21, AATCC 30 pt. III, Bromo-phenyl Blue Staining Test

COATING ADHESION



UNCOATED FILTER



COATED FILTER

ROBUST ANTIMICROBIAL PERFORMANCE

Protocol: ISO 22196		*Ec*			*Sa*		
Sample #	Sample Description	Viable Organisms		Log Reduction	Viable Organisms		Log Reduction
	Inoculum [TEMPO (Ec-1:500 JNB, Sa-1:250 JNB)]	170000			260000		
04	Untreated Filter; replicate 1	> 4900000		0.0	12000		2.0
05	Untreated Filter; replicate 2	4900000		0.0	19000		1.8
06	Untreated Filter; replicate 3	> 4900000		0.0	30000		1.6
07	Microban Coating A; replicate 1	< 100		4.7	< 100		4.4
08	Microban Coating A; replicate 2	< 100		4.7	< 100		4.4
09	Microban Coating A; replicate 3	< 100		4.7	< 100		4.4
01	C_PP PGCs; replicate 1	> 4900000			2100000		
02	C_PP PGCs; replicate 2	> 4900000			> 4900000		
03	C_PP PGCs; replicate 3	> 4900000			2100000		
	Mean of Untreated Controls for Reduction Calculation	4900000			2785340		

ROBUST ANTIMICROBIAL PERFORMANCE (CONT'D)

Protocol: AATCC Test Method 100		*Ec*		*Sa*	
Sample #	Sample Description	Viable Organisms	Log Reduction	Viable Organisms	Log Reduction
	Inoculum [TEMPO (5% NB) 2019 method. Samples autoclaved prior to testing. Letheen neutralizer.]	220000		170000	
04	untreated nonwoven; replicate 1	> 4900000	0.0	3000000	0.4
05	untreated nonwoven; replicate 2	> 4900000		910000	
06	untreated nonwoven; replicate 3	> 4900000		2500000	
07	Microban Coating A; replicate 1	2000	2.7	< 100	4.7
08	Microban Coating A; replicate 2	< 100		< 100	
09	Microban Coating A; replicate 3	> 4900000		< 100	
01	lab cotton controls; replicate 1	> 4900000		> 4900000	
02	lab cotton controls; replicate 2	> 4900000		> 4900000	
03	lab cotton controls; replicate 3	> 4900000		> 4900000	
	Mean of Untreated Controls for Reduction Calculation	4900000		4900000	

ROBUST ANTIMICROBIAL PERFORMANCE (CONT'D)

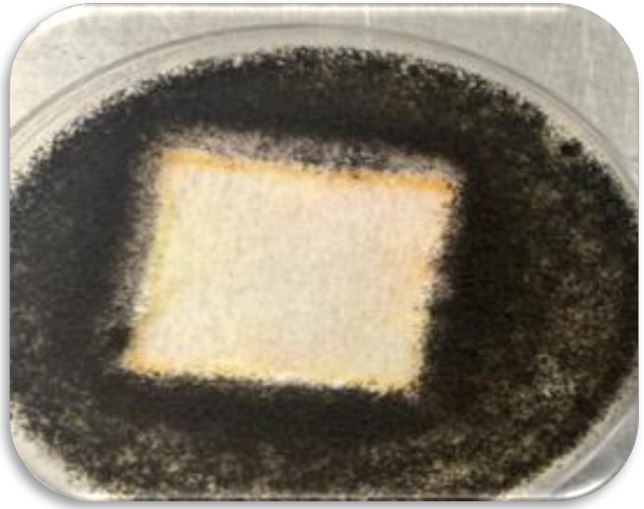
Protocol: ASTM E-2180		*An*		*Ec*		*Sa*		*G21*	
Sample #	Sample Description	Viable Organisms	Log Reduction	Viable Organisms	Log Reduction	Viable Organisms	Log Reduction	Rep 1	Rep 2
	Inoculum [Plate Count (An Agar Slurry) 96 hour contact.]	700000		230000		680000			
04	Filter untreated; replicate 1	370000	0.3	> 4900000	0.0	130000	-2.0	2	2
05	Filter untreated; replicate 2	30000	1.4	> 4900000	0.0	11000	-0.9		
06	Filter untreated; replicate 3	730000	0.1	> 4900000	0.0	1900	-0.2		
07	Microban Coating A; replicate 1	2700	2.5	< 100	4.7	< 100	3.6	0	0
08	Microban Coating A; replicate 2	600	3.1	< 100	4.7	< 100	3.6		
09	Microban Coating A; replicate 3	700	3.1	< 100	4.7	< 100	3.6		
01	C_PP PGCs; replicate 1	790000		> 4900000		200			
02	C_PP PGCs; replicate 2	960000		> 4900000		1000			
03	C_PP PGCs; replicate 3	740000		> 4900000		12000			
	Mean of Untreated Controls for Reduction Calculation	824853		4900000		1339			

