



Advances in Plasma Deposition of Functional Nanocoatings for Textile and Filtration Applications

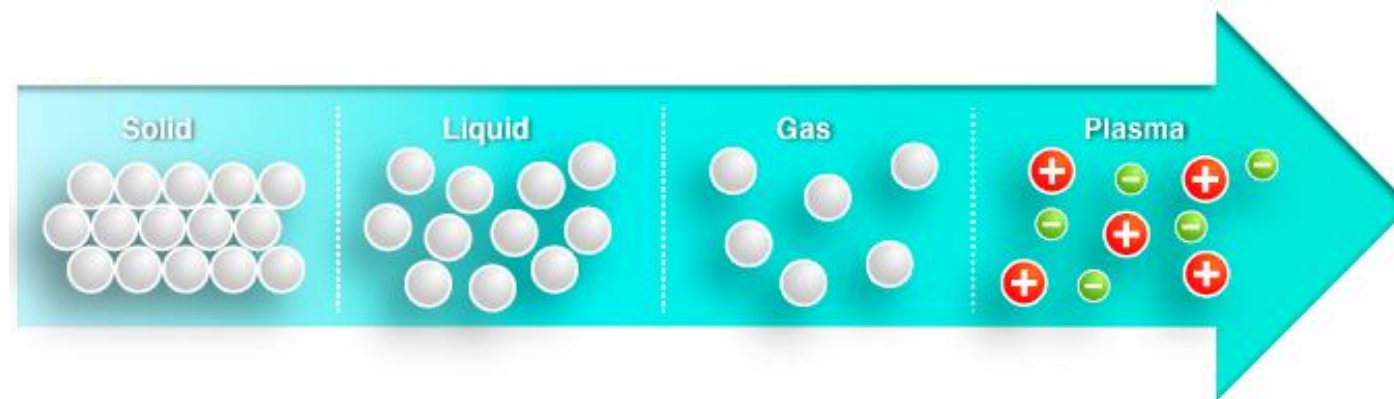




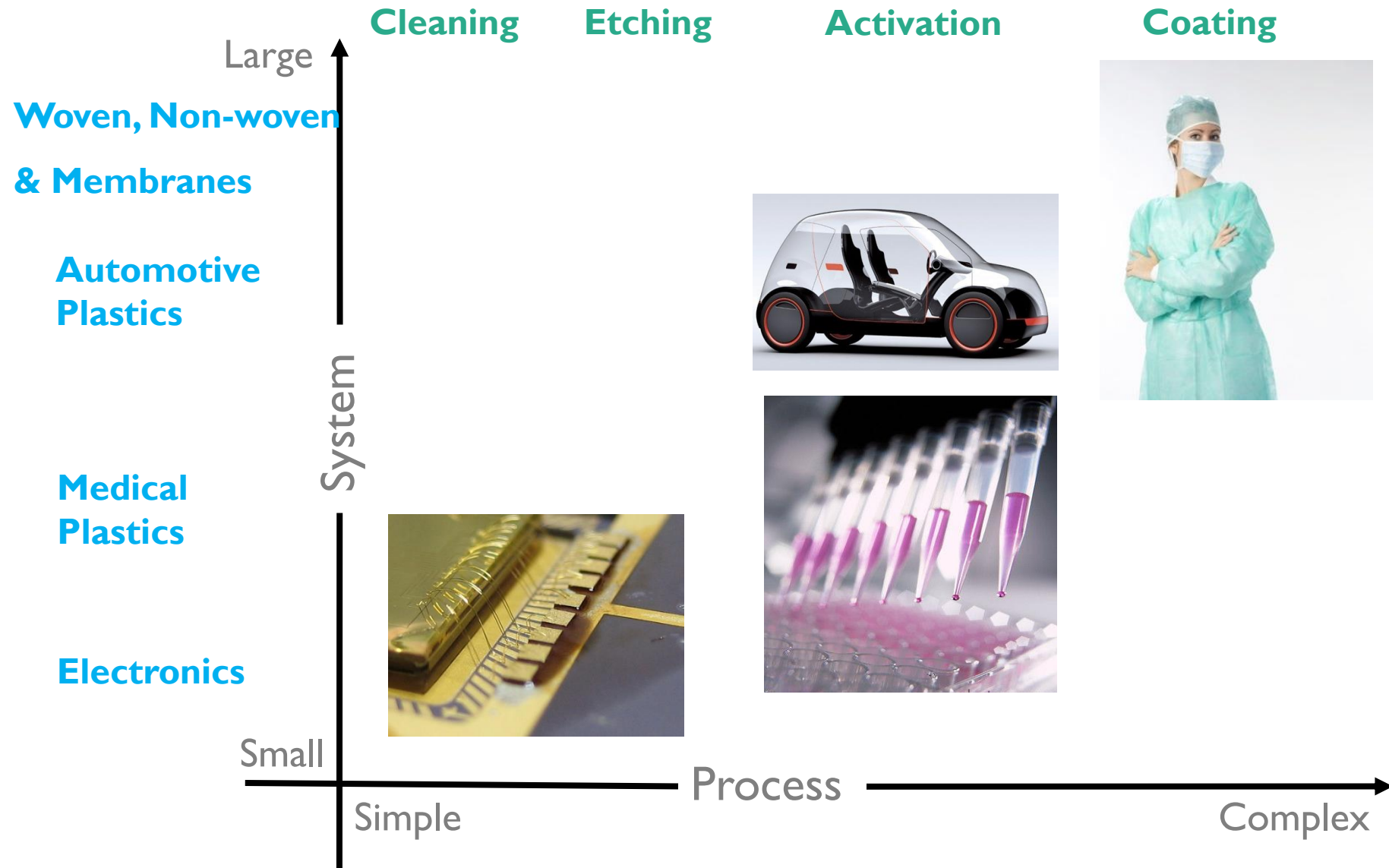
- Europlasma's mission is to supply innovative nanocoating solutions based on low pressure plasma technology
- Europlasma is helping its customers to achieve the highest performance with a production process that has the lowest environmental footprint
- Commercialized under the brand **Nanofics[®]**



