BONNTILE HONG KONG LTD
邦盛建材有限公司

AGC

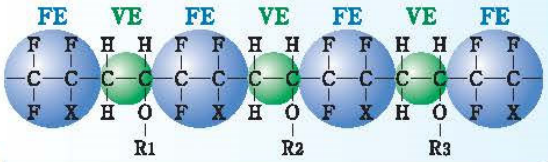
BONNFLON M Coating System
BONNFLON M-SR Coating System
(Low Pollution)
Fluororesin Coating System for Metal-base Materials

BONNFLON

Development of Lumiflon®

The world's first solvent-soluble fluoropolymer for coatings was developed 37 years ago, and it is still being used with the same structure. This fluoropolymer for coatings was commercialized in 1982 as "Lumiflon®" by Asahi Glass. Chemically Lumiflon® is a fluoroethylene-vinyl ether alternating copolymer (see Figure 1).

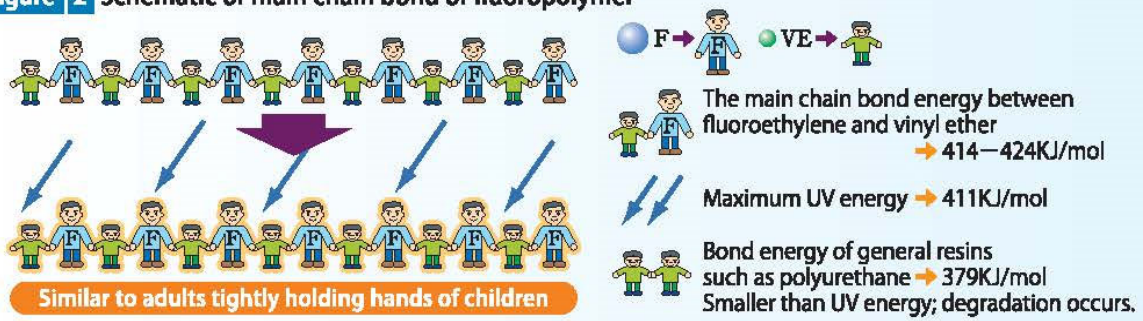
Figure 1 Fluoropolymer for coatings, Lumiflon® Structure of fluoroethylene (FE) and vinyl ether (VE)



This amorphous resin is soluble in general organic solvents, has high transparency, can be cured by cross-linking sites, and creates tough coating films from room temperature to 250℃. The alternating copolymer structure gives high durability and excellent chemical resistance.

The energy of the alternative main chain bond between fluoroethylene and vinyl ether is higher than the maximum UV energy of sunlight, and so in principle, it does not degrade. In contrast, other resins such as polyurethane break down and deteriorate due to their low bond energy (see Figure 2).

Figure 2 Schematic of main chain bond of fluoropolymer



Data on Weatherability and Life Cycle Costs

The high weatherability not only leads to long-lasting beautiful coatings but also drastically reduces Life Cycle Cost because repainting time decreases compared to conventional coatings. Simultaneously, it decreases the volatility of solvents, thus reducing VOC and conserving resources (see Figures 3 and 4).

Figure 3 Fluoropolymer's weatherability

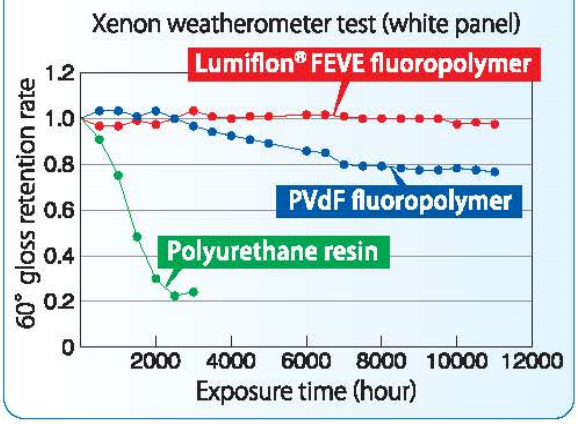
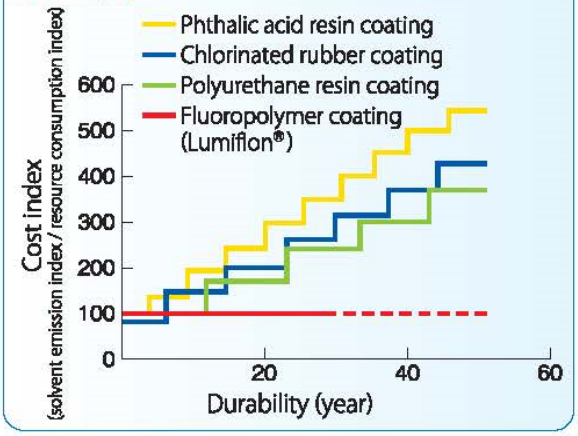


Figure 4 Fluoropolymer's life cycle costs



List of Awards for Lumiflon®

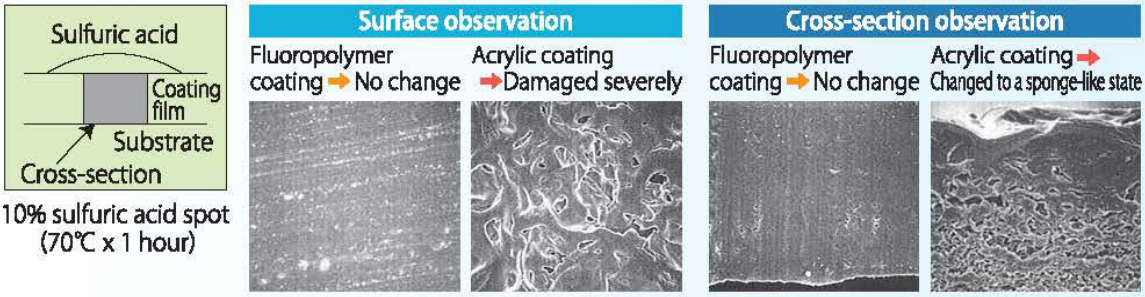
- 1983 : Nikkan Kogyo Shimbun's Best 10 New Products Award
- 1983 : Nikkei Inc.'s Nikkei Product Award
- 1984 : The Chemical Society of Japan's Chemical Technology Award
- 1985 : Ichimura Award for Achievement
- 1989 : Japan Chemical Industry Association's Technology Award

Basic Data

❶ Resistance to acid rain 10% sulfuric acid spot

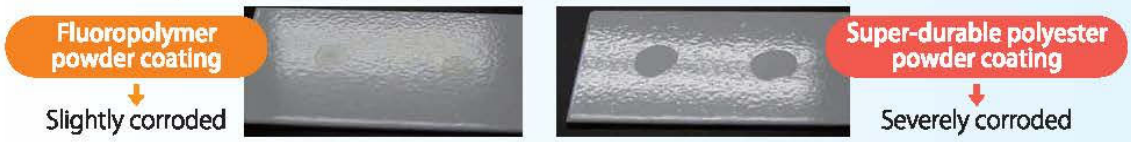
Figure 5 shows photos of cross-sections of coatings spotted with 10% sulfuric acid and heated at 70℃ for 1 hour. Fluoropolymer and acrylic resin coatings with melamine hardener are compared. The acrylic coating has deteriorated to a sponge-like state, whereas there is no visible change in the fluoropolymer coating.

Figure 5 Coating film spotted with acid Comparison between fluoropolymer Lumiflon® and acrylic resin



❷ Chemical resistance test 3% sulfuric acid spot (compared to the conventional powder coating)

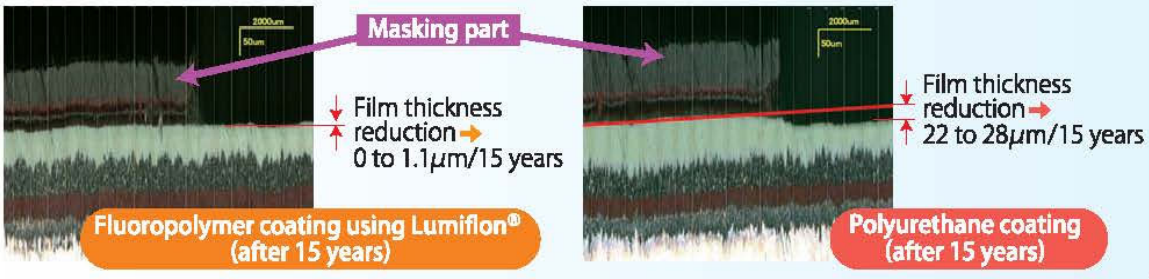
Figure 6 Coating spotted with acid Comparison between fluoropolymer powder coating using Lumiflon® and super-durable polyester powder coating



❸ Degree of coating thickness reduction (15-year exposure: comparison with polyurethane resin on the rooftop of Chugoku Technical and Engineering Office in Hiroshima)

In the fluoropolymer coating using Lumiflon®, little wear was observed over the 15-year period. In contrast, wear of 2μm per year was observed in the polyurethane coating **(see Figure 7)**.