FLEXIBLE AND DURABLE ANTIMICROBIAL COATING (PET FIBERS)

Sample description	Antibacterial		Antifungal
	Ec	Sa	ASTM G21
Microban Coating	>99%	>99%	Pass

Fungal Growth: AATCC TM30 (pt.III)

Untreated Filter



Filter with Anti-microbial Coating

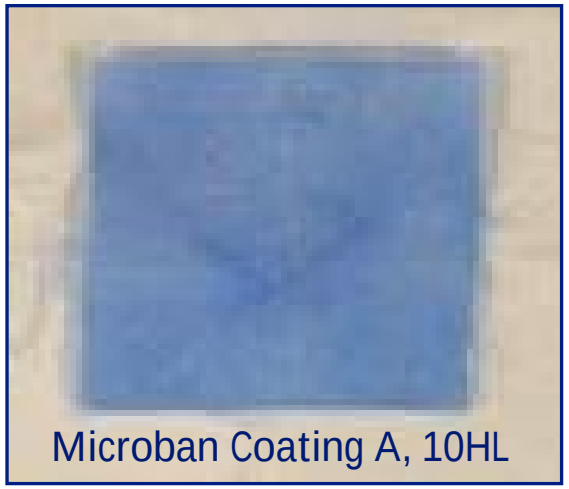
FLEXIBLE AND DURABLE ANTIMICROBIAL COATING (PET FIBERS)

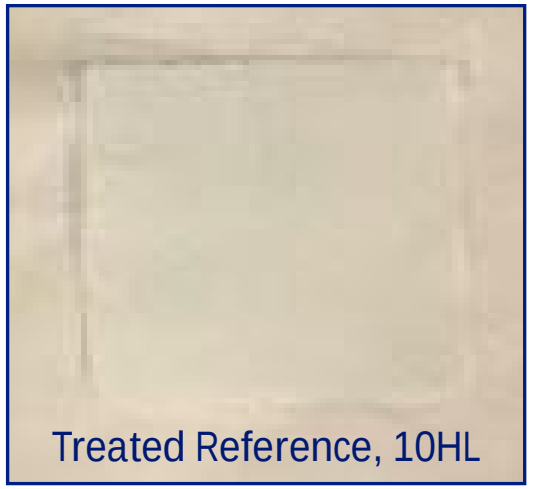
Home Laundering Durability

Sample description	10 HL LP1 Frontload ASTM E2149	
	Ec	Sa
Wash Durable Microban Coating	>99.8%	>97.7%

