Coatings Trends & Technologies SUMMIT

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The Westin Chicago Lombard
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Innovative Solutions: Replacing PFAS in Coatings for a Sustainable Future

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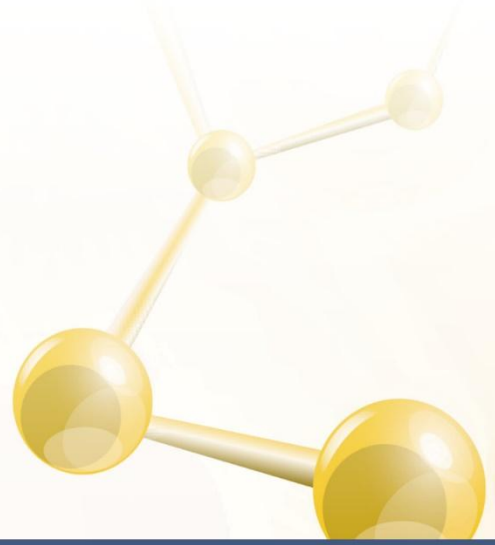

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What are PFAS?

New OECD Definition as of 2018: "PFAS are defined as fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), i.e., with a few noted exceptions, any chemical with at least a perfluorinated methyl group (–CF3) or a perfluorinated methylene group (–CF2–) is a PFAS."

US EPA working definition for PFAS is "substances that structurally contain the unit R-(CF2)-C(F)(R′)R″. Both the CF2 and CF moieties are saturated carbons and none of the R groups (R, R′ or R″) can be hydrogen." (i.e., chemicals with at least two adjacent carbon atoms, where one carbon is fully fluorinated and the other is at least partially fluorinated.)

What makes PFAS so unique?

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Can have some or all of the following properties:

» Repel oil, water, and other liquids

» Temperature resistance

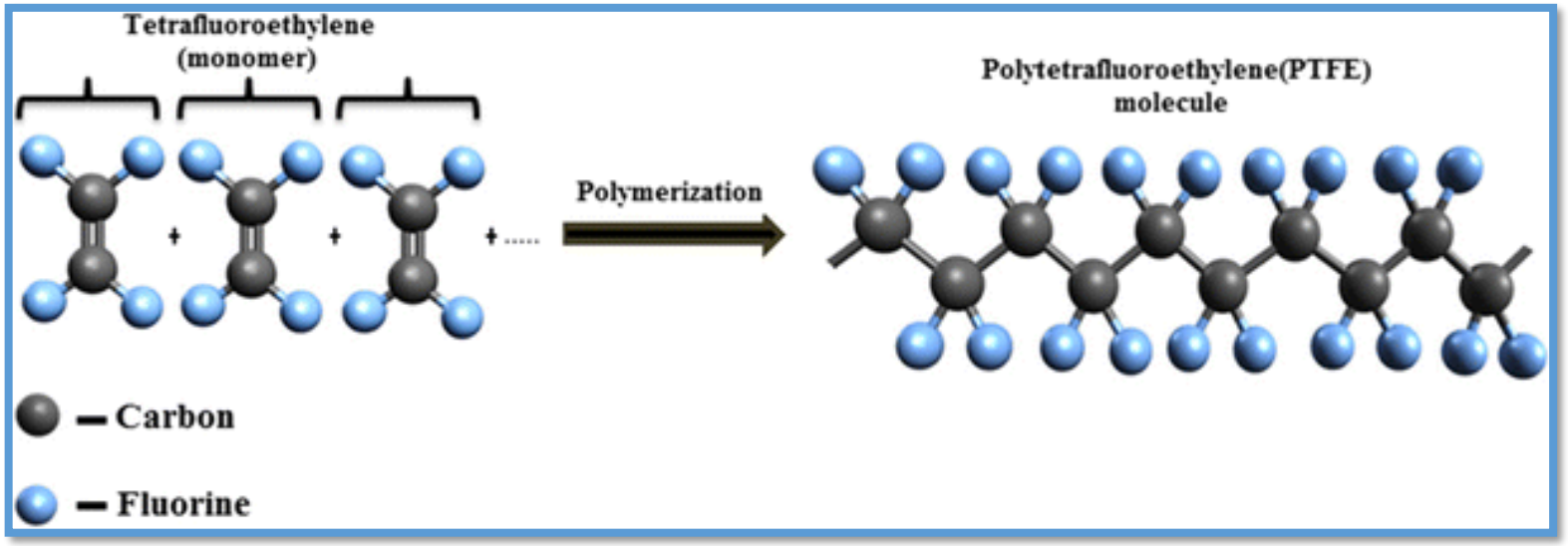
» Friction reduction

» Stability and durability

Where can you find PFAS?

What PFAS Are Used in Coatings?

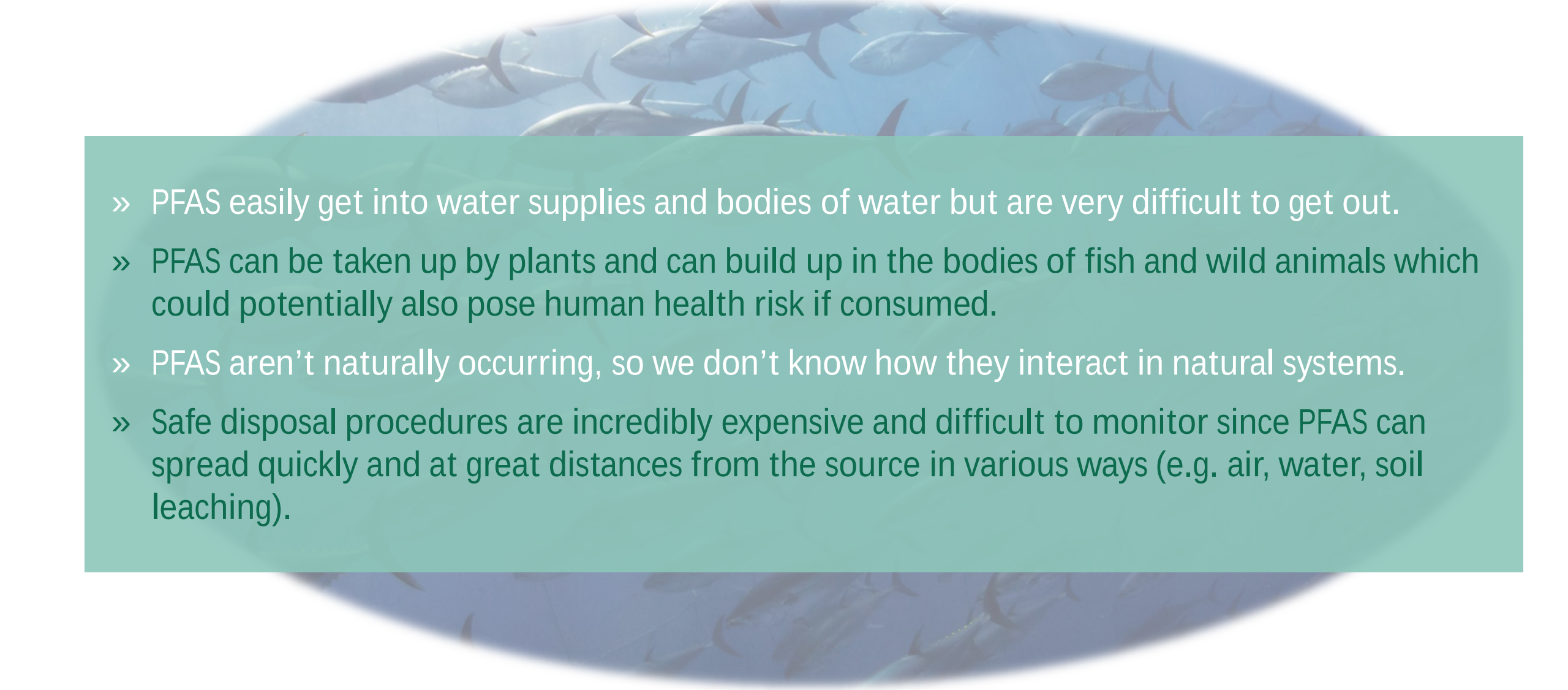
- PTFE-containing waxes
- Fluorosurfactants



