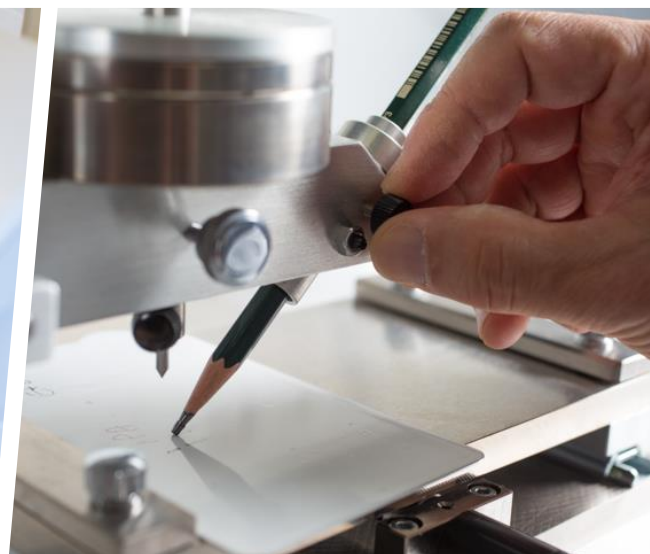
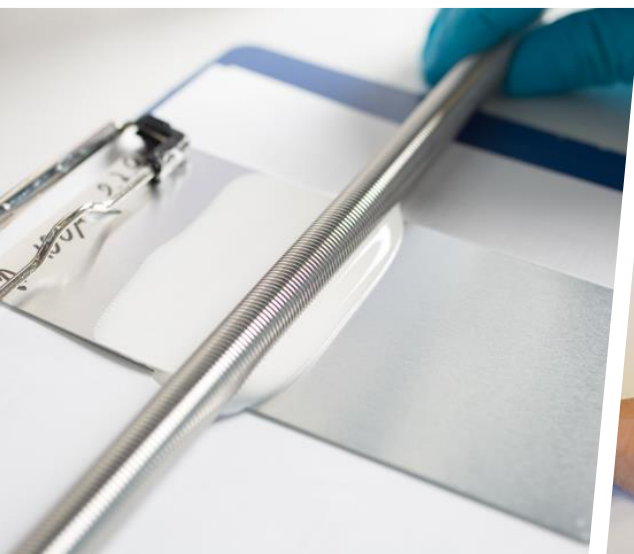




Positively Innovative



January 20, 2022

## ***ZEFFLE GKD-210***

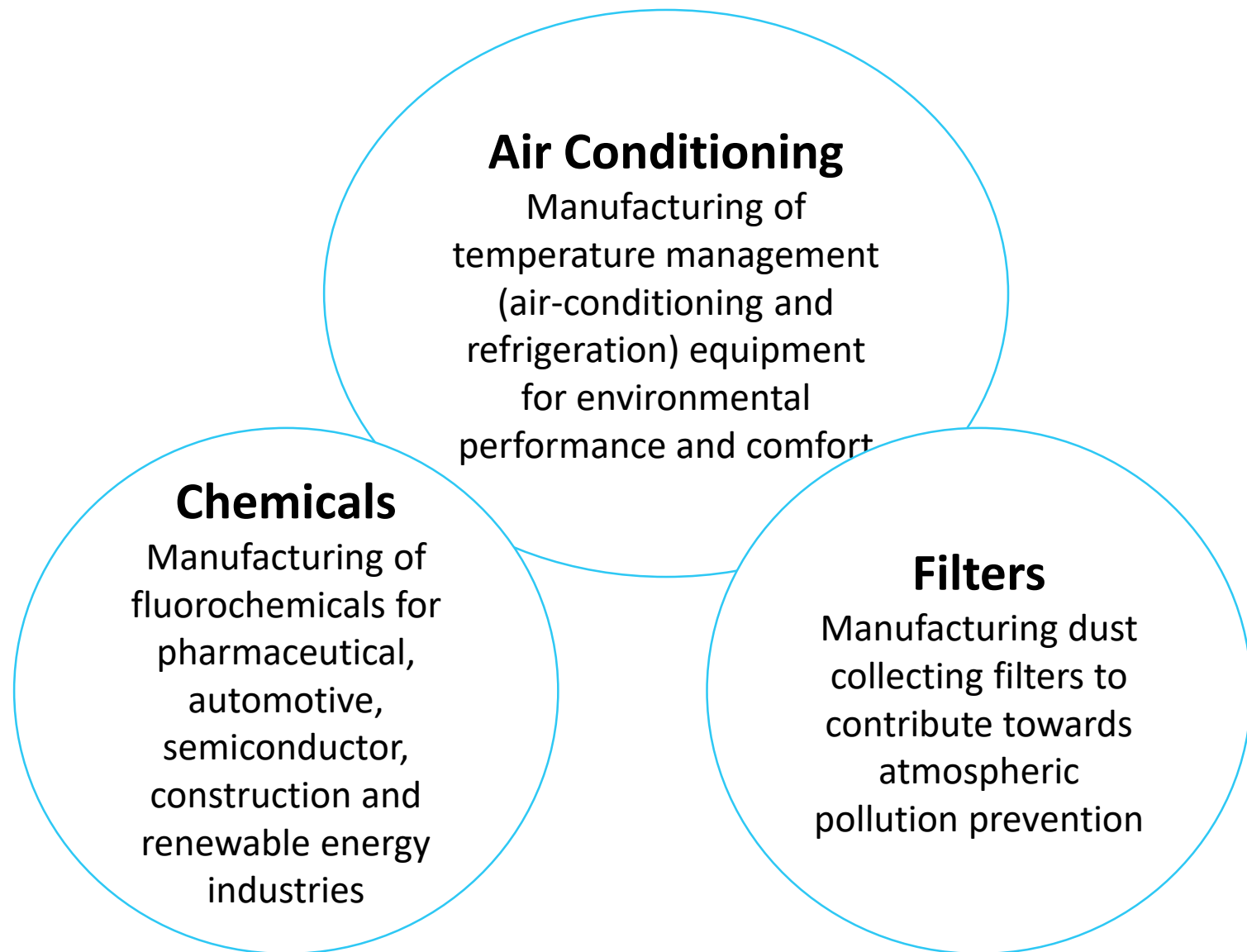
Waterborne Fluoropolymer for excellent weathering, chemical and stain resistance performance