Nanoscaled functionalisation into core of
complex shaped materials and products



- Plasma is generated by an electromagnetic discharge
- In a gas at low or atmospheric pressure (and low temperature)
- Reaction takes place on the substrate surface





- Reaction takes place at the surface of the substrate
- Permanent coating
- Invisible, permanent and durable
- The functionality of coating depends on precursor: hydrophilic, hydrophobic, oleophobic,...

Coating Type	Markets	Functionality
PlasmaGuard®	Halogene free coating Electronics/Medical/Filtration	Durable Water Repellent (DWR)
Nanofics® 110	Electronics/Medical/Filtration	Oleophobic L5-6 WCA > 110°/120°
Nanofics® Kappa	Air Filtration	Electrets Oleophobic L3-5
Nanofics® 110 S	Electronics	Waterproof Barrier Coating with Hydrophobic Top Layer
Nanofics® 110 SE	Electronics	Sweatproof Barrier Coating with Hydrophobic Top Layer
Nanofics® 10S	Medical/Filtration	Hydrophilic WCA < 10°

Loading with 3D products



CD 1000/1800/2500mm width Nanofics
Low pressure roll-to-roll concept



Materials

- Non-wovens
- Membranes: nanofibres, PTFE, ...
- Technical mesh
- Porous plastics
- Fabrics
- Laminates
- Finished products
- Foams
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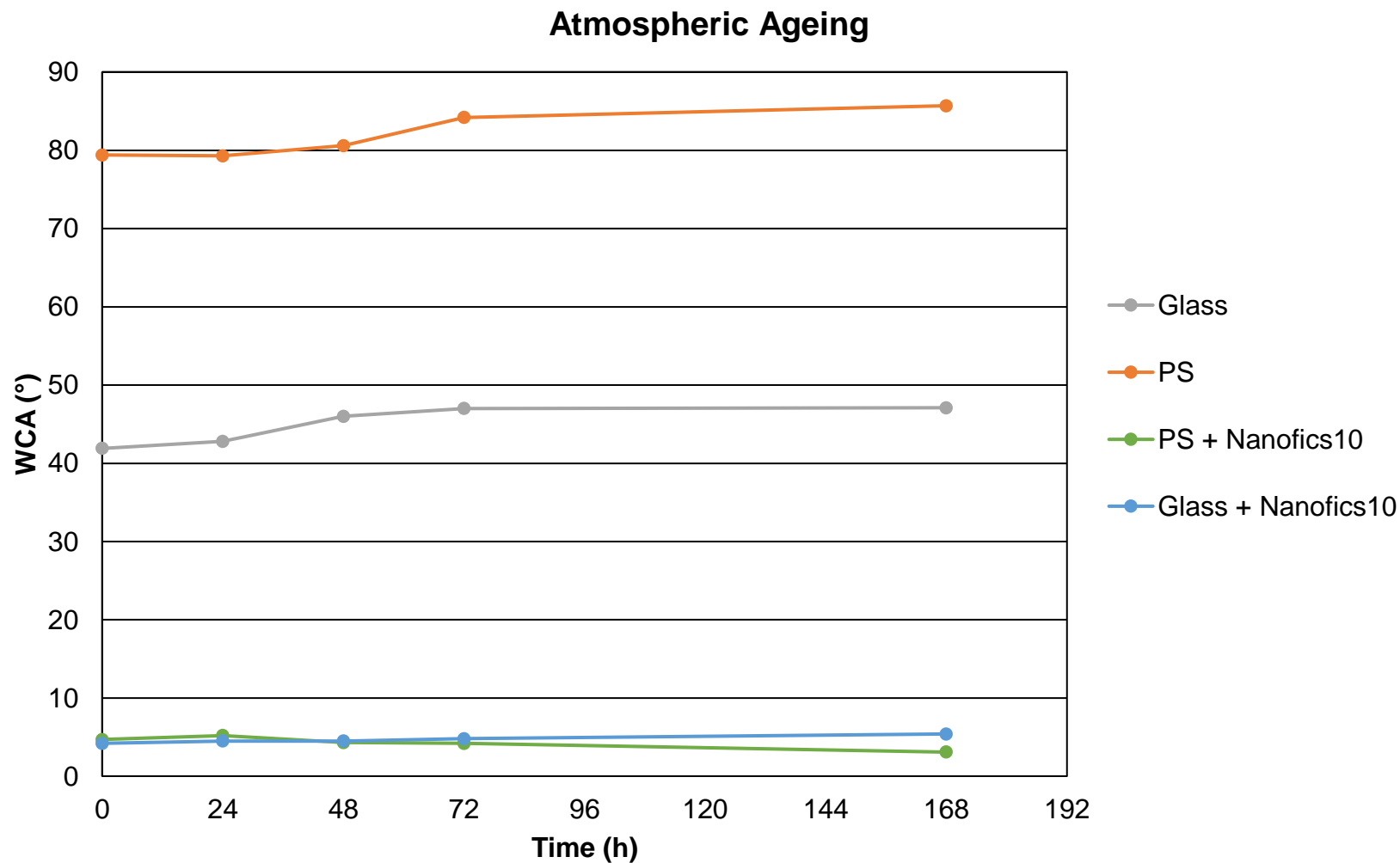
Functionalities

- Hydrophilic
- Oleophobic
- Hydrophobic
- DWR
- Electrets
- Release Liners
- ...