PFAS – Potential Health Risks

- PTFE-containing waxes
- Increased cholesterol levels
- Decreased vaccine response in children
- Changes in liver enzymes
- Increased risk of high blood pressure or pre-eclampsia in pregnant women
- Small decreases in infant birth weights
- Increased risk of kidney or testicular cancer
- PFAS have been found in human blood in studies worldwide.

PFAS – Potential Risks to the Environment



- PFAS easily get into water supplies and bodies of water but are very difficult to get out.
- PFAS can be taken up by plants and can build up in the bodies of fish and wild animals which could potentially also pose human health risk if consumed.
- PFAS aren't naturally occurring, so we don't know how they interact in natural systems.
- Safe disposal procedures are incredibly expensive and difficult to monitor since PFAS can spread quickly and at great distances from the source in various ways (e.g. air, water, soil leaching).

Snapshot of PFAS Regulations

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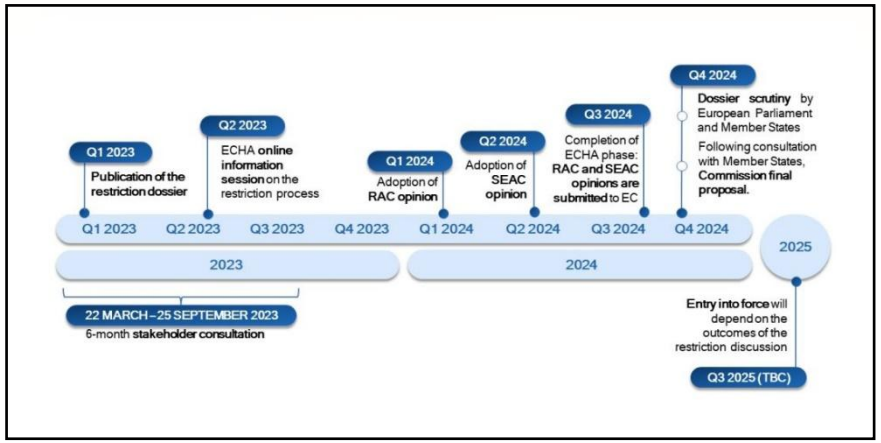
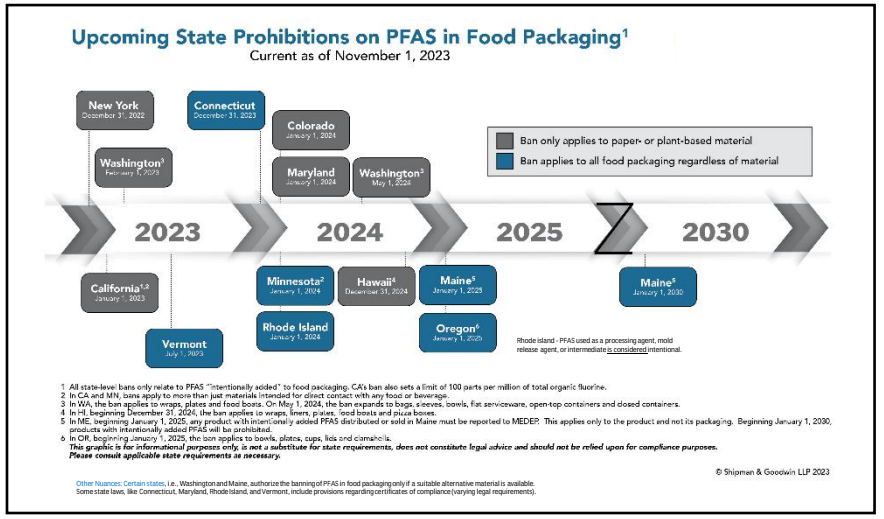
A Moving Target!

- The DEFINITION of PFAS differs between the EU and the US…
- PFAS RESTRICTIONS differ between the EU and the US…
- Even within the US, restrictions differ from state to state…

EU REACH Restrictions Potential Timeline

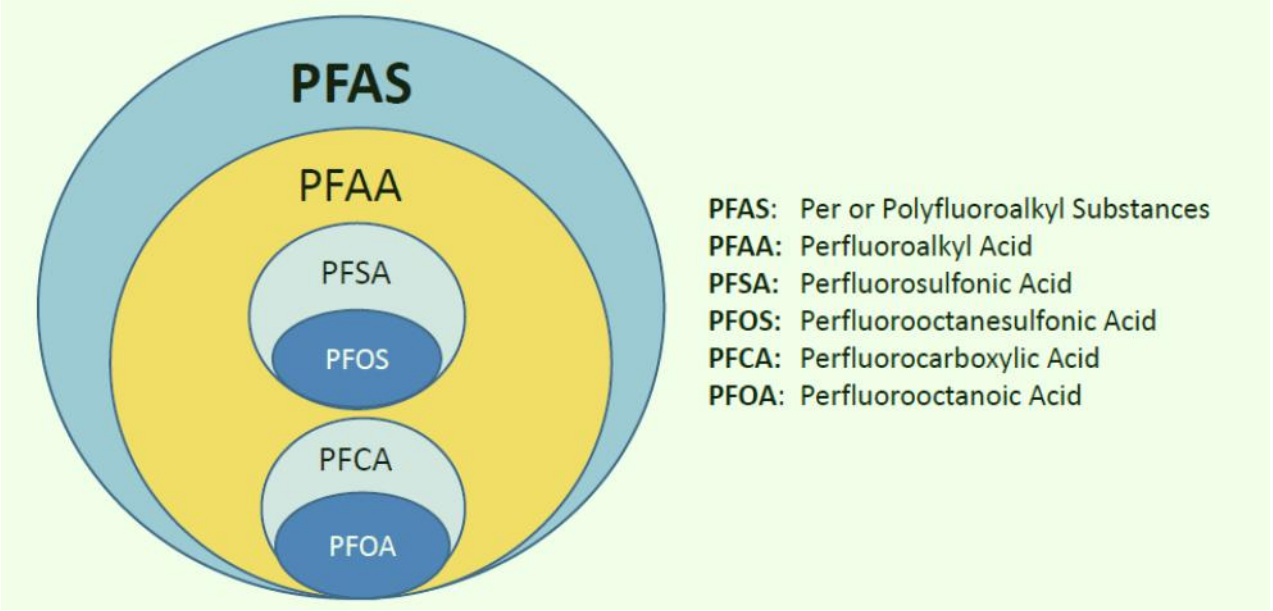


US State PFAS Food Packaging Prohibitions Timeline



Snapshot of PFAS Regulations

...In the end, the expectation is that ALL PFAS will be banned/restricted for use in coatings, with few exceptions.