1. DAIKIN Industries Business Overview
2. DAIKIN sustainability efforts
3. Fluorochemical Business
4. Coating binder ZEFFLE technology
5. Introduction of new water-borne ZEFFLE technology

# 1. DAIKIN Industries Business Overview

# Corporate Data

Company Name	Daikin Industries, Ltd. (Head Office: Osaka , Japan)
Incorporated	1934 (founded in 1924)
Capital	1.1 billion Euro (fiscal 2020:consolidated)
Sales	19.1 billion Euro (fiscal 2020:consolidated)
Number of Employees	84,870 (March, 2021)
Number of Group Companies	315 consolidated subsidiaries (30 in Japan; 285 overseas) (March, 2021)



## 2. DAIKIN's Sustainability Overview

# DAIKIN's sustainability efforts

- Refrigerant recovery and reclamation initiatives in Europe (SDG 12,13 and 17)
- Recovery and recycling activity of fluoropolymers (SDG 8, 12 and 14)
- Measures concerning use of PFOA (SDG 6 and 12)
- Green Procurement Initiatives (SDG 3,8 and 12)
- Green Heart Factory Initiatives (SDG 12, 15 and 17)
- Forests for the Air Project (SDG 1,2,3,4,6, 7, 8, 9, 12, 13, 14,15, 17)



[https://commons.wikimedia.org/wiki/File:Sustainable\\_Development\\_Goals.svg](https://commons.wikimedia.org/wiki/File:Sustainable_Development_Goals.svg)



Forests for the Air Project

<https://www.daikinchemicals.com/company/sustainability.html>



[https://www.daikin.com/csr/environment\\_special/](https://www.daikin.com/csr/environment_special/)