Figure 7 Degree of coating thickness reduction seen in cross-sections of the coatings (horizontal scale 1/20)



Follow-up Research Conducted with Government Agencies

Tokiwa Bridge

Previously, it had been painted with a chlorinated rubber paint, but after 8 years, it was repainted with Lumiflon® fluoropolymer paint and has remained in good condition for 25 years since.

Daiichi Mukaiyama Bridge

New bridge. Zinc-rich paint was used as a primer to prevent corrosion. It remains in good condition after 25 years. Phthalic acid resin coating, which was applied at the same time, was repainted after 16 years.

Nikko River Bridge

New bridge. Zinc-rich paint was used as a primer to prevent corrosion. The original appearance remains after 20 years.

Actual Achievements

Civil Engineering

Important standards : Honshu-Shikoku Bridge Authority's Coating Standards (1990), Handbook for Steel Highway Bridge Coating (1990), JISK-5659 (1998), Nagoya Expressway Public Corporation's Design Standards (2002), standards of various former public corporations related to highways, etc. (1992-2002), New Handbook on Painting and Corrosion Prevention of Steel Highway Bridges (2005)

Akashi-Kaikyo Bridge

Coating completed in 1998.
Main towers, main cables, hanger ropes, and all other exterior surfaces are coated with fluoropolymer paint.

The Honshu-Shikoku Bridge Authority specified the use of fluoropolymer paint as the standard coating for new bridges as well as for repainting, beginning in 1990.

Rainbow Bridge's main towers

Coating completed in 1993.
As an expressway bridge in the Tokyo Bay area, it adopted fluoropolymer coating early on.

Kiyosu Bridge

Coating completed in 2005.
Since repainting was done at the site, mild solvent-based paints were used as both modified epoxy resin paint for the under/middle-coats and fluoropolymer paint for the topcoat.

Tokyo Gate Bridge

Coating completed in 2012.
- Anti-corrosion primer : Zinc-rich paint 75μm
- Undercoat : Epoxy resin paint 120μm
- Middle coat : Paint for fluoropolymer topcoat (basically epoxy resin paint) 30μm
- Topcoat : Fluoropolymer paint 25μm

A recently opened bridge that crosses Tokyo Bay. It is also popular for its unique shape which looks like a dinosaur.

Introduction

Fluorourethane coatings based on FEVE (fluoroethylene vinyl ether), have been used globally for over 30 years. This technology has a proven record of outstanding performance with respect to outdoor exposure, offering the highest standard in gloss and colour retention. Besides excellent aesthetic performance, long time corrosion protection is achievable as well and therefore FEVE resins find many applications as part of protective coating systems. One particular application where both long-term aesthetic and protective performance is required are bridge coatings. Steel bridges need to be protected with the best possible anti corrosive coating technology but are also often iconic structures where visual appearance is of importance. Furthermore, repainting bridges is a cumbersome and expensive job which emphasizes the benefits of long lasting coating systems even more.

This technical brochure will detail the use of Lumiflon coatings for Bridge applications. Showing an example of a bridge coated more than 30 years ago in Japan without ever being repainted.

Coatings that passed the new ISO 12944-6 standard, category C5 (very high corrosive environment) and ISO 12944-9 CX (high impact areas) tests protocols, are also shown. These coating were formulated with EU available raw materials and the testing was performed and assessed by COT in Haarlem the Netherlands, an independent research laboratory certified to perform industrial specification testing for the coating industry.

LUMIFLON™

Fluoroethylene vinyl ether (FEVE) resins were developed in Japan in the late 1970's and were first commercialized in 1982. FEVE resins are amorphous A-B type copolymers with repeating units of fluoroethylene and substituted vinyl ether (see Figure 1). Unlike pure fluoropolymers, FEVE resins are soluble in solvents due to the vinyl ether groups. Solvent solubility transforms FEVE resins from high performance polymers into high performance resins for coatings. [1]

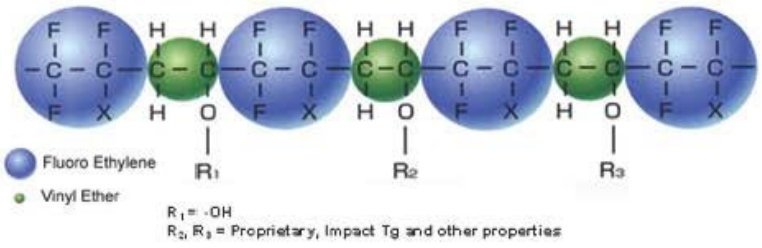


Figure 1. Alternating Structure of FEVE Resins

FEVE resins have characteristics of both fluoropolymers and hydrocarbons. The fluoroethylene groups are the strength of the FEVE resin. These groups are responsible for the polymer's high resistance to UV degradation. The C-F bond is very strong (see Table 1). The energy of this bond is higher than the energy of UV radiation at 290nm which is ~411KJ/mol. The alternating pattern, shown in figure 1, is critical for the extreme UV resistance properties. The chemically stable and UV resistant fluoroethylene units sterically and chemical protect the neighbouring vinyl ether units. [1]

Table 1. Bond energy of Fluoro-Chemicals and Commodity Chemicals [2]

Resin	C-C Chain	KJ/mol	C-F. C-H	KJ/mol
Fluoro Compound	CF3-CF3	414	F-CF2-CH3	523
Fluoro Compound	CF3-CH3	424	CF3CH2-H	447
Commodity Chemical	CH3-CH3	379	CH3CH2-H	411

The vinyl ether groups make FEVE polymers useable as resins for paint. Without the vinyl ether groups, FEVE resins would not be soluble in solvent. This solubility is what allows FEVE resins to be used in a wide array of coating formulations that can be applied in factory or on-site settings. A wide range of curing temperatures can be employed ranging from Room Temperature to 230 °C. The vinyl ether groups also contribute to high gloss and allow for functional groups, like hydroxyl groups, to be incorporated into the structure. Below is a table showing typical properties of FEVE resins. [1]

Table 2. Typical Properties of FEVE Resins

Property	Value
Fluorine Content	20-30 wt%
OH Value	47-170 mg KOH/g
COOH Value	0-15 mg KOH/g
Molecular Weight	M_n = 15000-100000
Specific Gravity	1.4 – 1.5
Morphology	Glassy (T_g = 20-50°C
Solubility Parameter (cal'd)	8.8

As explained above FEVE resins are renowned for their extremely high durability due to the high C-F bond energy. Therefore, they do not degrade under the influence of UV radiation from the sun. Fluorourethane topcoats have been tested in both accelerated and natural weathering. The following figures show the weathering performance typical of fluorourethane coatings based on FEVE resins. Figure 2 shows a comparison of a FEVE coating to polysiloxane and acrylic urethane based coatings in QUV accelerated weathering. The FEVE coating clearly outperforms the other resins which are renowned on their own in the industry for their good weatherability. Furthermore Figure 3 shows South Florida exposure of a clear and a yellow FEVE coating. This data clearly shows the excellent performance of the FEVE based coating technology achieving a gloss retention of around 70% after 10 years of exposure.