Sustainability Principles

- Minimal negative effects to health and living organisms
  - Non toxic
  - Biocide-free
  - Low SVOCs
- Minimal contribution to the production of greenhouse gases
  - Low to no VOCs
- Avoidance of non-biodegradable organic materials that persist in the environment
- Selection of materials preferentially made from renewable, bio-based carbon sources over fossil-derived sources

Replacing PFAS for Sustainability

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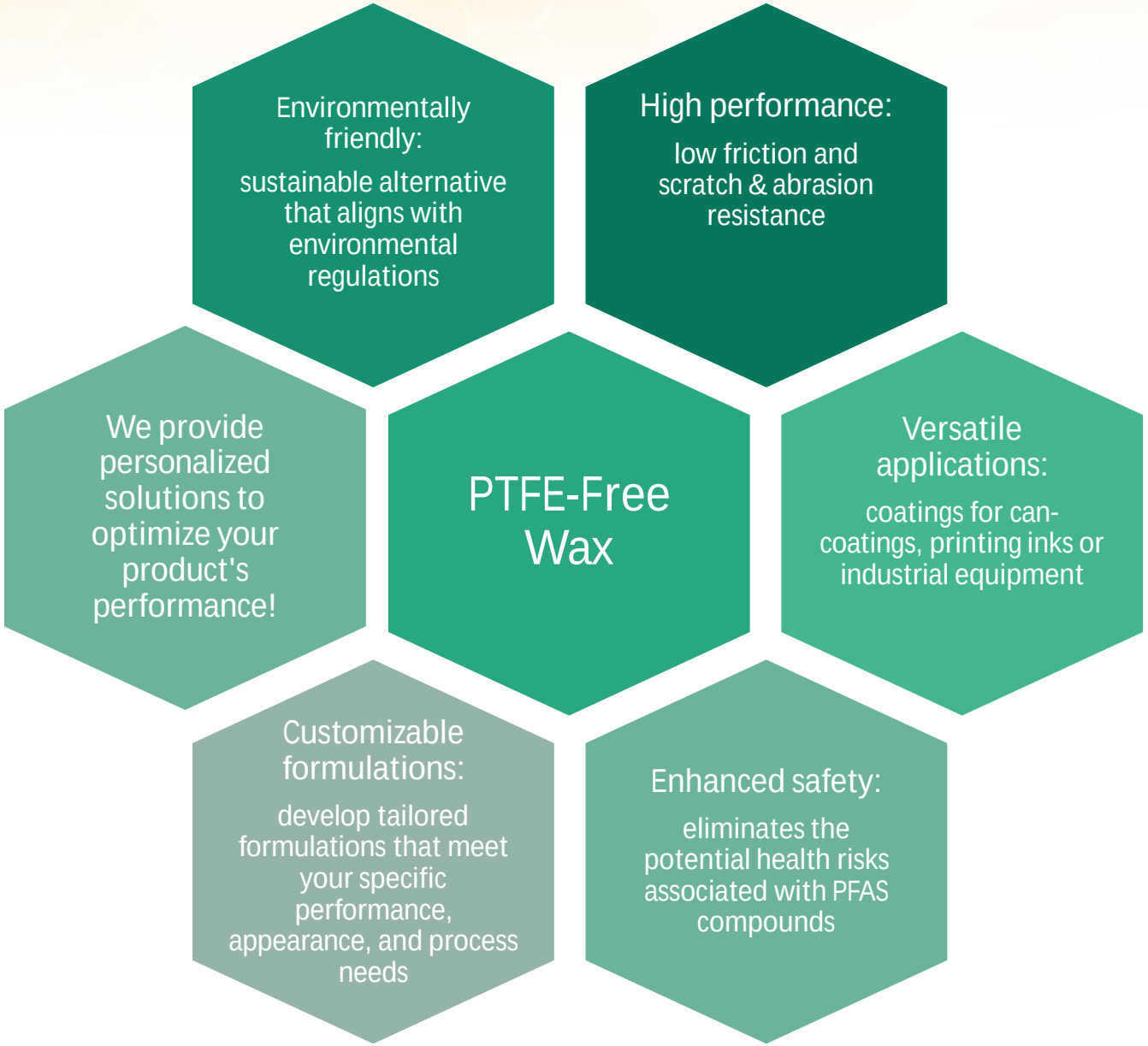
Identifying PFAS replacements and creating new PFAS-free coatings reduces risks to health and the environment while supporting sustainability initiatives

02 | PTFE-Free Waxes

PTFE-Free Wax Additive Solutions



Discover the future of coatings & inks with our groundbreaking PTFE-free wax additive range:

As a leading expert in wax additives, we understand the evolving needs of our customers and the growing concerns surrounding PFAS compounds. In response to these challenges, we have developed advanced polymer blends that eliminate the need for PTFE while maintaining exceptional performance.