# 3. Fluorochemical Business



## A wide variety of Fluorochemical products



Fluoropolymers



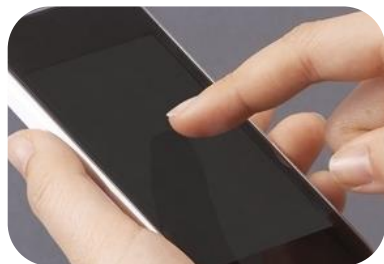
Fluoroelastomers



Fluoro Coatings



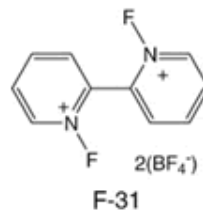
Water and oil repellents



Fluorinated anti-fingerprint Coatings



Mold release agents



Fluorinated intermediates

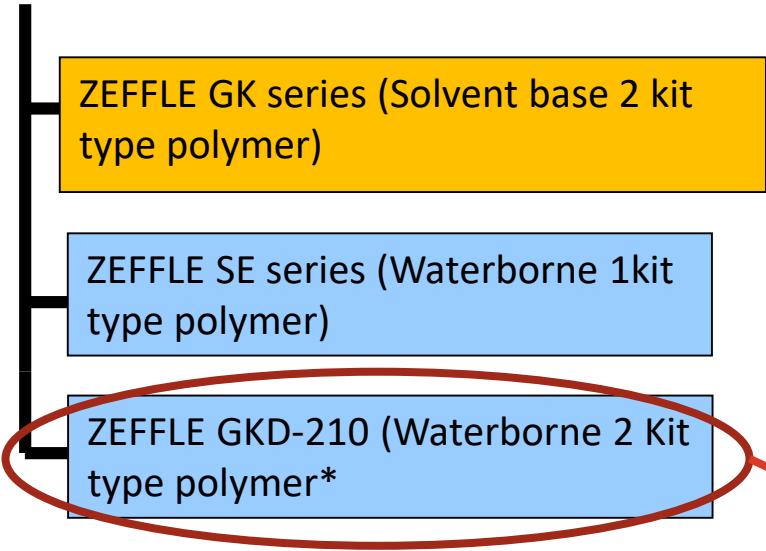


Refrigerants and Fluorocarbon gases

## 4. Introduction to ZEFFLE Technology

## Raw material ZEFFLE & the ZEFFLE base coatings

### Raw materials for coating



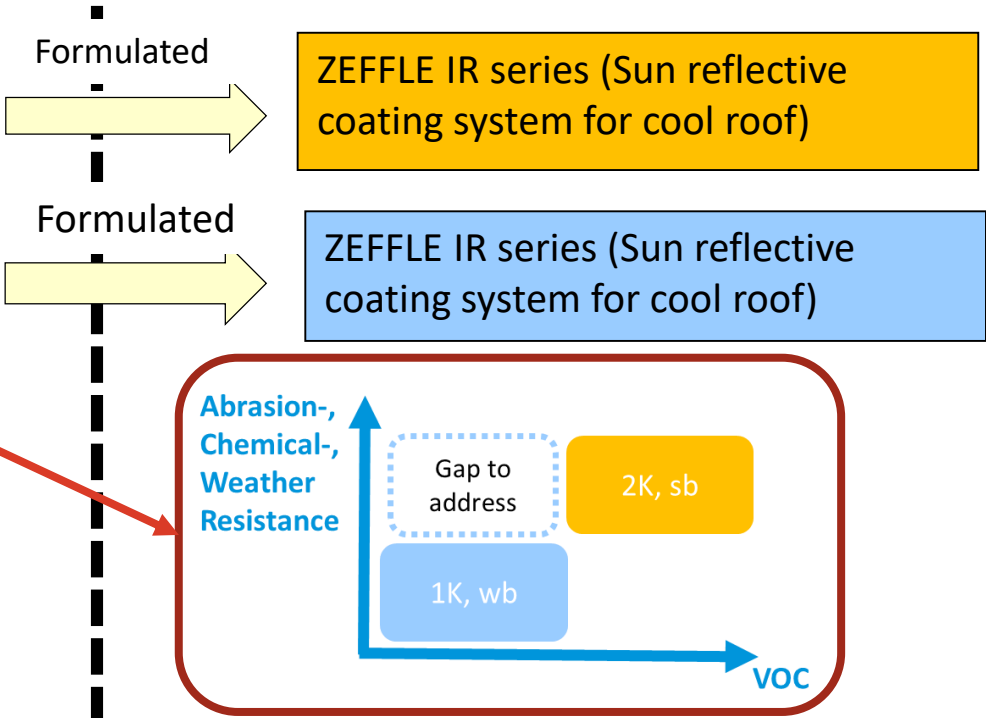
Excellent:

- Weatherability
- Corrosion resistance
- Chemical resistance
- Solvent resistance
- Soil remove ability (easy-to-clean)

Main Application:

GK: On site & Coil Coat  
SE: On site & in Facility

### Coating (ready to use type product)



Excellent:

- Durability
- Solar Reflection
- Heat Emissivity

Main Application (Onsite):

GK: Metal (Roof, Tanks, Transport)  
SE: Bitumen, Concrete Roof

Bridge



PV Back sheet



Bumper(Car)



Chemical Resistance  
Solvent resistance

Weatherability

Dirt removability



Chemical Tank



Skyscraper



Car seat

Chemical plant  
equipment,  
Medical  
equipment  
etc...