BPB Testing after Washing with Anionic Detergent


Microban Coating A, 0HL


Microban Coating A, 10HL


Treated Reference, 10HL

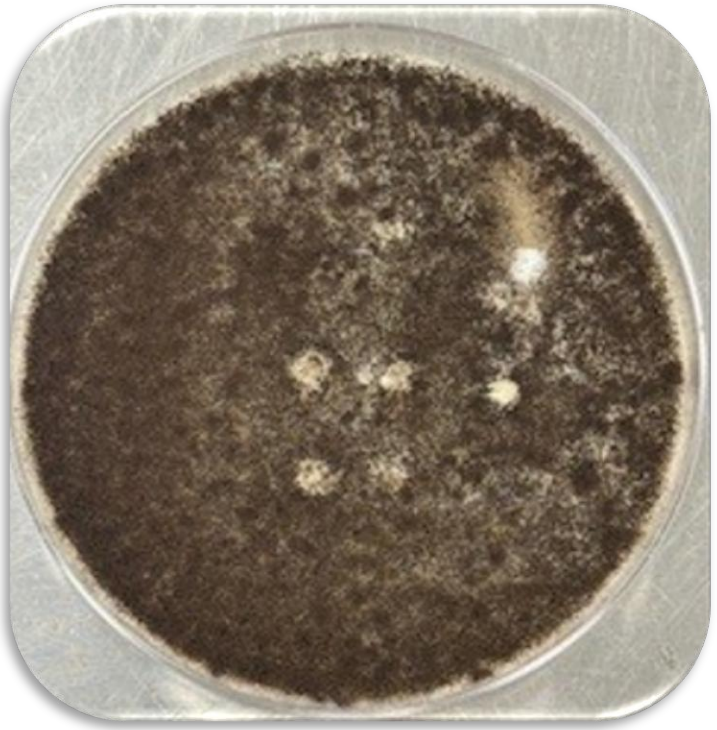
FLEXIBLE AND DURABLE ANTIMICROBIAL COATING- POLYPROPYLENE FIBERS

- End Use: Filtration Media
- Substrate Properties: Porous Polypropylene Nonwovens
- Test Methods: AATCC 30 pt. III

FLEXIBLE AND DURABLE ANTIMICROBIAL COATING- POLYPROPYLENE FIBERS

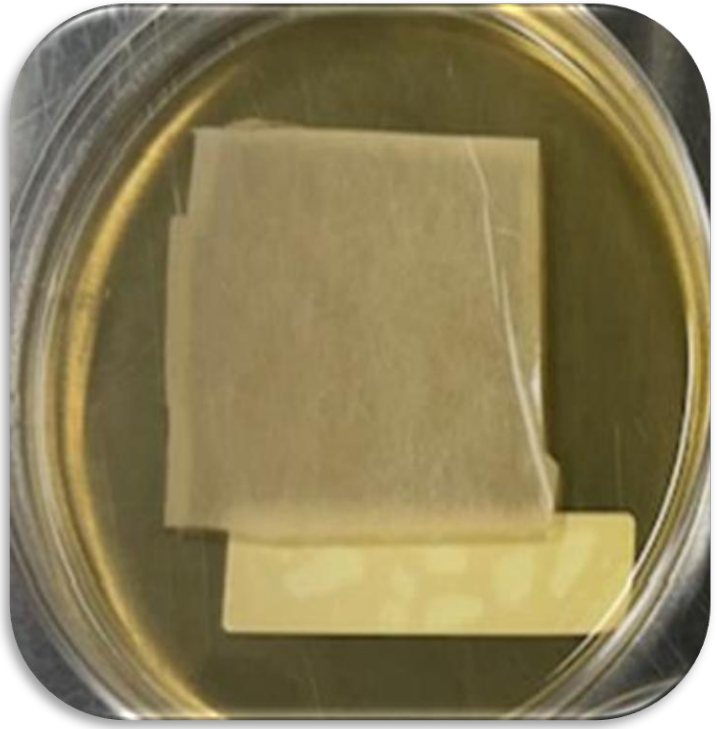
Fungal Growth: TM30 (pt.III)

Uncoated PP



Microban Coating A on PP

Microban Coating B on PP



Microban Coating B protects polypropylene better than Microban Coating A

EXTERIOR MULITFUNCTIONAL COATINGS

- Many surfaces are covered with protective coatings
- Exterior coatings require strong durability against factors such as temperature, rain, and UV exposure