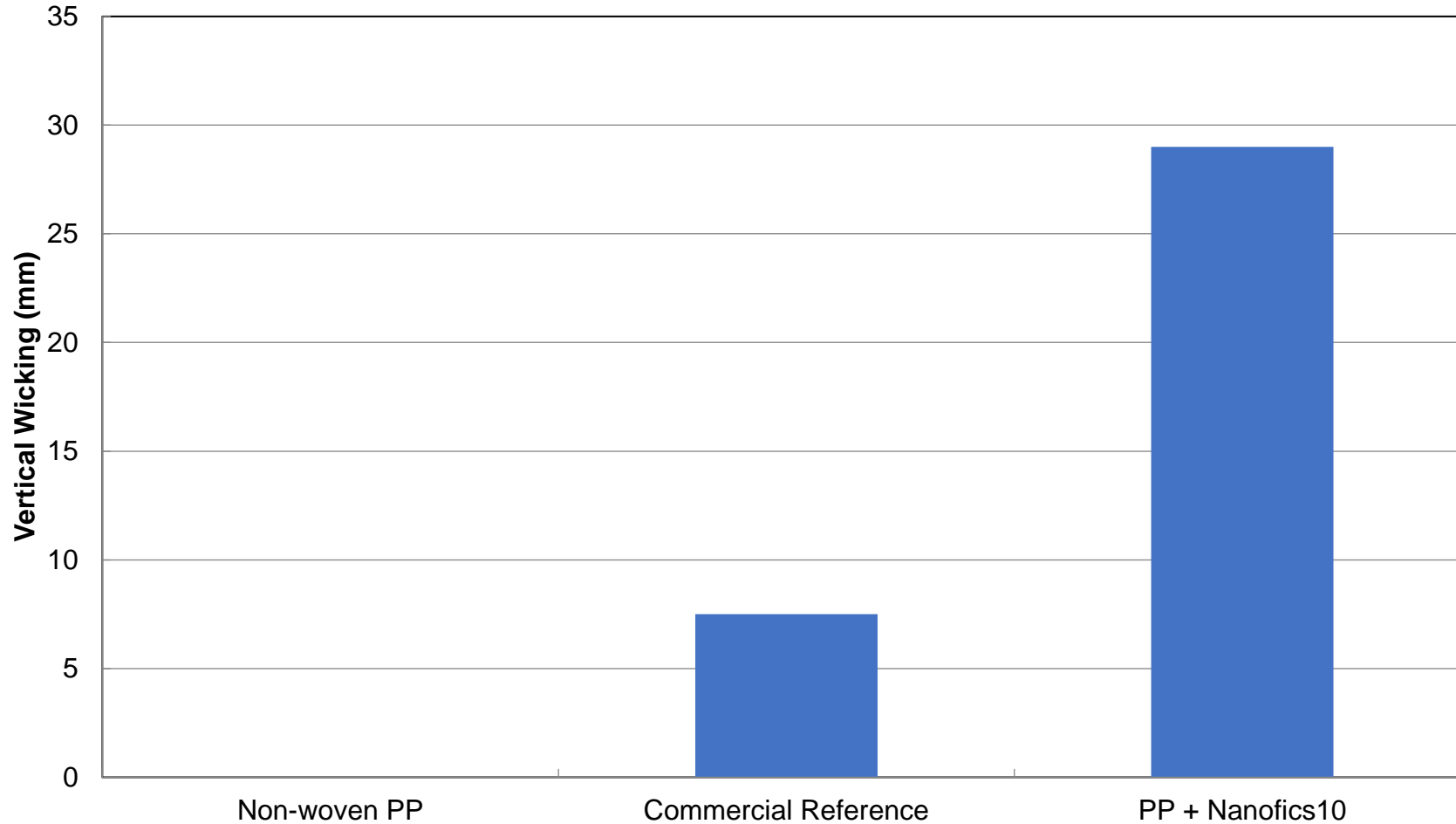
- Deposition of permanent hydrophilic effect

Coating type	Water Contact Angle (ASTM D5946)
Nanofics 10S	< 10°

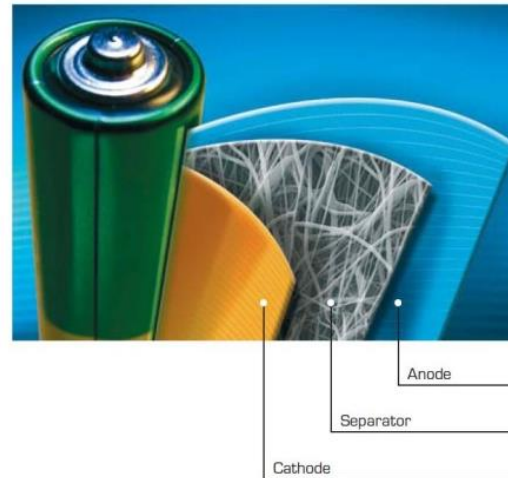




AATCC 197 (1 min in KOH + H₂O)