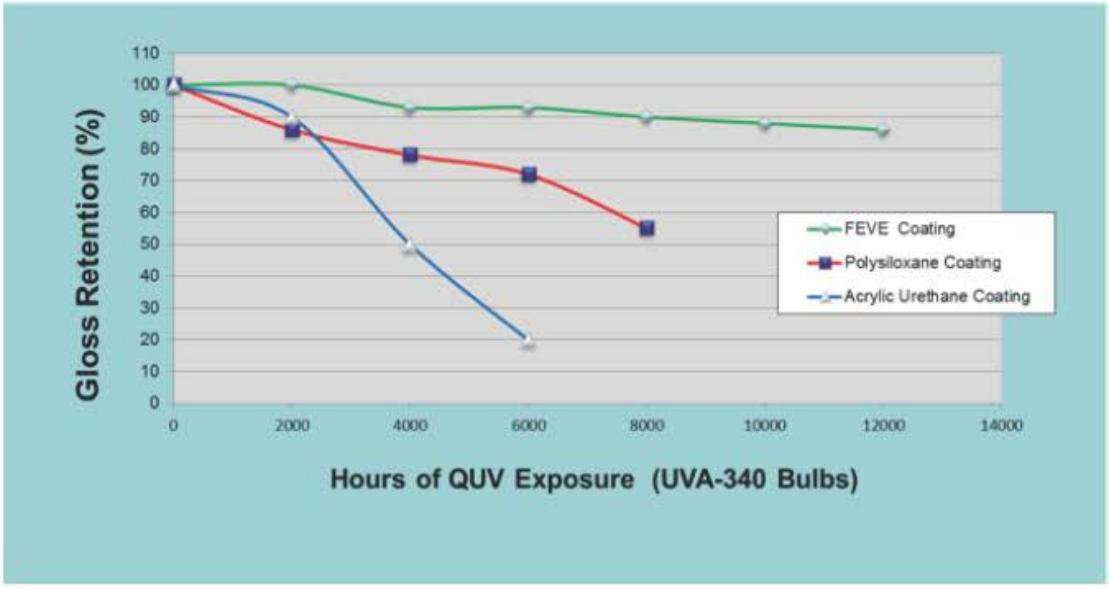


Figure 2. QUV Exposure of an FEVE Based Coating

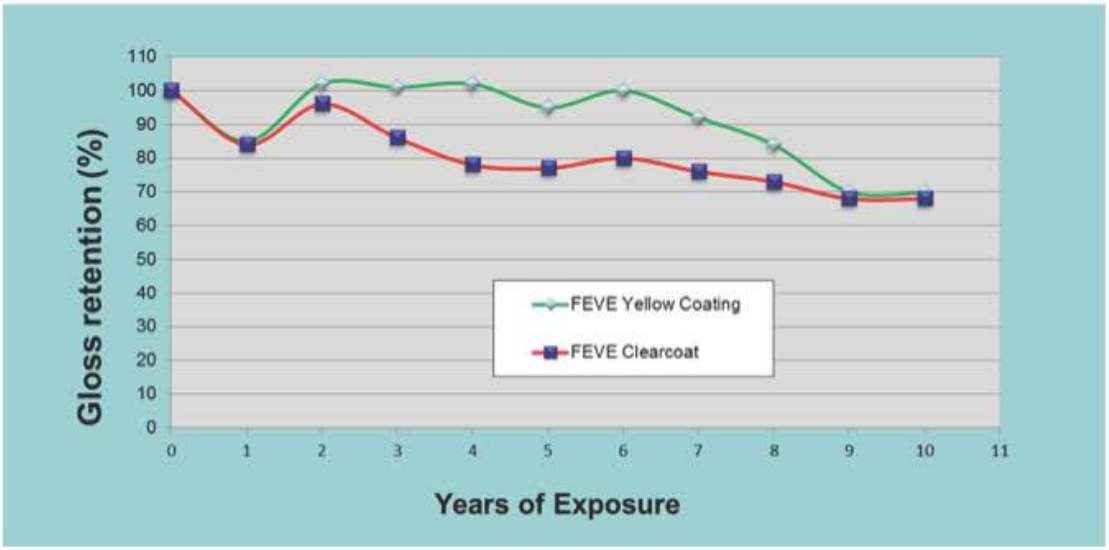


Figure 3. South Florida Exposure of an FEVE Based Coating

Besides excellent gloss and color retention FEVE topcoats also offer a great benefit in terms of general protection of underlying substrates. Due to the high UV resistance and lack of degradation of the resin the coating itself will stay intact much longer than for example an acrylic urethane based topcoat. Figures.4 and 5 show film consumption for the fluoro-polymer coating and polyurethane coating in cross section after 15 year of exposure. A portion of the coating was covered with tape and thus was not exposed to sunlight. Under the tape the film was not damaged. The film thickness of each topcoat after 15 years outdoor exposure could be compared to the original film thickness under the tape. After 15 years, the fluoro-polymer topcoat has lost about 1.1µm total (less than 0.1 µm/year), while the polyurethane topcoat has lost 22-28µm (about 2µm/year).

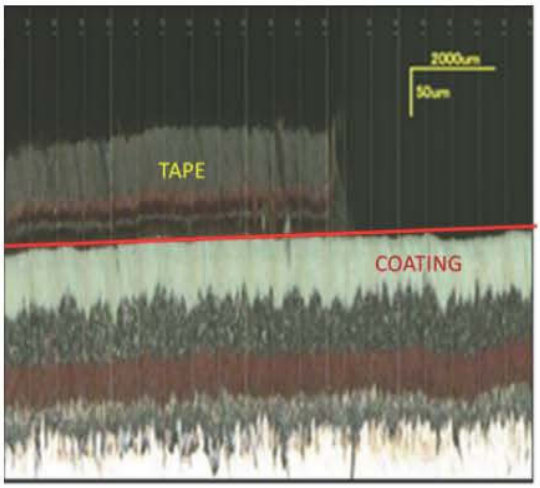


Figure 4. FEVE white coating. 1 micron of erosion after 15 years of exposure

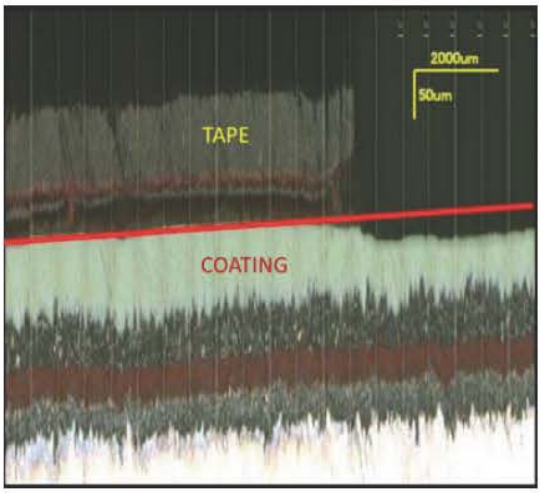


Figure 5. Polyurethane white coating. 22-28 micron of erosion after 15 years of exposure.

In Figure 6, two sections of the coating are analysed by Imaging IR (IRT7000[3]). That measurement can detect amide (II) absorbance and quantify it in comparison to theC-H band or C-F band. A chemical map is generated, which shows the distribution of the amide bond through the cross-section. The color gradient of this map directly relates to the concentration of isocyanates. In the case of the Fluoro-polymer, comparing the cross-section which has been light-sealed (map A) and the cross-section which has been exposed (map B) shows that the decomposition of isocyanates is very limited. Indeed, the same intensity in the gradient can be observed with the red color present through the depth of both cross-sections. In the case of the Polyurethane, the protected cross-section (maps C) and the exposed cross-section (map D) show large differences. In the map of the exposed cross-section, the yellow color indicates that the isocyanate concentration is much lower in comparison to that of the protected cross-section in red. UV light has induced the degradation of the isocyanate in the polyurethane coating, even at a 20µm depth from the surface. In practice this means that from a protection point of view one could use a much thinner topcoat if FEVE technology is used thus saving paint and application costs.

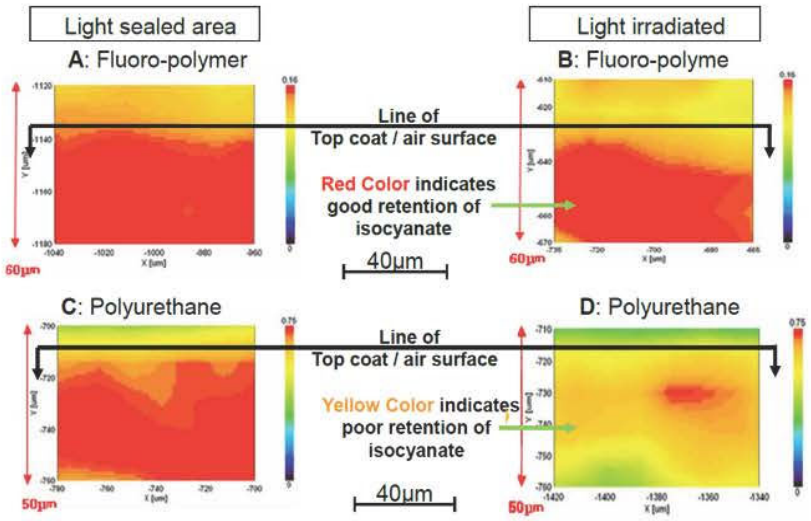


Figure 6. Isocyanates retention of each cross section of coats about mild light seal or irradiated surface area

Finally, in figure 7 Impedance Spectroscopy is shown which demonstrates that using a FEVE based topcoat offers benefits with respect to anti corrosive properties as well. In the experiment a standard corrosion inhibiting primer was used. The only difference is the topcoat technology. Also in this study the fluoropolymer based topcoat shows improved performance over polyurethane technology.

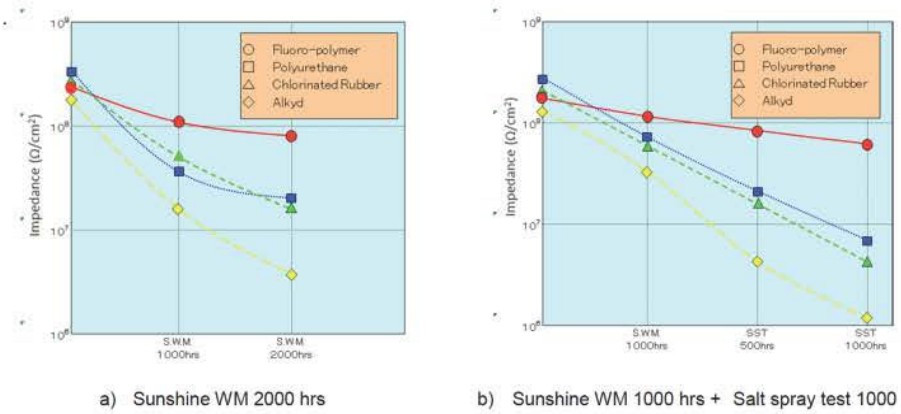


Figure 7. Impedance Spectroscopy

Bridge Applications in Japan

Ever since the development of FEVE resins by AGC in the early 80's the Japanese road authorities have carried out performance testing and evaluations of coating sytems based on FEVE resins. The outstanding dubrability that was found led to the mandatory use of fluorinated topcoats for bridges throughout Japan.