PFAS FREE DURABLE FUNGAL AND ALGAE RESISTANT COATINGS

- End Use: Exterior Building Materials
- Substrate Properties: Flat, flexible, PVC, roofing membranes
- Test Methods: UV Stability, Block Resistance, Dirt Pick Up, AATCC TM 30 pt III, Internally developed algae growth methods

PFAS FREE DURABLE FUNGAL AND ALGAE RESISTANT COATINGS

OUTDOOR WEATHERING

GENERAL PURPOSE OUTDOOR ACRYLICS

Average Gloss Retention after 1398hrs

Formulation	Avg. Gloss Retention (%)
Microban Coating	92.17
Commercial Acrylic A	88.46
Commercial Acrylic B	77.57
Commercial Acrylic C	38.15

COMMERCIAL ROOF COATINGS

Average Gloss Retention after 1367hrs

Formulation	Avg. Gloss Retention (%)
Microban Coating	91.12
Acrylic Roof Coating	11.88

FLUORO-RESINS

Average Gloss Retention after 1000hrs

Formulation	Avg. Gloss Retention (%)
Microban Coating	102.94
Fluoro-resin Coating	83.74

Exterior coating shows superior gloss retention compared to various acrylics and even fluoro-resins

PFAS FREE DURABLE FUNGAL AND ALGAE RESISTANT COATINGS

Block Resistance

Block Resistance	Commercial PVDF control	Microban Coating
Block resistance (room temperature)		
0.5 kg weight	-	++
Block resistance (60 degrees C for 1 hour)		
0.5 kg weight	-	++

Testing performance summary

- Samples were folded and clipped at the ends allowing the coating to come into contact with itself
- 500 g weight was added to the sample to the weight of finished material
- Weight and clip were released after 24 hours to see if the fabric would release or continue to stick
- PVDF control remained stuck to itself after 24 hours; had to manually remove
- Coating formulation was able to release once weight was removed and clip was removed showing no tackiness