- Blood filters (PBT)
- Bioreactor media for cell cultivation
- Porous plastics
- Ni-MH battery separators (PP)
- Evaporative pads for air conditioners





Process	Oil (ISO 14419)	Characteristics
Nanofics® 110	≥ 5 to 7	PFOA- and PFOS-free
Nanofics® kappa	≥ 3	Increase charging durability

- Increase air filter efficiency
- Without affecting pressure drop ($< 0,5$ % weight gain from coating)
 - Higher energy efficiency
 - Lower cost of ownership
 - More comfort for the end user

- HEPA air filters for clean rooms, home air purification systems, gas turbines, respirator masks, foams, gaschromatographie...





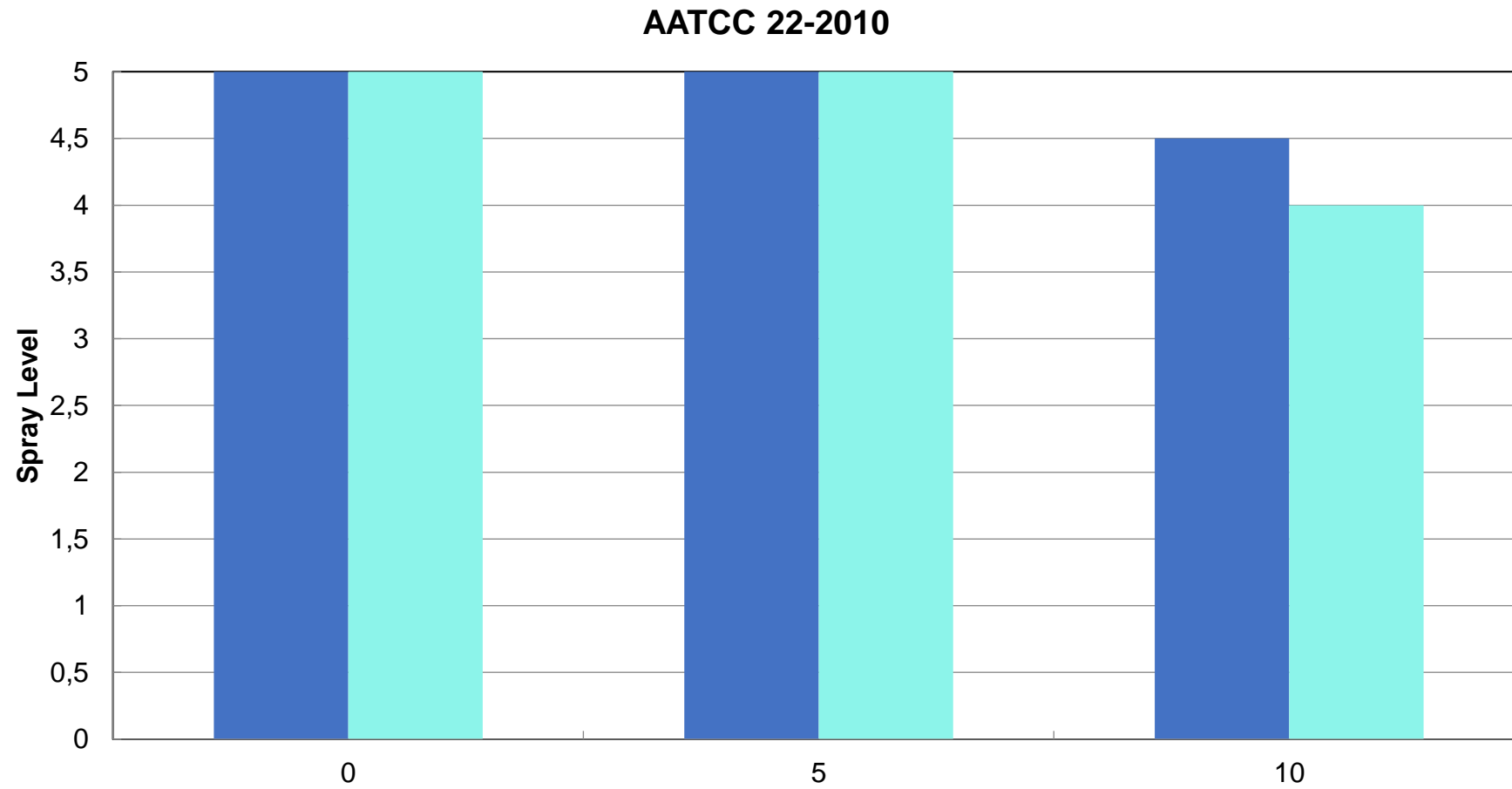
Non-woven PP	Coating (Y/N)	Charged (Y/N)	Resistance (mm H ₂ O)	Flow Rate (l/min)	Penetration (%)
Type 1 (35 g/m ²)	N	N	4,0	32	40
	Y	N	4,0	32	7,67
	Y	Y	3,8	32	0,01
Type 2 (25 g/m ²)	N	N	2,4	32	60
	Y	N	2,3	32	22
	Y	Y	2,5	32	0,13