The Daiichi-Mukaiyama bridge was newly build in 1987 (see figure 8). The primer and middle coats were shop applied and the topcoat system, based on a Lumiflon resin system, was applied on site. Color and gloss measurements were taken initially and after 22 and 30 years. Furthermore the coating was inspected for chalking and other degradation signs. As is demonstrated in Table 3 and Figure 9 the paint system performed excellent after 30 years of service life. A gloss retention of over 70% was measured after wiping the coating free of dust and dirt. Also, no rust peeling or cracking was observed. Color measurements could not be compared due to a change in colorimetric techniques throughout the years. However the red color still appears as bright as when it was applied 30 years ago.

Figure 8. Daiichi-Mukaiyama bridge

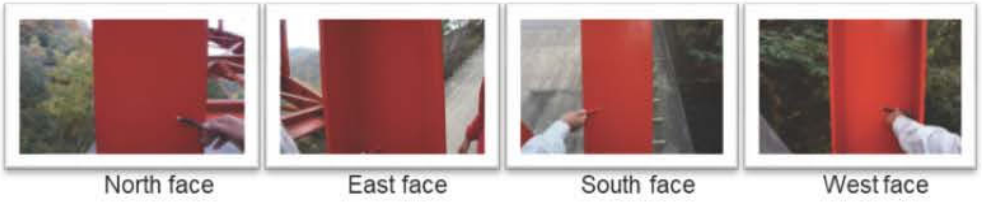


Figure 9. Daiichi-Mukaiyama bridge inspection after 30 years

Table 3. Gloss Retention.

		Initial	22 years	30 years
Non wiped	Measured value	52.4	46.5	28.3
	Retention	-	88.7%	54%
Wiped	Measured value	52.4	49.9	38.7
	Retention	-	92.5%	78%

Table 4. Appearance Observation after 30 years.

	Part Investigated	Rust	Peeling	Crack
Upstream Side	Brace	0	0	0
	Cross Girder	0	0	0
	Arch Rib	0	0	0
Downstream Side	Brace	0	0	0
	Cross Girder	0	0	0
	Arch Rib	0	0	0

Bridge coatings in Europe

In Europe, most countries have their own specifications for bridge coatings. These specifications are often referring to the ISO 12944 standard for coating performance requirements in different corrosive environment classes. In some countries coating systems first need to be tested according to these requirements at an independent certified testing institute before they can be placed on a qualified product list. After which the coatings can be applied on bridge structures. These specifications only look at the corrosion protection performance of the coating system. Aesthetic longevity is not considered. As of today almost all bridge coating systems in Europe are based on polyurethane or polysiloxane topcoat technology. These systems are able to pass the corrosion testing and as aesthetic durability is not specified there seems to be no need for fluorinated systems. The use of FEVE coating systems will greatly increase the maintenance intervals. Over the lifetime of a bridge it will thus offer significant cost saving. This is recognized more and more in industry, and bridge owners are asking for prolonged durability (> 30 years) both on corrosion and aesthetic performance. A first example of this is an Italian specification for fluorinated coating systems called ANAS IT.CDTG.05.18.

In recent years a number of bridges in Europe have been coated with fluorinated resins as a result of these developments. Figure 10 shows two such examples, one in Switzerland and one in Italy. However, the share of FEVE based coatings in the grand scheme remains small.

Figure 10. European Bridge applications

Specification Testing [3]

Recently, ISO published a new version of its 12944-specification document. The new specification now includes a section on testing for 25 years protection for the different corrosive environments which is mentioned in the 12944-6 section. Furthermore, an added section called 12944-9 now details testing for CX environment and different immersion classes. AGCCE decided to reformulate the Japanese commercial topcoat formulations with EU available raw materials and test these systems to the new ISO standards at the COT research laboratory in Haarlem which is accredited to perform specification testing. Two white coatings and a red coating were tested. All passed the specification testing as will be shown below.

Three topcoat formulations were submitted for specification testing at COT Haarlem. Two different whites, which used a standard TiO2 grade (white 1) and a high durable TiO2 grade (white 2), and a red topcoat were applied. The primer and middle coat for each system was the same. Application and testing of the full coating systems was performed at COT in Haarlem, the Netherlands. Table 5 depicts the different coating systems.

Table 5. Coating system

Coating	White 1 (dft µm)	White 2 (dft µm)	Red (dft µm)
Bonn Zinc No.20 ZHB	60	60	60
Bonnflon primer for steel towers No.630	200	200	200
Bonn Epocoat No.30 HB Grey	30	30	30
Lumiflon Topcoat	30	30	30

The substrates were steel panels blasted to Sa 2.5 grade cleanliness according to ISO 8501-1. Surface roughness Medium (G) according to ISO 8503-1.

ISO 12944-6 Testing results

Test Specification:	ISO 12944-6
Corrosivity Category:	C5
Durability range:	very high
Test regime:	2

Table 6. Assessment after Cyclic Ageing test: White 1

Cyclic Ageing ISO 12944-6 Annex B Exposure 2688 hours			COT sample number 1-6-18/0344			
			Panel 1.3	**Panel 1.10**	**Panel 1.13**	**Rewquirement**
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		2.1	2.5	2.6	≤ 3.0
	ISO 4624	Adhesion (MPa)	9.5	7.4	8.4	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			8.3	8.4	8.3	
			100% C	100% C	100% C	
			9.2	7.8	9.6	
			100% C	100% C	100% C	

Table 7. Assessment after Cyclic Ageing test: White 2

Cyclic Ageing ISO 12944-6 Annex B Exposure 2688 hours			COT sample number 1-6-18/0345			
			Panel 2.10	**Panel 2.13**	**Panel 2.14**	**Requirement**
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		2.6	3.0	2.2	≤ 3.0
	ISO 4624	Adhesion (MPa)	9.2	8.6	7.9	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			8.8	9.5	8.1	
			100% C	100% C	100% C	
			9.1	8.3	9.0	
			100% C	100% C	100% C	

Table 8. Assessment after Cyclic Ageing test: Red

Cyclic Ageing ISO 12944-6 Annex B Exposure 2688 hours			COT sample number 1-6-18/0346			
			Panel 19	**Panel 20**	**Panel 21**	**Requirement**
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		2.8	2.2	2.7	≤ 3.0
	ISO 4624	Adhesion (MPa)	10.3	9.8	7.8	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			8.8	8.8	7.7	
			100% C	100% C	100% C	
			8.0	8.9	8.9	
			100% C	100% C	100% C	

ISO 12944-9 Testing results

Test Specification:	ISO 12944-9
Corrosivity Category:	CX
Immersion Category:	Im4

Table 9. Assessment after Cyclic Ageing Test: White 1

Cyclic Ageing ISO 12944-9 Annex B Exposure 4200 hours			COT sample number 1-6-18/0344			
			Panel 19	**Panel 20**	**Panel 21**	**Requirement**
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		3.7	3.2	2.9	≤ 9.0 mm (CX)
	ISO 4624	Adhesion (MPa)	9.0	9.0	7.6	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			9.8	7.9	8.9	
			100% C	100% C	100% C	
			9.2	8.8	8.4	
			100% C	100% C	100% C	

Table 10. Assessment after Cathodic Disbondment test: White 1

Cathodic disbondment ISO 15711 - Method A Exposure 4200 hours	COT sample number 1-6-18/0344			
	Panel 1.11	Panel 1.12	Panel 1.17	Requirement
Disbondment diameter (mm)	6	6	6	
	-	-	-	
	-	-	-	
	-	-	-	
ECD (mm)	0	0	0	≤ 20 mm

Table 11. Assessment after Immersion test: White 1

Immersion test ISO 2812-2 – ISO 15711 Exposure 4200 hours			COT sample number 1-6-18/0344			
			Panel 1.1	Panel 1.5	Panel 1.7	Requirement
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		8.2	8.2	9.3	≤ 6.0 mm
	ISO 4624	Adhesion (MPa)	100% C	100% C	100% C	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	8.2	8.2	9.3	
			100% C	100% C	100% C	
			8.2	8.2	9.3	
			100% C	100% C	100% C	
			100% C	100% C	100% C	

Table 12. Assessment after Cyclic Ageing test: White 2

Cyclic Ageing ISO 12944-9 Annex B Exposure 4200 hours			COT sample number 1-6-18/0345			
			Panel 2.3	Panel 2.8	Panel 2.9	Requirement
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		3.7	3.8	3.5	≤ 9.0 mm (CX)
	ISO 4624	Adhesion (MPa)	8.5	7.6	7.8	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			8.6	9.9	8.1	
			100% C	100% C	100% C	
			7.6	7.0	9.3	
			100% C	100% C	100% C	