PFAS FREE DURABLE FUNGAL AND ALGAE RESISTANT COATINGS

Red Iron Oxide

DIRT PICK UP

1000hr QUV

Water Rinse

Dirt Resistant Coating

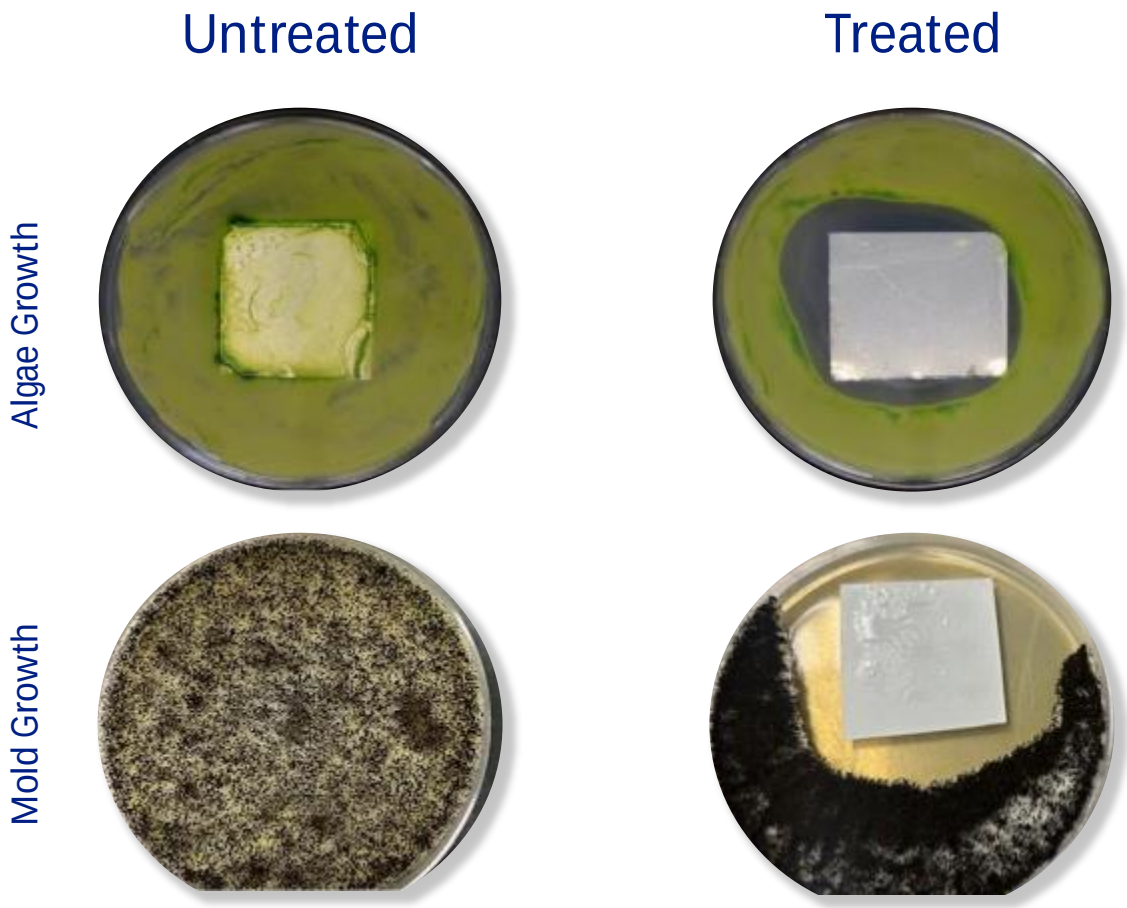
Dirt Build-up is easily rinsed

Commercial Control

Dirt Build-up remains

PFAS FREE DURABLE FUNGAL AND ALGAE RESISTANT COATINGS

Exterior coating designed to protect substrates from mold/fungi and algae growth



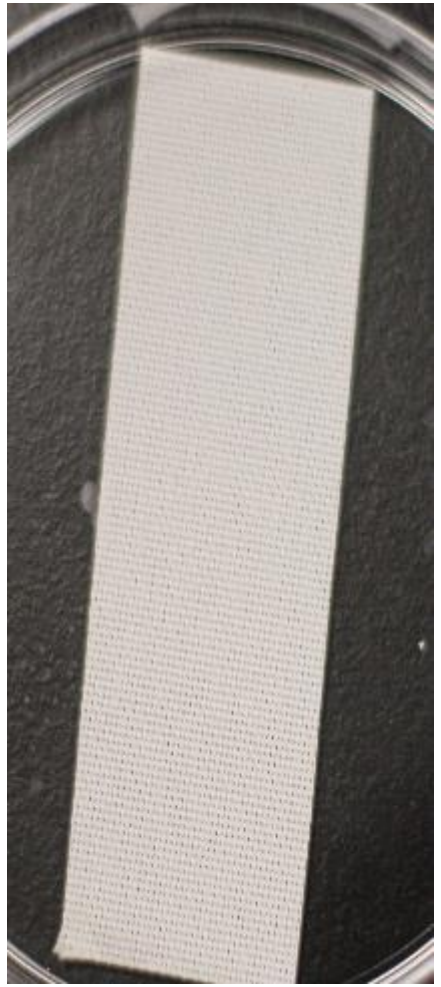
PFAS FREE DURABLE FUNGAL AND ALGAE RESISTANT COATINGS

Tier 2 Algae growth studies are designed to mimic real conditions

Algae Growth

Untreated

Treated



MISCELLANEOUS FUNCTIONALITES

REGULATORY PRESSURES

PFAS-Free

Heavy-Metal Free

Low-VOCs

Bio-Based

TEST METHODS

Abrasion

Hardness

Tensile

Contact Angle

Odor Control

Anti-microbial

CONCLUSION

Multifunctional coatings need to be multifaceted and perform in ways that resonate with end users

THANK YOU FOR YOUR ATTENTION

QUESTIONS ARE WELCOME