PTFE-Containing and PTFE-Free Waxes

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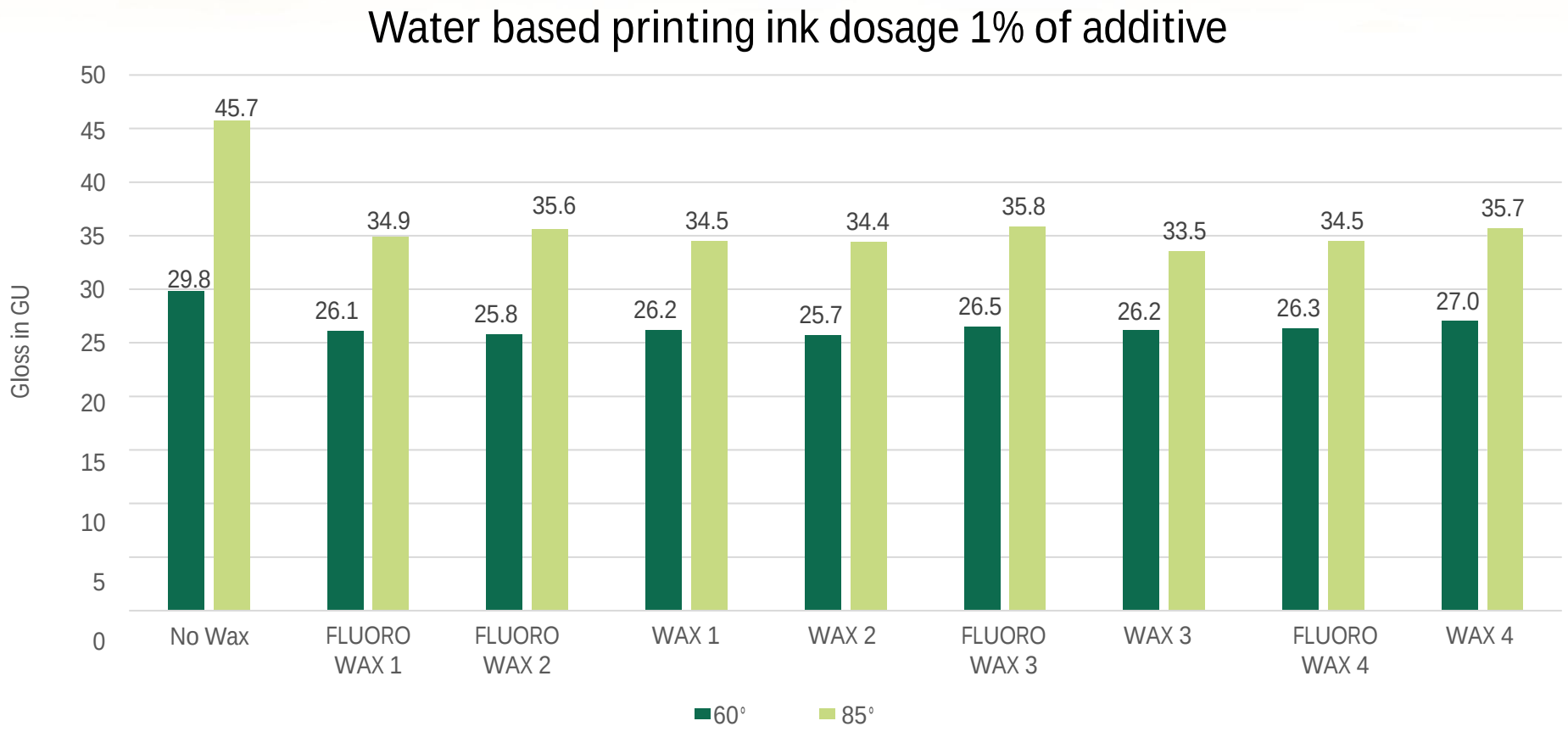
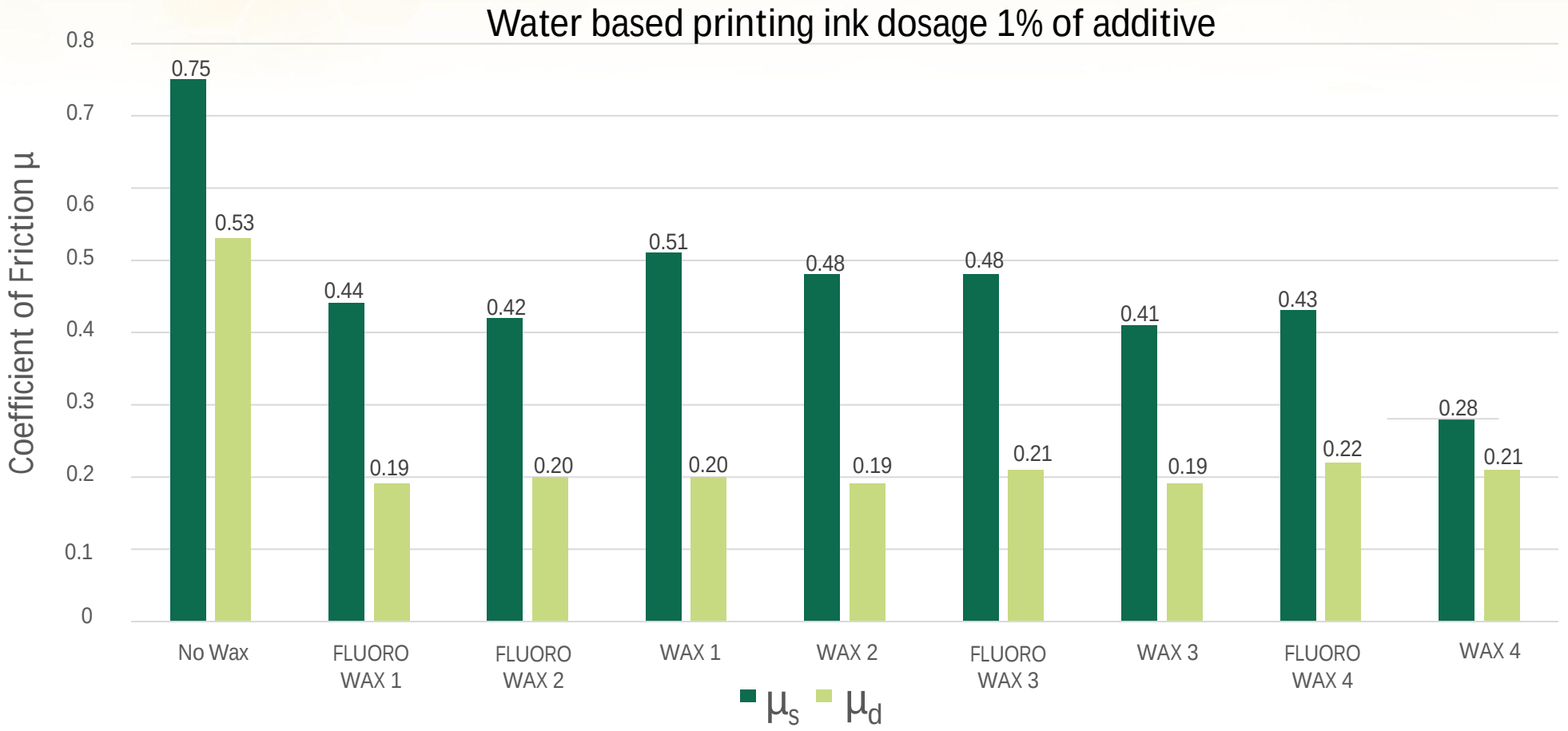
Product name	Chemistry	Average particle size d50	Maximum particle size d99	PTFE containing
FLUORO WAX 1	Polyolefin + PTFE	4 µm	10 µm	Yes
WAX 1	Polyolefin	4 µm	10 µm	No
FLUORO WAX 2	Polyolefin + PTFE	4 µm	10 µm	Yes
WAX 2	Polyolefin	4 µm	10 µm	No
FLUORO WAX 3	Polyolefin + PTFE	6 µm	15 µm	Yes
WAX 3	Polyolefin	6 µm	15 µm	No
FLUORO WAX 4	Polyolefin + PTFE	7 µm	20 µm	Yes
WAX 4	Polyolefin	6 µm	20 µm	No