Table 13. Assessment after Cathodic Disbondment test: White 2

Cathodic disbondment ISO 15711 - Method A Exposure 4200 hours	COT sample number 1-6-18/0345			
	Panel 2.6	Panel 2.11	Panel 2.12	Requirement
Disbondment diameter (mm)	6	6	6	
	-	-	-	
	-	-	-	
	-	-	-	
ECD (mm)	0	0	0	≤ 20 mm

Table 14. Assessment after Immersion test: White 2

Immersion test ISO 2812-2 – ISO 15711 Exposure 4200 hours			COT sample number 1-6-18/0345			
			Panel 2.15	Panel 2.19	Panel 2.20	Requirement
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		0	0	0	≤ 6.0 mm
	ISO 4624	Adhesion (MPa)	9.2	7.3	7.1	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			8.5	6.3	8.4	
			100% C	100% C	100% C	
			8.3	6.9	7.9	
			100% C	100% C	100% C	

Table 15. Assessment after Cyclic Ageing test: Red

Cyclic Ageing ISO 12944-9 Annex B Exposure 4200 hours			COT sample number 1-6-18/0346			
			Panel 11	Panel 13	Panel 14	Requirement
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		3.5	3.8	3.8	≤ 9.0 mm (CX)
	ISO 4624	Adhesion (MPa)	7.9	7.8	9.1	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			6.5	6.6	8.9	
			100% C	100% C	100% C	
			8.4	7.6	8.7	
			100% C	100% C	100% C	

Table 16. Assessment after Cathodic Disbondment test: Red

Cathodic disbondment ISO 15711 - Method A Exposure 4200 hours	COT sample number 1-6-18/0346			
	Panel 5	Panel 10	Panel 16	Requirement
Disbondment diameter (mm)	6	6	6	
	-	-	-	
	-	-	-	
	-	-	-	
ECD (mm)	0	0	0	≤ 20 mm

Table 17. Assessment after Immersion test: Red

Immersion test ISO 2812-2 – ISO 15711 Exposure 4200 hours			COT sample number 1-6-18/0346			
			Panel 8	Panel 17	Panel 18	Requirement
Q	ISO 4628-2	Blistering	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-3	Rusting	Ri 0	Ri 0	Ri 0	Ri 0
Q	ISO 4628-4	Cracking	0(S0)	0(S0)	0(S0)	0(S0)
Q	ISO 4628-5	Flaking	0(S0)	0(S0)	0(S0)	0(S0)
	Corrosion from scribe (mm)		0	0	0	≤ 6.0 mm
	ISO 4624	Adhesion (MPa)	7.6	8.6	6.0	≥ 2.5 MPa No A/B break unless ≥ 5MPa
		Break area (%)	100% C	100% C	100% C	
			7.5	8.5	8.8	
			100% C	100% C	100% C	
			6.8	7.6	9.4	
			100% C	100% C	100% C	

All three coatings systems passed the requirements for test methods showing their outstanding protective performance in the toughest environments.

Conclusion

FEVE resins offer great benefits for use in bridge coating paint systems. The technology has a proven record of accomplishment in Japan of over 30 years performance. Furthermore, the testing carried out at COT has verified the performance of coating systems formulated with EU available raw materials to the highest ISO 12944 specification standards.

References

[1] Kristen Blankenship, "Formulation Techniques Using FEVE Resins in Waterborne and High Solids Coatings," Proceedings of the Forty-Second Annual International Symposium of Waterborne, High Solids, and Powder Coatings Symposium, p. 251 (2015).

[2] E. Bure, "Smart Fluorinated Organic Molecules", Molecular structure and energetics vol.3, Chap.4 pp141-191(1986)

[3] Testing and application of coatings performed at: COT Haarlem, The Netherlands (http://www.cot-nl.com/?lang=en)

Appendix 1

Formulations

The topcoat formulations that were used in the testing can be found below.

White 1

Pigment Paste		**(Parts by Weight)**
LUMIFLON™	LF 200	16.7
Solvent	Xylene	14.08
Dispersant	Disperbyk-163*	1.18
Pigment	Ti-Pure R-960**	26.95
	Total	58.9
* *BYK-Chemie*		
** *DuPont*		
Let Down		**(Parts by Weight)**
Pigment paste	Above described	58.9
LUMIFLON™	LF 200	39.5
Defoamer	BYK-141*	0.1
Catalyst	1/1,000 DBTDL (Xylene)	0.4
Rheology modifier	BYK-430*	0.6
Thickner	BYK-431*	0.5
	Total	100.0
* *BYK-Chemie*		
Paint Formulation		
Main pack	Above described	100
Hardener	Desmodur N3300***	6.1
*** *Covestro*		

White 2

Pigment Paste		(Parts by Weight)
LUMIFLON™	LF 200	16.7
Solvent	Xylene	13.66
Dispersant	Disperbyk-163*	1.6
Pigment	PFC-105**	26.95
	Total	58.9
* *BYK-Chemie*		
** *ISK ; Ishihara Sangyo Kaisha*		

Let Down		(Parts by Weight)
Pigment paste	Above described	58.9
LUMIFLON™	LF 200	39.5
Defoamer	BYK-141*	0.1
Catalyst	1/1,000 DBTDL (Xylene)	0.4
Rheology modifier	BYK-430*	0.6
Thickner	BYK-431*	0.5
	Total	100.0
* *BYK-Chemie*		

Paint Formulation		
Main pack	Above described	100
Hardener	Desmodur N3300***	6.1

Red

Pigment Paste		(Parts by Weight)
LUMIFLON™	LF 200	68.38
Solvent	Xylene	10.3
Solvent	Butyl acetate	12.77
Dispersant	Disperbyk-163*	3.1
Pigment	Holtint Red F2R (type1)**	4.4
Matting agent	ACE MAT OK412***	0.05
	Total	99.0
* *BYK-Chemie*		
** *Hollandia International*		
***Evonik Resource Eficiency		

Let Down		(Parts by Weight)
Pigment paste	Above described	99.0
Defoamer	BYK-141*	0.2
Catalyst	1/1,000 DBTDL (Xylene)	0.3
Thickner	BYK-431*	0.5
	Total	100.0
* *BYK-Chemie*		

Paint Formulation		
Main pack	Above described	100
Hardener	Desmodur N3300****	7.33
**** *Covestro*		

様々な環境下で性能を発揮する
高性能フッ素樹脂塗料

BONNFLON GT

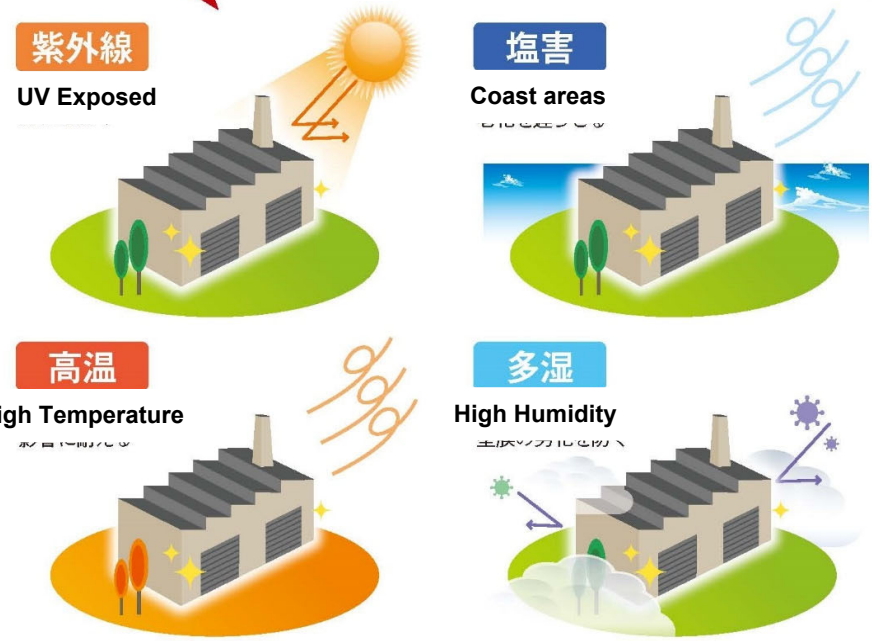
ボンフロンGT(Great Tolerance)とは

Fluoropolymer-resin based coatings responded to particular status environment Explanation of GT (Great Tolerance) AGC Coat-tech, Co. Ltd., has improved about restraint of photocatalytic reaction of titanium oxide that had often been seen in particular status environment.
In a particular status environment (Severe environments such as High temperature, High humidity, Coast areas, Isolated inlands), BONNFLON GT enables the full performance of fluoropolymer coatings.