- Data obtained with TSI Certitest 8130 apparatus (loading with NaCl-particles)
- Materials and data supplied by Monadnock Non-Wovens LLC

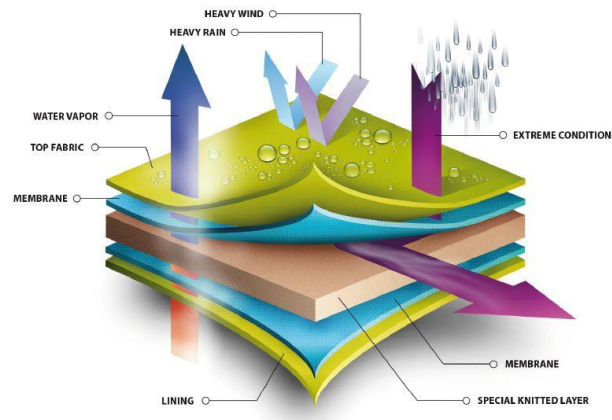


Process	WCA (ASTM D5946)	Characteristics
Nanofics [®] I10	$\geq 110^\circ$	NF I10 : PFOA- and PFOS-free
PlasmaGuard [®]		Halogen Free Durable Water Repellent (DWR)

- Increase water repellency
- Coating is resistant to multiple washings
- Little impact on air and water vapor permeability



- Technical membranes for sporting & outdoor
- Speaker fabric
- Acoustic mesh





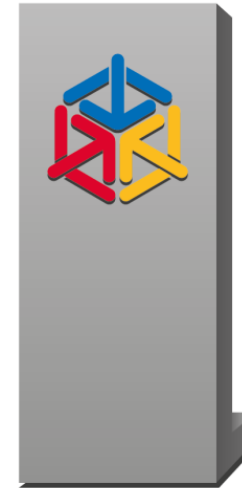
- Compared to wet chemical processing, plasma nanocoating has significant environmental benefits
 - **80%** reduction in consumption of DWR coating chemicals
 - **100%** reduction in water consumption
 - **50%** reduction in energy consumption
 - No need for crosslinking agents, chlorides, formaldehyde and other toxic products used in wet chemical DWR
- Halogen free chemistries



 PlasmaGuard



ITMA 2015
Best Innovation in Sportswear
and Outdoor Apparel



**ISPO AWARD
GOLD WINNER**
2016/2017

ISPO 2016
Best Performance Footwear
Component

CES 2017
Innovation Awards Honoree
Tech For A Better World



Filtrex
Innovation Award
2017 Nominee

- Plasma nanocoating solutions based on 25 years research & development
- First industrial coater installed in 1998
- Advances both in low pressure and atmospheric plasma => next generation technology
- Technology spreading for several industrial applications in filtration market
- Highest performance for lowest environmental footprint