Gloss in Water-Based Printing Ink



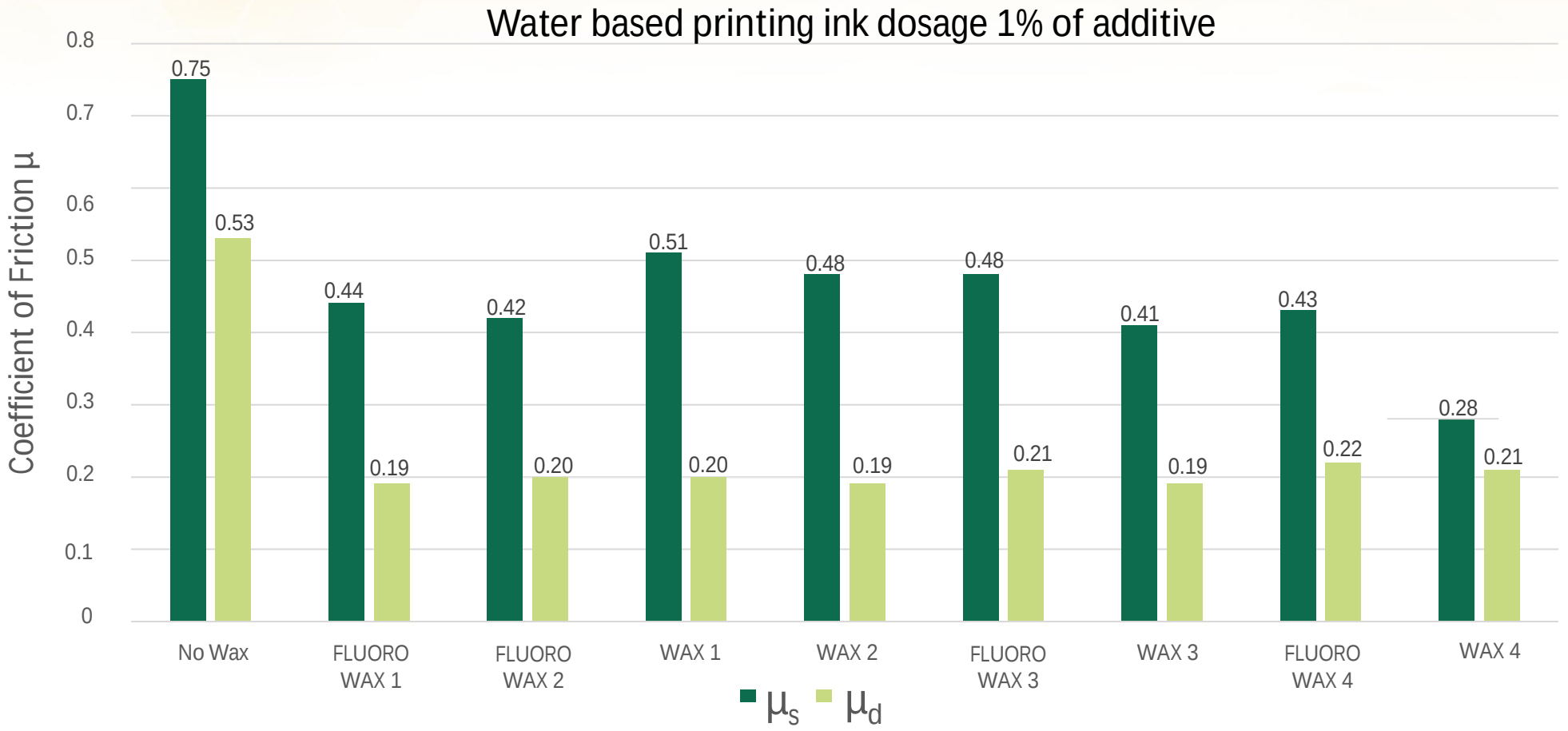
As shown in the graph above all tested wax products have a matting effect on the water based printing ink. Between the tested wax additives containing PTFE and those without there is no significant difference in gloss.

Coefficient of Friction in Water-Based Printing Ink



All tested wax products show a strong improvement of the coefficient of friction.
The wax additives without PTFE lead to similar results as the products without PTFE-addition.

Coefficient of Friction in Water-Based Printing Ink



All tested wax products show a strong improvement of the coefficient of friction.
The wax additives without PTFE lead to similar results as the products without PTFE-addition.