## 4. Introduction to new water-borne ZEFFLE grade

We developed GKD-210, a new waterborne fluoropolymer for paints and coatings industry with an objective to reduce the VOCs amount while maintaining the excellent functions of solvent borne fluoropolymers such as weather, chemical and stain resistance.

GKD-210 is suitable for customers facing VOC countermeasures in on-site painting or who needs to add the Excellent Chemical resistance, Cleanability and Weathering resistance features of fluorine chemistry to existing water-based paints.



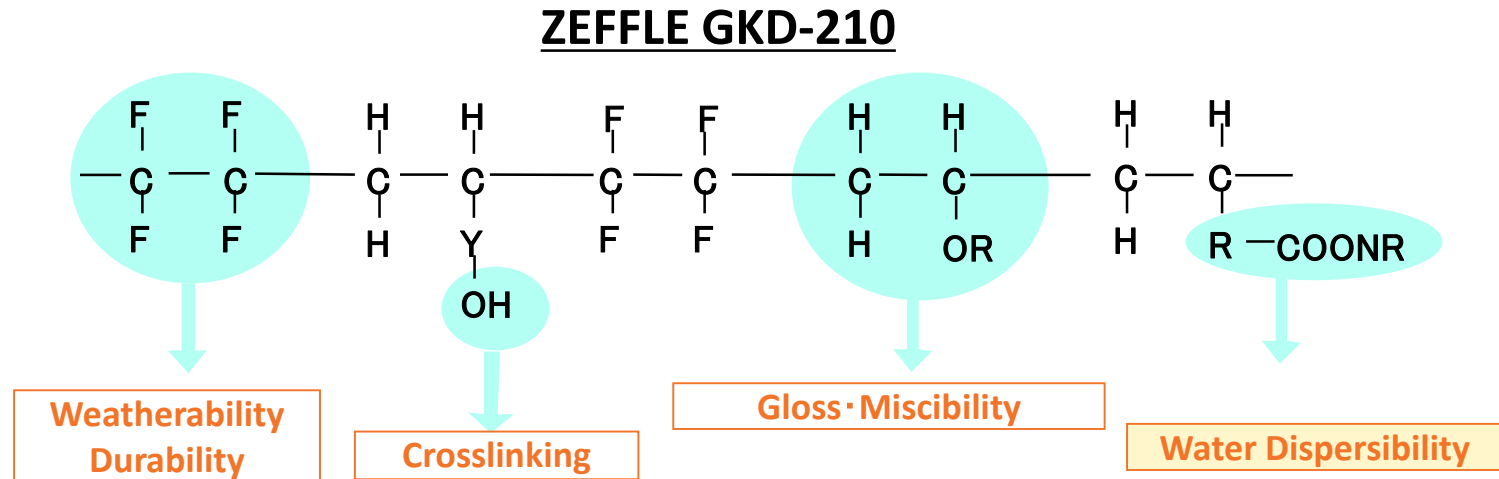


**VOC Reduction (Slide 19)** in field coatings for high durability applications where mostly only solvent-based solutions can be used (heavy duty corrosion protection, buildings)

**Excellent Weatherability (Slide 20)** for objects demanding highest durability performance and least maintenance and recoating



**Easy Clean property (Slide 22 and 23)** for interior paints that can be only water-based (furniture, car seat, etc.)



- Copolymer of Tetrafluoroethylene (TFE) and Hydrocarbon Olefins with pendant OH groups
- Curable ( $\sim$  RT – 80°C) with poly isocyanate
- Waterborne for low VOC coating formulations



Typical physical properties	
Appearance	Milky white liquid
Solids	40 mass%
OH Value	100 mg KOH/g of polymer
Acid Value	20 mg KOH/g of polymer
Minimum film forming temperature (MFFT)	18-25°C
pH	7.0 - 9.0
Average particle diameter	130-200nm
Rotational viscosity	≤ 100 mPa·s at 25°C