ボンフロンGTの特長

AGC COAT-TECH CO., LTD has improved about restraint of photocatalytic reaction of titanium oxide that had often been seen in particular status environment.
In a particular status environment (Severe environments such as UV exposed, High Temperature, High Humidity, Coast areas, isolated islands)

ボンフロンGTは沿岸部・離島など厳しい環境下で建物をしっかりと保護



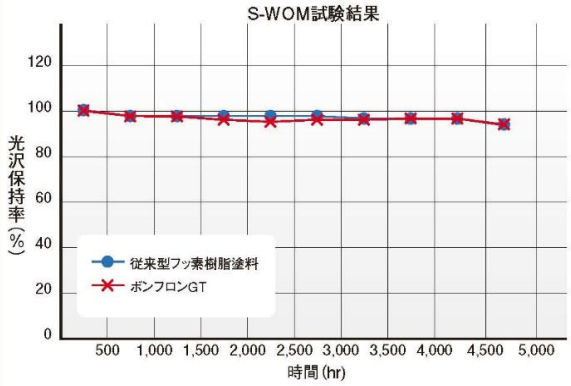
詳しくは弊社までお問合せください。

「ボンフロンGT」の性能データ

BONNFLON GT shows the Improvement of remarkable weather resistance comparing with traditional coating under Super accelerated weathering test.

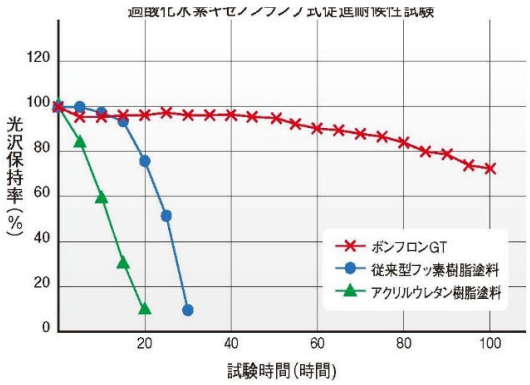
促進耐候性試験

Accelerated Weathering Test by S-WOM



光触媒劣化促進耐候性試験

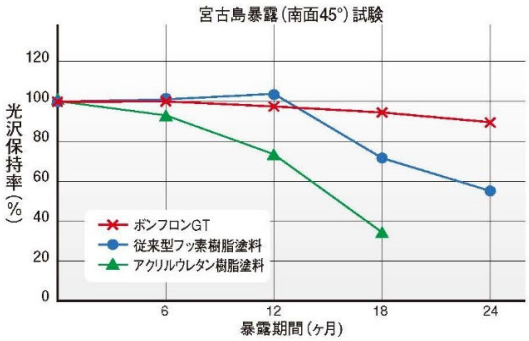
SUPER Accelerated Weathering Test by Xenon Lamp Used Hydrogen Peroxide



宮古島暴露試験

BONNFLON GT shows the improvement of remarkable weather resistance cornering with BONNFLON with the result of Super accelerated weathering test.

Therefore, BONNFLON GT enables excellent weather resistance under several environment.



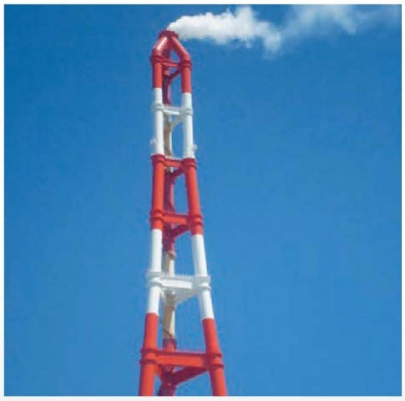
About Super Accelerated weathering test by Xenon lamp used Hydrogen Peroxide
It is different from normal accelerated weathering test, and its test method forces titanium oxide used white pigments to deterioration of photocatalytic.

施工例

沿岸部（海に近い建物）や特殊環境（沖縄等）で効果を発揮します。


沖縄国際大学 5号館


神戸市総合教育センター


AGC鹿島工場煙突

Bonnflon M, M-SR Coating System

Fluororesin Coating System for Metal-Base Materials

- Stanley Electric Co., Ltd. Hatano Factory 2nd Building

  Designed and constructed by Takenaka Corporation

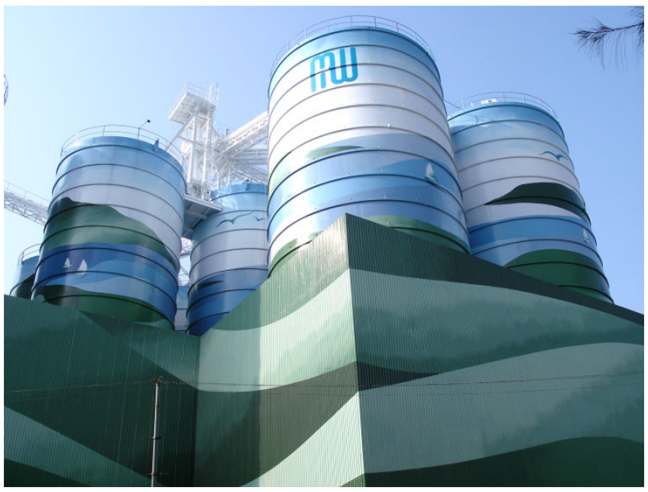
Characteristics

The fluororesin paint, Bonnflon-M GT#2000 and Bonnflon-M GT#2000SR is soluble and hardens at normal temperature, is a high-quality finishing topcoat for metal-base substrate. The fluororesin coating system, Bonnflon M, prevents the metal-base substrate from corrosion and deterioration.

The system may be applied not only on buildings but also on many others, including chemical plants, marine substrates, water treating plants and other special structures that demand the highest resistance against chemicals, salty water or heat.

- Footbridge at Sheung Shing St., Homantin

- Kwai Shing East Ph. 7



- Tai Po Silo

1. Excellent Weatherability

Excellent weatherability and UV resistance, the basis features of fluororesin, prevent coating surface from degradation.

2. Strong Anti-chemicals/solvents (Acid Rain)

Excellent properties of the products against chemicals including alkaline, acidic substances and a range of solvents with excellent weatherability highly function in being applied in chemical industry areas and under harsh weather conditions like in seashore.

3. Cost Saving Performance

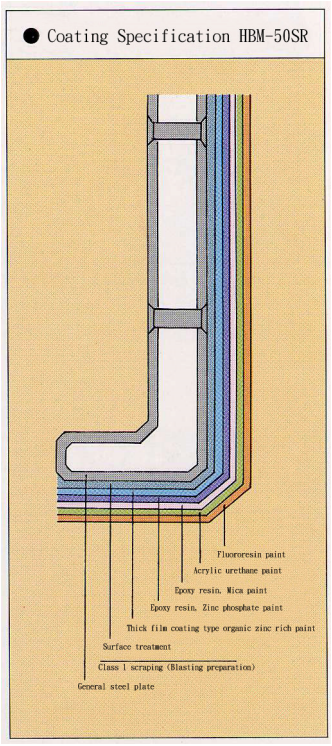
Excellent weatherability extends the maintenance cycle significantly compared to the conventional coating system. Considering the cost of repainting (preliminary cost + labour cost), the material cost becomes remarkably low.

4. Excellent Recoating

Bonnflon has the excellent property of recoating. Repainting and repairing with a paint of its kind are easy.

5. Low Pollution

Bonnflon M-SR coating system protects coated surface from contaminated materials including grease substances. When raining, rainfall runs across the surface with less stain stripes by rain. Thus, contaminated materials are easily washed away.



Bonnflon M, M-SR Coating System Standard Specification

Specification	Applicable Materials	New Construction Coating or Repaint	Base Adjustment	Painting Site
HBM-15 HBM-15SR	Steel plate for general structure Steel products	New construction coating	Class 1 Scraping	Factory + Onsite
HBM-30 HBM-30SR	Steel plate for general structure Steel products	Repaint	Class 3 Scraping leave active film as it is	Onsite
HBM-50 HBM-50SR	Zinc plating surface, aluminum material, bonderized steel sheet iron	New construction coating	Conversion treatment degreasing, cleaning	Onsite
HBM-60 HBM-60SR	Zinc plating surface, aluminum material, bonderized steel sheet iron	Repaint	Remove deteriorated coating, leave active film as it is	Onsite

Surface Preparation

The function of excellent anticorrosion coating system for metal-base substrates can be achieved relying on coating adhesion and careful surface treatment on metal surface. Surface treatment is the most important process in anticorrosion coating and affects coating durability.

The selection of suitable coating system depends on anti-corrosiveness, humidity, dry period and the surface condition such as existing paint film, etc. Thus, the surface treatment must be considered in the specification of Bonnflon M Coating System.