Rub Resistance in Water-Based Printing Ink

No Wax

1 % FLUORO WAX 1

1 % FLUORO WAX 2

1 % WAX 1

1 % WAX 2

Rub Testing Device, 200 cycles – weight load 600 g

Rub Resistance in Water-Based Printing Ink

1% FLUORO WAX 3

1% WAX 3

1% FLUORO WAX 4

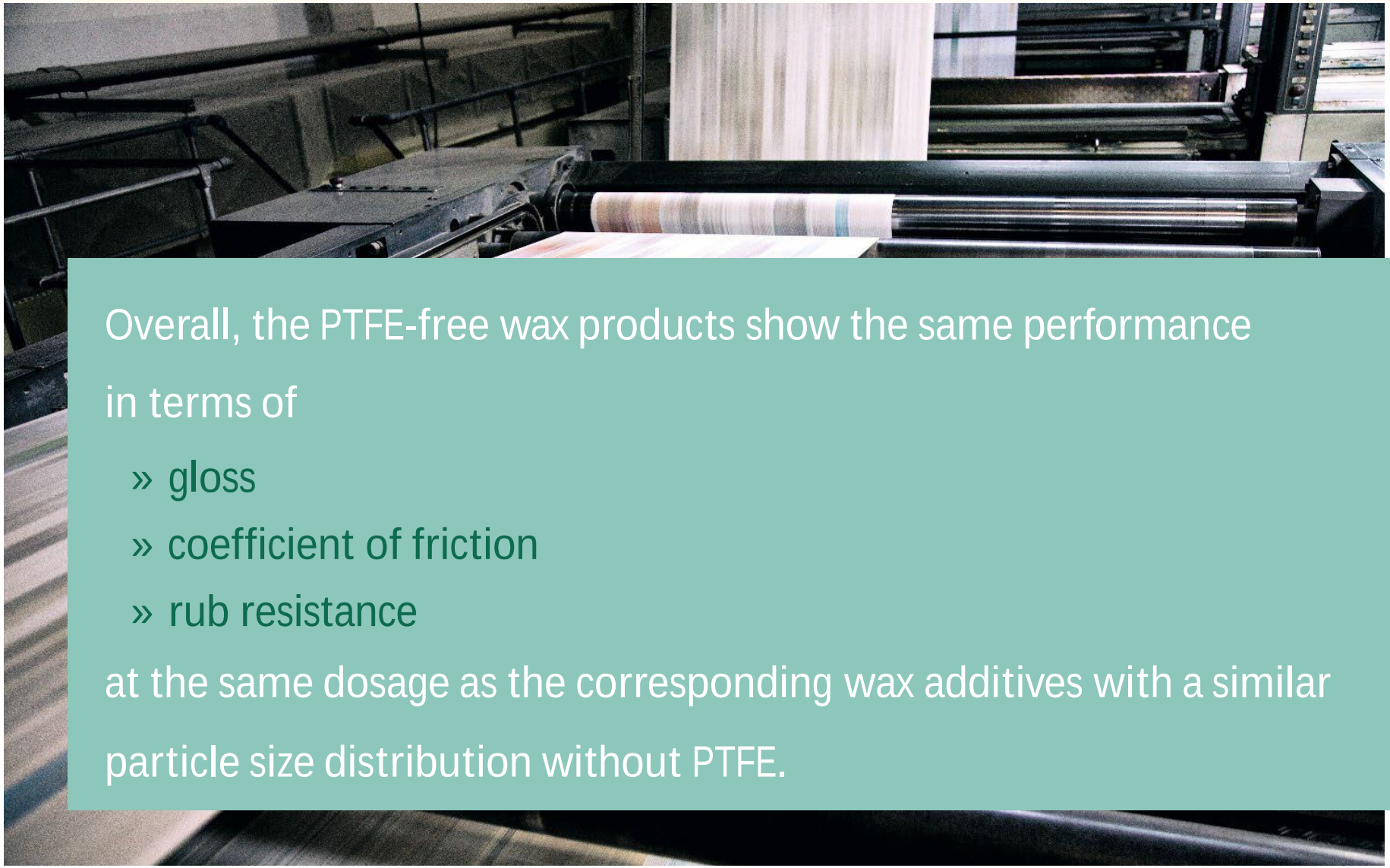
1% WAX 4

All tested wax products show a strong improvement on the rub resistance of the water-based printing ink.

The PTFE-free wax additives and those containing PTFE result in similar rub resistance.

Rub Testing Device, 200 cycles – weight load 600 g

PTFE-Free Wax Summary



Overall, the PTFE-free wax products show the same performance in terms of

- gloss
- coefficient of friction
- rub resistance

at the same dosage as the corresponding wax additives with a similar particle size distribution without PTFE.

PTFE-Free Wax Summary

While PTFE-free wax products may have many similar properties to waxes containing PFAS, additional testing should be done to confirm performance in the end use application.

03 | PFAS-Free Surfactants

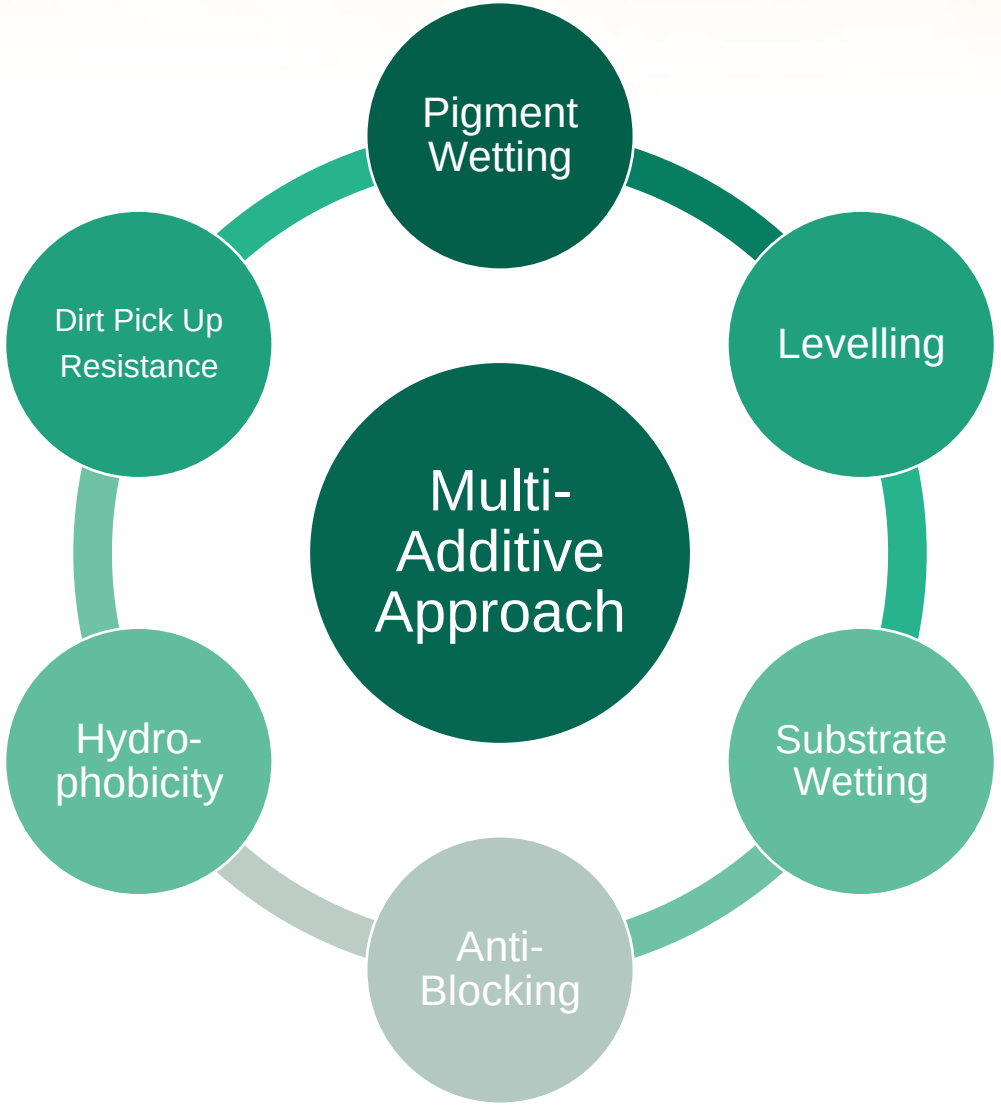
Why are Fluorosurfactants Used In Coatings?

- Lower surface tension allows coatings to wet, level, and spread more effectively.
- Improve dirt pick up and resistance to chemical, oils, and moisture
- They can simplify formulation by reducing the need for multiple additives (anti-block, wax, defoamer, etc.)
- Can use very little dosage
- Can be used in a wide range of coatings
  - Applications include architectural coatings for interior and exterior use, wood coatings, flooring, industrial coatings for metal and plastics, and inks

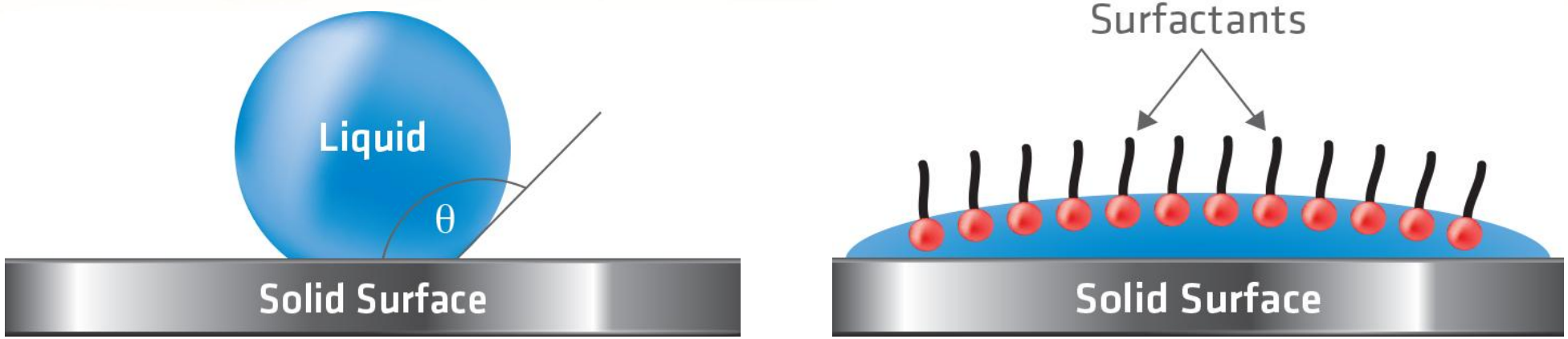
Multi-Additive Approach

PFAS-free additives are available that provide functions that perform similarly to fluorosurfactants.