# Formulation example(white paint)

- Confidential -

Grade		Function / Supplier	Mass%
Pigment Paste			
	D.I.Water	—	22.70
	Ti-pure R-960	TiO <sub>2</sub> / Chemours	70.00
	DISPERBYK-190	Dispersant / BYK	7.00
	BYK-028	Defoamer / BYK	0.30
	Total		100.00
Component 1 (Part A)			
	Pigment Paste	—	31.10
	GKD-210	Polymer / Daikin	67.70
	BYK-028	Defoamer / BYK	0.50
	BYK-345	Wetting agent / BYK	0.50
	ACRYSOL RM-8W	Thickener / DOW	0.20
	Total		100.00
Component 2 (Part A + Part B)			
	Component 1 (Part A)	—	100.00
	Easaqua XD803	Hardener / Vencorex	20.90
	Total		120.90

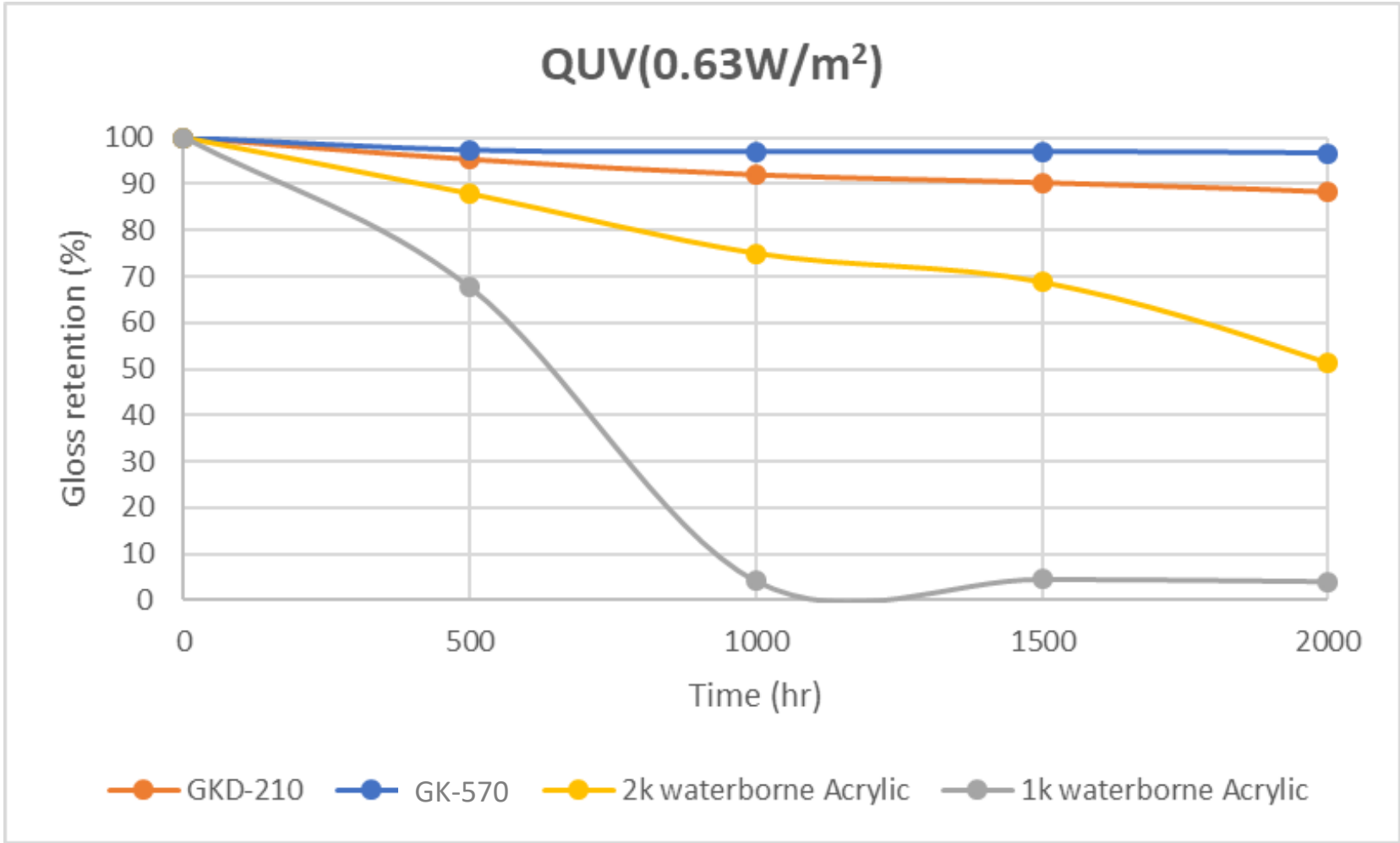
GKD-210 is a waterborne polymer for paints. Therefore, compared to GK-570, which is a solvent-based resin counterpart, the amounts of VOCs in paints can be greatly reduced.