It is recommend to choose the class higher than the specified surface treatment. The methods and class of surface treatment for surface specifications are as follows:

Surface Preparation Method and Degree

Type of Scraping	Method	Surface Preparation	Related Specification SSPC*1 (USA)	Related Specification SIS*2 (Sweden)
Class 1	Blasting	Remove old coating and rust completely to obtain gray white color	SSPC -SP5	SIS Sa3
			SSPC -SP10	SIS Sa2½
	Acid cleaning	Remove black pitch and rust completely	SSPC -SP8	—
Class 2	Power tool	Remove old coating and rust until steel surface exposed. When active coating exists, wet on the surface.	SSPC -SP3	SIS St3
Class 3	Hand tool (Power tool)	Remove deteriorated coating with tool on whole surface. Remove rust to expose iron surface exposes.	SSPC -SP2	SIS St2

*1 SSPC Surface Treatment Specification: STEEL STRUCTURES PAINTING COUNCIL
*2 SIS Specification: SVENSK STANDARD SIS05.99.00

Standard Specifications of Bonnflon HBM-15 Coating System

[Applicable materials] General structural steel, steel lumber,
[Application category] Class 1 scraping

[Applicable category] New construction coating at factory and site

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m²)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Class 1 scraping Blasting preparation SSPC-SP 10 (SIS 2.5 or higher)							
Undercoat-1	Bonnzinc #20ZHB (Thick coating film type organic zinc rich coat)	22.5 : 2.5	0 ~ 5 Exclusively used thinner	0.45	50	1	2 days or more, within 6 days	Spray
Secondary surface preparation	1. Wash the coated surface in the factory and dry completely after removing adhered saline matter. 2. Damaged area on undercoat from the welded joint on site which may cause the defect of coating film, surface treatment should be doned before the apply of repairing coat. 3. Remove the rust including white rust on the coating surface completely with power tool. Remove grease or dust by using thinner etc.							
Repairing coat	Bonnzinc #20ZHB (Thick coating film type organic zinc rich coat)	22.5 : 2.5	0 ~ 5 Exclusively used thinner	—	—	(1)	1 day or more, within 7 days	Brush
Undercoat-2	Bonn Epocoat #30HB (Epoxy polymer zinc phosphate based coat)	12.8 : 3.2	0 ~ 5 Exclusively used thinner	0.15	30	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat-1	Eporime MC (Epoxy polymer Mica based coat)	11.2 : 4.8	0 ~ 5 Exclusively used thinner	0.20	40	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat-2	Bonnflon GT#2000 (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more, within 7 days	Roller Brush Spray
Finishing coat	Bonnflon GT#2000 Topcoat (Thick coating film type fluororesin coat)	13 : 1	20 ~ 30 Bonnflon thinner	0.15	30	1	—	Roller Brush Spray

(Note 1) The needed quantity differs in specifications under special conditions such as seaside and/or chemical environment. Inorganic zinc rich (Bonnzinc#10QC) is also available.
(Note 2) Factory application: After the blasting apply Bonnzinc #20Z by spray (0.20 ~ 0.25 kg/m² 25μ) immediately
(Note 3) Brushes and rollers can be used as the coating method.
But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

Standard Specifications of Bonnflon HBM-30 Coating System

[Applicable materials] General structural steel, steel lumber,
[Application category] Class 3 scraping, remove old coated surface and remain active film

[Applicable category] Repaint on site

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m²)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Class 3 scraping Remove deteriorated film and rust with hand or power tool such as electric sander grinder, scraper, wire wheels. Scraping the rust generated portions until steel surface exposes.							
Undercoat	Bonn Epocoat #10MP (Epoxy polymer red-lead coat)	17.6 : 2.4	0 ~ 5 Exclusively used thinner	0.24	40	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat-1	Eporime MC (Epoxy polymer Mica based coat)	11.2 : 4.8	0 ~ 5 Exclusively used thinner	0.25	50	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat-2	Bonnflon #2000 Surfacer (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more	Roller Brush Spray
Finishing coat	Bonnflon #2000 Topcoat (Thick coating film type fluororesin coat)	13 : 1	20 ~ 30 Bonnflon thinner	0.15	30	1	—	Roller Brush Spray

(Note 1) Bonn Epocoat #10MP can be applied onto the old coated surface (active film condition) such as alkyd, polyvinyl, epoxy, urethane based coat
(Note 2) Brushes and rollers can be used as the coating method.
But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

Standard Specifications of Bonnflon HBM-50 Coating System

[Applicable materials] Zinc plating surface, aluminum material, bonderized steel sheet iron [Applicable category] New construction coating on site
[Application category] Degreasing, cleaning

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m^2)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Decreasing, cleaning Remove adhered dust, greases by an appropriate method.							
Undercoat	Bonn Epocoat #35HB (Epoxy polymer zinc phosphate coat)	12.8 : 3.2	0 ~ 5 Exclusively used thinner	0.30	60	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat	Bonnflon #2000 Surfacer (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more, within 7 days	Roller Brush Spray
Finishing coat	Bonnflon #2000 Topcoat (Thick coating film type fluororesin coat)	13 : 1	20 ~ 30 Bonnflon thinner	0.15	30	1	—	Roller Brush Spray

(Note 1) When coating in locations such as seaside, industrial area and indoor pool where corrosion environment are severe, apply Eporime MC (0.25 kg/m^2 (50μ) on the 2nd layer for 4 layer specifications.
(Note 2) Brushes and rollers can be used as the coating method.
But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

Standard Specifications of Bonnflon HBM-60 Coating System

[Applicable materials] Zinc plating surface, aluminum material, bonderized steel sheet iron [Applicable category] Repaint on site
[Application category] Class 3 scraping, remove old coated surface and remain active film

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m^2)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Class 3 scraping Remove deteriorated film and rust with hand or power tool such as electric sander grinder, scraper, wire wheels. Remain active films.							
Undercoat	Bonn Epocoat #55MP (Epoxy polymer zinc phosphate coat)	12.8 : 3.2	0 ~ 5 Exclusively used thinner	0.17	40	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat	Bonnflon #2000 Surfacer (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more, within 7 days	Roller Brush Spray
Finishing coat	Bonnflon #2000 Topcoat (Thick coating film type fluororesin coat)	13 : 1	20 ~ 30 Bonnflon thinner	0.15	30	1	—	Roller Brush Spray

(Note 1) When coating in locations such as seaside, industrial area and indoor pool where corrosion environment are severe, apply Eporime MC (0.25 kg/m^2 (50μ) on the 2nd layer for 4 layer specifications.
(Note 2) Bonn Epocoat #55MP can be applied onto the old coated surface (active film condition) such as alkyd, polyvinyl, epoxy, urethane based coat
(Note 3) Brushes and rollers can be used as the coating method.
But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

Standard Specifications of Bonnflon HBM-15 SR Coating System

[Applicable materials] General structural steel, steel lumber
[Application category] Class 1 scraping
[Applicable category] New construction coating at factory and site

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m²)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Class 1 scraping Blasting preparation SSPC-SP 10 (SIS 2.5 or higher)							
Undercoat-1	Bonnzinc #20ZHB (Thick coating film type organic zincrich coat)	22.5 : 2.5	0 ~ 5 Exclusively used thinner	0.45	50	1	2 days or more, within 6 days	Roller Brush Spray
Secondary surface preparation	1. Wash the coated surface finished in the factory and remove the adhered saline matte, then dry it completely. 2. For welded parts jointed at the site and undercoat film damaged parts that may cause coat film defectiveness, repairing coating shall be done after thorough surface preparation. 3. The rust generated on the coated surface shall be completely removed with power tools, etc. Fats and oils, dust, etc. shall also be removed by using a thinner or adequate methods.							
Repairing coat	Bonnzinc #20ZHB (Thick coating film type organic zincrich coat)	22.5 : 2.5		—	—	(1)	1 day or more, within 7 days	Brush
Undercoat-2	Bonn Epocoat #30HB (Epoxy polymer zinc phosphate based coat)	12.8 : 3.2	0 ~ 5 Exclusively used thinner	0.15	30	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat	Eporime MC (Epoxy polymer Mica based coat)	11.2 : 4.8	0 ~ 5 Exclusively used thinner	0.20	40	1	1 day or more, within 7 days	Roller Brush Spray
Finishing coat-1	Bonnflon #2000 Surfacer (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more	Roller Brush Spray
Finishing coat-2	Bonnflon #2000SR Topcoat (Low pollution type fluororesin coat)	12.5 : 2.5	20 ~ 30 Bonnflon thinner	0.13	25	1	—	Roller Brush Spray

(Note 1) The needed quantity differs in specifications under special conditions such as seaside and/or chemical environment. Inorganic zinc rich (Bonnzinc#10QC) is also available.
(Note 2) Factory application: After the blasting apply Bonnzinc #20Z by spray (0.20 ~ 0.25 kg/m² 25μ) immediately
(Note 3) Brushes and rollers can be used as the coating method. But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

Standard Specifications of Bonnflon HBM-30 SR Coating System

[Applicable materials] General structural steel, steel lumber,
[Application category] Class 3 scraping, remove old coated surface and remain active film
[Applicable category] Repaint on site

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m²)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Class 3 scraping Remove deteriorated film and rust manually or be powered tools (electric sander grinder, scraper, wire wheels, etc.). Scrape the rust generated portions until the steel exposed							
Undercoat	Bonn Epocoat #10MP (Epoxy polymer red-lead coat)	17.6 : 2.4	0 ~ 5 Exclusively used thinner	0.24	40	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat-1	Eporime MC (Epoxy polymer Mica based coat)	11.2 : 4.8	0 ~ 5 Exclusively used thinner	0.25	50	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat-2	Bonnflon #2000 Surfacer (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more	Roller Brush Spray
Finishing coat	Bonnflon #2000SR Topcoat (Low pollution type fluororesin coat)	12.5 : 2.5	20 ~ 30 Bonnflon thinner	0.15	30	1	—	Roller Brush Spray