- 1:1 direct replacement may not be possible.
- Products may be used in combination to achieve the desired properties.



Surfactants: Surface Tension Reducers



Coating Surface Tension < Substrate Surface Energy = Proper Wetting and Spreading

Fluorosurfactants are excellent at reducing the surface tension of coatings and can strongly improve wetting and levelling

Anti-Block Data

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Architectural Paint 1

Additive	Dosage	Wetting	Block Score 24 hours Ambient	Block Score 120 °F 24 hours
Blank	--	10	3	4
FLUOROSURFACTANT	*	10	10	9
Non-PFAS Additive (Surfactant)	0.50	10	10	9

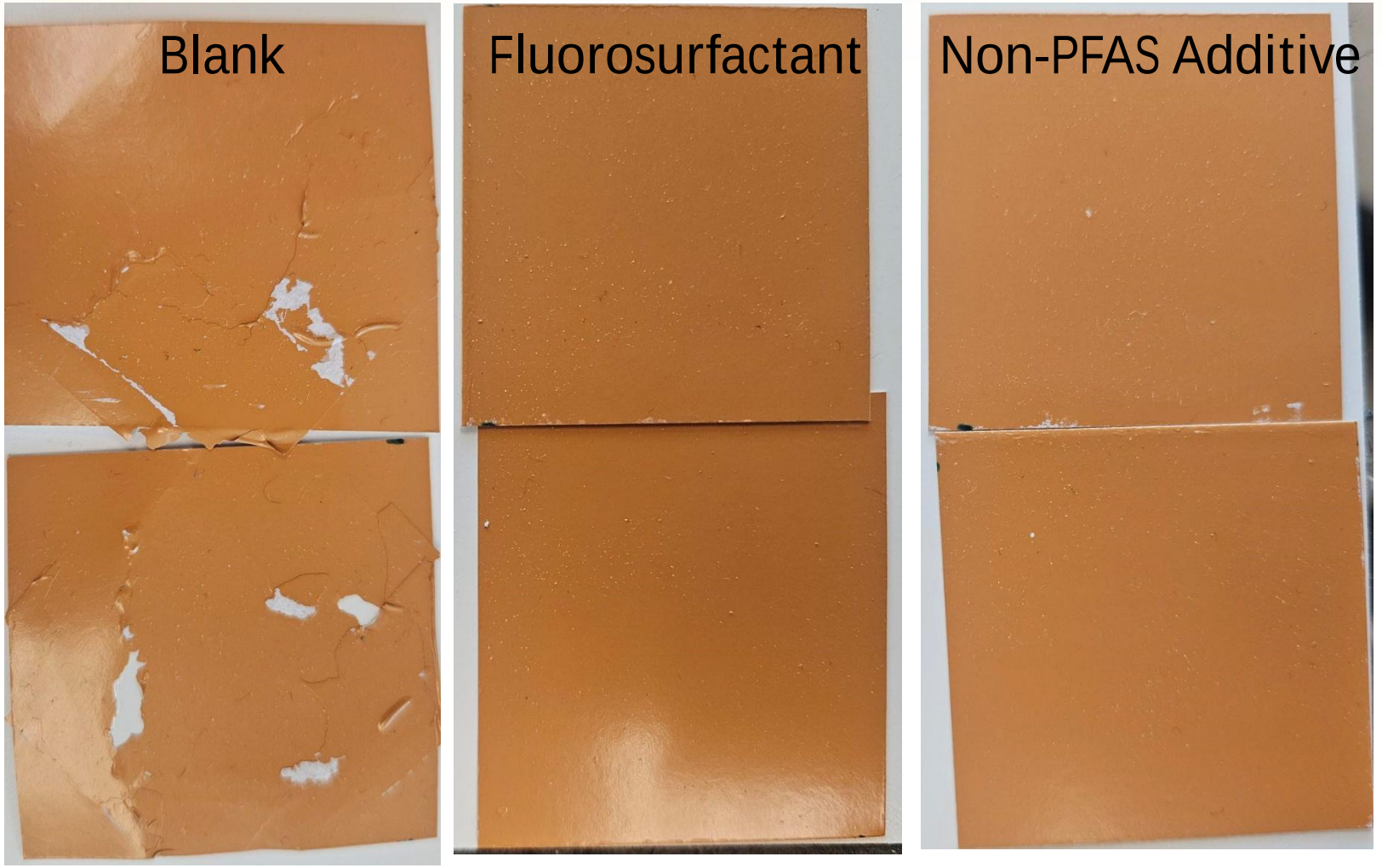
Architectural Paint 2

Additive	Dosage	Wetting	Block Score 24 hours Ambient	Block Score 120 °F 24 hours
Blank	--	10	3	4
FLUOROSURFACTANT	*	10	10	10
Non-PFAS Additive (Surfactant)	0.50	10	10	10

Wetting Rating: 1-10 (10 = no defects), Block Score: 1-10 (10 = complete release, no stick/tear)