[ VOC amount comparison in a white paint formulation ]

Item	Method	Note	2k waterborne GKD-210	2K solvent borne GK-570
Volatile Organic Compounds (VOC)	Dispersion/ Polymer solution	g/L	0	368
	Base Liquid	g/L	0	387
	Base Liquid + Hardener	g/L	66	357

Water borne GKD-210 has the same levels of weatherability as solvent borne GK-570, since GKD-210 has a similar fluorine content to that of GK-570.

[ QUV-B ]







Item		Condition
Illuminance at Light		0.63 W/m <sup>2</sup>
Light source		UV fluorescent lamp
Light Wavelength (nm)		313
Cycle		Light ↔ Dew
Light	Time (hrs.)	4
	Temperature (°C)	60
Dew	Time (hrs.)	4
	Temperature (°C)	50

Note: temperature as black panel temp

➤ Formulated coating tested under normal QUV-B test

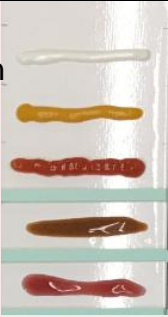




As fluorine compounds have non-adhesive and antifouling properties, the GKD-210 coating has excellent dirt removability compared with acrylic water-based paints.

[ Dirt removability ]

Resin	2k waterborne GKD-210	2K solvent borne GK-570	2K Waterborne Acrylic	1K Waterborne Acrylic
Color	White	White	White	White
Hardener	XD803 (IPDI+HDI)	D140N (IPDI+HDI)	XD803 (IPDI+HDI)	none
Initial L*	96.3	97.2	96.3	96.8
After L*	96.1	97.0	72.2	48.3
$\Delta L$	-0.2	-0.2	-24.1	-48.5
				

Test Method: Spray carbon water on panels  
Set temperature at 60°C for 1hr  
Wash with brush with running water

Due to the non-adhesive and antifouling of fluorine compounds, the GKD-210 coatings have excellent stain resistance compared with acrylic water-based paints.

[ Stain resistance ]	GKD-210 2k waterborne	GK-570 2K solvent borne	Acrylic 2K Waterborne	Acrylic 1K Waterborne
Hardener	XD803	D140N	XD803	None
Sunscreen	1	0	4	5
Mustard	1	0	5	5
Ketchup	0	0	0	0
Coffee	0	0	3	3
Red wine	0	0	0	0
Total	2	0	12	13
<div><div>Initial</div><div><div>sunscreen</div><div>mustard</div><div>Ketchup</div><div>coffee</div><div>Red wine</div></div></div>				

0 – Excellent 5- Worse

Other than VOC content, GKD-210’s formulation has almost similar properties as GK-570.

[ Properties of GKD-210 and GK-570 in a white paint formulation ]

Item	Method	Note	2k waterborne GKD-210	2K solvent borne GK-570
Volatile Organic Compounds (VOC)	Dispersion/ Polymer solution	g/L	0	368
	Base Liquid	g/L	0	387
	Base Liquid + Hardener	g/L	66	357
Gloss	ISO2813 (JIS K5600 4-7)	60°	75-80	75-82
Pencil hardness	ISO15184 (JIS K5600 5-4)		F	F
Adhesion	ISO2409 (JIS K5600 5-6)	1 mm width cross- cut, delamination with tape	No peel-off	No peel-off
Solvent resistance	ASTM D4752 (Double rubbing)	MEK	No change	No change
Warm water resistance	ISO2812-1 (JIS K5600 6-1)	Immersion for 7days at 50°C	No change	No change
Acid resistance	ISO2812-1 (JIS K5600 6-1)	5% H <sub>2</sub> SO <sub>4</sub> aq. 7 days at RT	No change	No change
Alkali resistance	ISO2812-1 (JIS K5600 6-1)	5% NaOH aq. 7 days at RT	No change	No change
Xylene marker removability	Red, Blue, Black	Wiping with ethanol	Removed	Removed



- Zeffle GKD-210 waterborne introduced for low VOC coating formulations
- GKD-210 has equivalent performance vs. GK570
- Water borne GKD-210 is designed for in field application – ambient cure and recoating possible
- GKD-210 coatings are UV, chemical and solvent resistant
- GKD-210 coatings are dirt and stain resistant