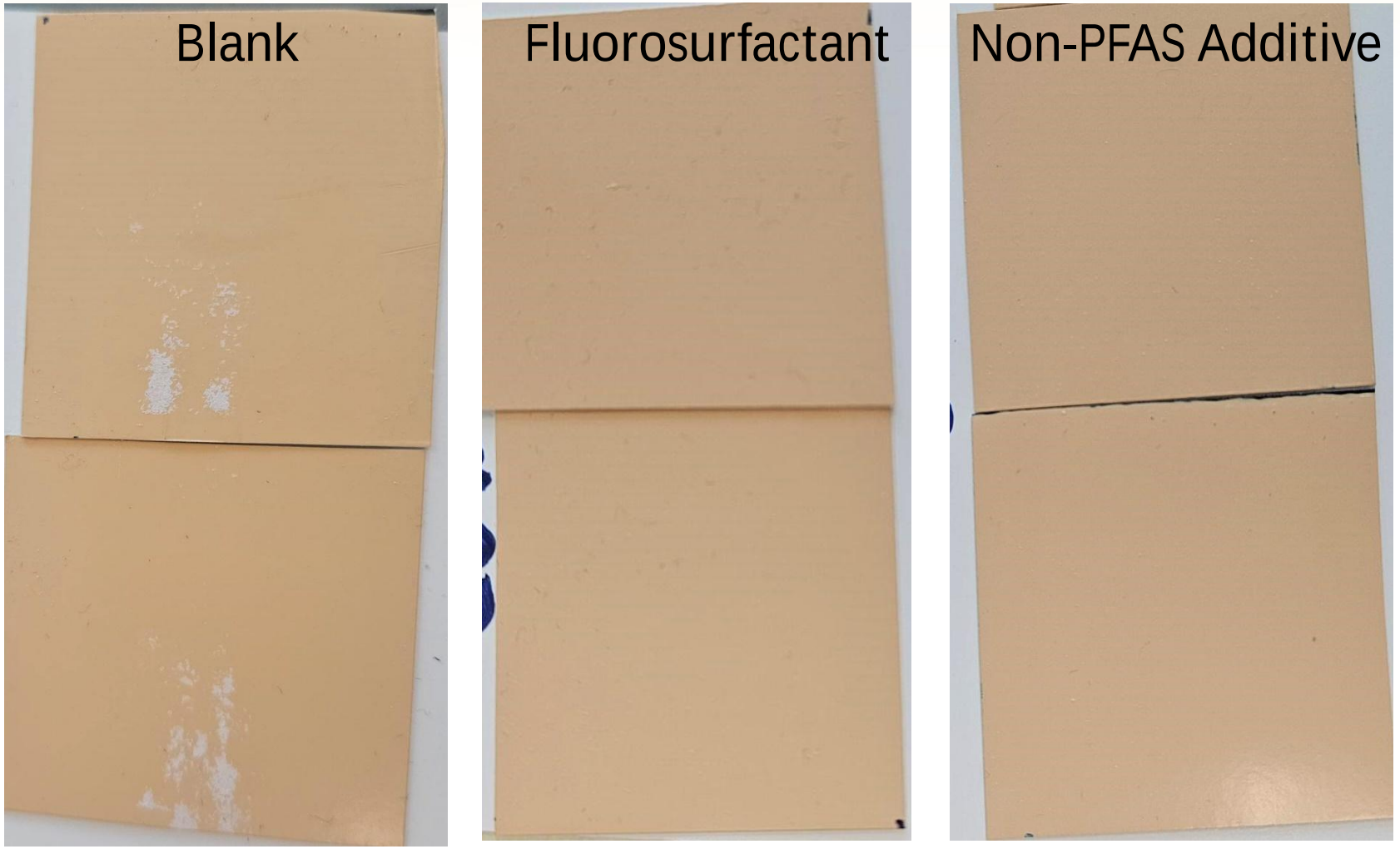
* The amount of fluorosurfactant was not disclosed by customer, but the typical additive dosage is <0.5%

Anti-Block Testing – Architectural Paint 1



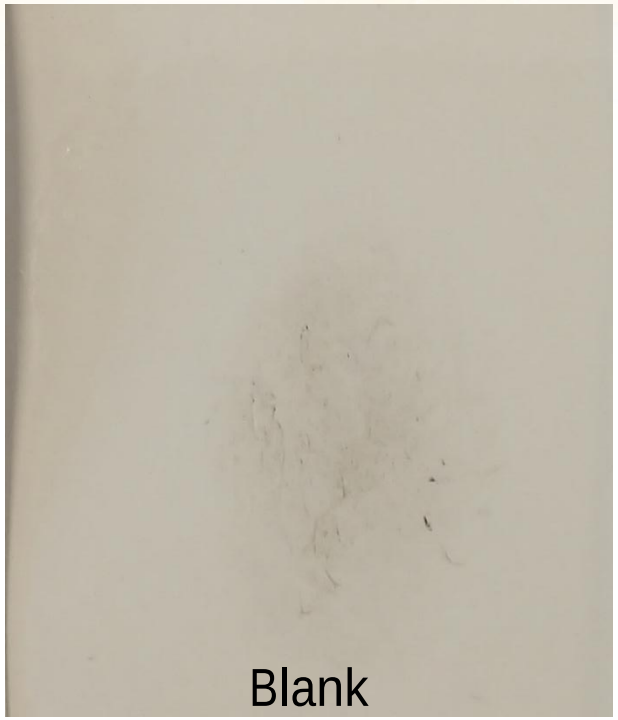
1000-gram weight on 1 inch x 1 inch square – 24 hours room temperature block

Anti-Block Testing – Architectural Paint 2

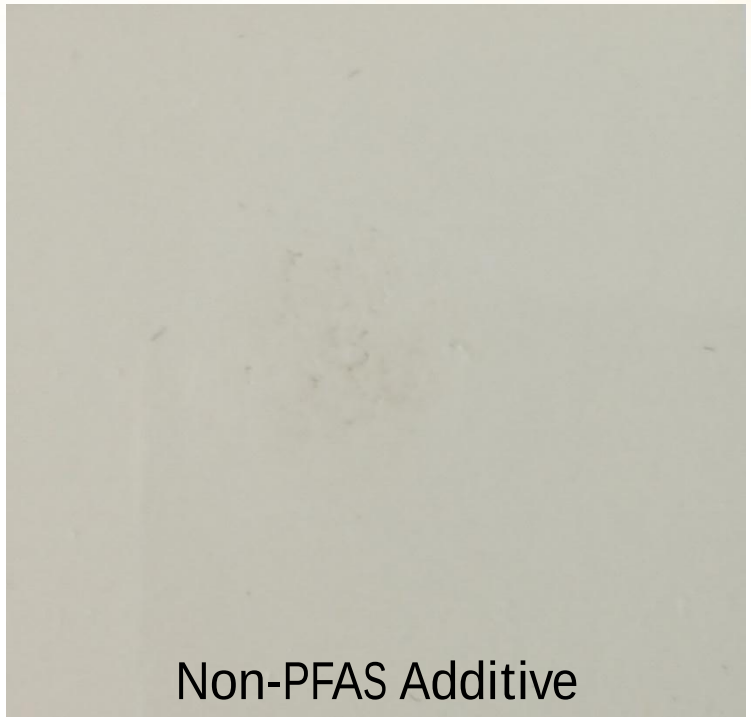


1000-gram weight on 1 inch x 1 inch square – 24 hours room temperature block

Dirt Pickup Testing – Water-Based Floor Coating


Blank


Fluorosurfactant


Non-PFAS Additive

Additive	Dosage	Dirt Knock Off	Dirt Wiped	Color Difference ΔE
Blank	--	5	6	2.74
Fluorosurfactant	0.03	8	8	1.89
Non-PFAS Additive (Wax Dispersion)	0.30	8.5	9	1.40

Dirt Knock Off/Wipe Rating: 1-10 (10 = no stain/residue)

04 | Conclusions

Conclusion

Additives containing PFAS have many unique properties that make it extremely difficult to replace in coatings, but with rapidly changing regulations and restrictions identifying or creating additives to replace them is necessary.

- 1:1 direct replacement may not be possible
- Products may be used in combination to achieve the desired properties
- Additional testing should be done to confirm performance in the end use application

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Thank you!

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