(Note 1) Bonn Epocoat #10MP can be applied onto the old coated surface (active film condition) such as alkyd, polyvinyl, epoxy, urethane based coat
(Note 2) Brushes and rollers can be used as the coating method. But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

Standard Specifications of Bonnflon HBM-50 SR Coating System

[Applicable materials] Zinc plating surface, aluminum material, bonderized steel sheet iron [Applicable category] New construction coating on site
[Application category] Degreasing, cleaning

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m²)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Decreasing, cleaning Remove adhered dust, greases by an appropriate method.							
Undercoat	Bonn Epocoat #35HB (Epoxy polymer zincphosphate based coat)	12.8 : 3.2	0 ~ 5 Exclusively used thinner	0.30	60	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat	Bonnflon #2000 Surfacer (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more	Roller Brush Spray
Finishing coat	Bonnflon #2000SR Topcoat (Low pollution type fluororesin coat	12.5 : 2.5	20 ~ 30 Bonnflon thinner	0.15	30	1	—	Roller Brush Spray

(Note 1) When coating in locations such as seaside, industrial area and indoor pool where corrosion environment are severe, apply Eporime MC (0.25 kg/m² (50μ) on the 2nd layer for 4 layer specifications.
(Note 2) Brushes and rollers can be used as the coating method.
But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

Standard Specifications of Bonnflon HBM-60 SR Coating System

[Applicable materials] Zinc plating surface, aluminum material, bonderized steel sheet iron [Applicable category] Repaint on site
[Application category] Class 3 scraping, remove old coated surface and remain active film

Process	Material to be used	Composition ratio Main agent : Hardener (kg)	Dilution (%)	Theoretical Spreading Rate (kg/m²)	Dried film thickness (μ/time)	Times of Coating	Coating Interval (20°C)	Coating Method
Surface preparation	Scraping: Remove deteriorated film and rust manually or by powered tools (electric sander grinder, scraper, wire wheels etc.) Remains the active films.							
Undercoat	Bonn Epocoat #55MP (Epoxy polymer zinc based coat)	12.8 : 3.2	0 ~ 5 Exclusively used thinner	0.17	40	1	1 day or more, within 7 days	Roller Brush Spray
Intermediate coat	Bonnflon #2000 Surfacer (Thick coating film type poly urethane based coat)	15 : 1	30 ~ 50 Exclusively used thinner	0.13	25	1	16 hours or more	Roller Brush Spray
Finishing coat	Bonnflon #2000SR Topcoat (Low pollution type fluororesin coat)	12.5 : 2.5	20 ~ 30 Bonnflon thinner	0.15	30	1	—	Roller Brush Spray

(Note 1) When coating in locations such as seaside, industrial area and indoor pool where corrosion environment are severe, apply Eporime MC (0.25 kg/m² (50μ) on the 2nd layer for 4 layer specifications.
(Note 2) Bonn Epocoat #55MP can be applied onto the old coated surface (active film condition) such as alkyd, polyvinyl, epoxy, urethane based coat
(Note 3) Brushes and rollers can be used as the coating method.
But care should be taken that the dilution ratio and the needed quantity differ from those of spray.

• Suitable Range of Maintenance Primer

Product	Material	Coating Specification	Old coatings which allow the recoating of maintenance primer (active film)
Bonn Epocoat #10MP	Steel plate for general structure, steel products	HBM-30 HBM-30SR	Alkyd, polyvinyl, epoxy, urethane
Bonn Epocoat #55MP	Zinc plating surface, aluminum material, bonderized steel sheet iron	HBM-60 HBM-60SR	

• Test Coating Method of Maintenance Primer … Ensure the coating of post-process.

Old Coating	Maintenance Primer			Coating Interval (20°C)	Post-process		
	Product	Quantity of Coating	Thickness of Dry Coating		Product	Quantity of Coating	Thickness of Dry Coating
Active film	Bonn Epocoat #10MP	0.24 kg/m²	40μ	1 day	Eporime MC	0.25 kg/m²	50μ
Active film	Bonn Epocoat #55MP	0.17 kg/m²	40μ	1 day	Bonnflon #2000 Surfacer	0.13 kg/m²	25μ

(Note 1) Check irregularity like lifting after the post-process.
(Note 2) Perform cross-cut adhesion test to check adherence after one week (20°C)

1 Coating Specification

Bonnflon a weather-resistant fluororesin paint, protects materials for a long term with suitable coating method. However, ineffective anti-rust and anti-corrosion surface treatment reduces the life of whole coating system. Please consider carefully the specification and method statement of different Bonnflon-M coating systems for different substrates.

2 Treatment of Processed Parts and Outside Angles

Perform anti-rust treatment such as touch-up and repaint on the processed parts and outside angles of welding.

3 Second Surface Treatment (Onsite Scraping)

3.1 Welded Parts

- Smooth the weld flux putter and bean parts by power tools (grinder) or Blasting to perform surface treatment.
- Remove alkali slug of weld parts and expose for one monthly or wash for neutralize completely after weld.
- Remove burned films or marks carefully.
- Repaint coating system in concaved parts and welded parts.

3.2 Bolt/Rivet Parts

Remove black scales with power tool and/or hand tool. It is very difficult to completely remove the black scales except by Blasting, so, the surface treatment often become ineffective. The selection of suitable coating system is very important.

3.3 Rusting Parts

For the damaged or deteriorated parts during transportation or installation, remove the rust with power tool to the degree of SSPC-SP3 (SIS St3). Perform blasting partially to get favorable result.

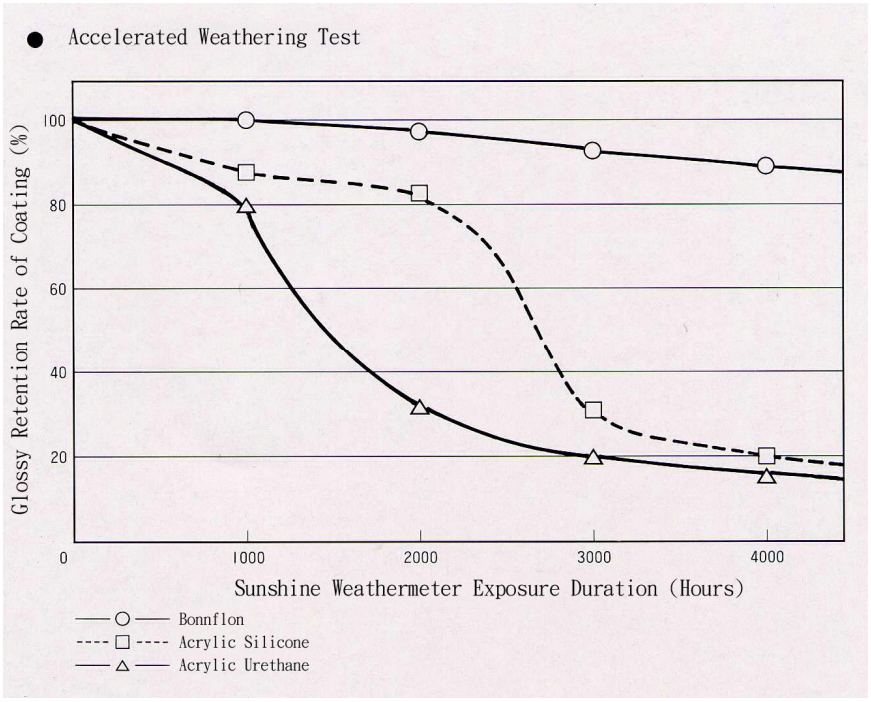
3.4 General

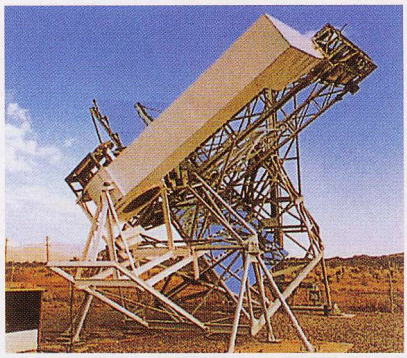
When sea salt particle attach on the coated surface during transportation, storage or installation, wash the surface with water. After washing, dry completely to dehydrate. Remove attached concrete, grease or black pitch with scraper or disc sander. If these tools cannot remove completely, use thinner.

When zinc rich paint is used for factory application, white rust may occur by exposure for a long time. Remove white rust with puff.

Weatherability of Bonnflon

Bonnflon has excellent weather resistance. In the accelerated weathering test by Sunshine Weathermeter, the Bonnflon coating film exposed for 4000 hours lowers only 10% or less of glossy retention. This is equivalent to 90% or more glossy retention in 20 years in general coating tests. Also the most severe climate conditioned test in EMMAQUA Testing Center in Arizona, U.S., there was no abnormality found after two million Langley irradiation, equivalent of approx. 20 years.





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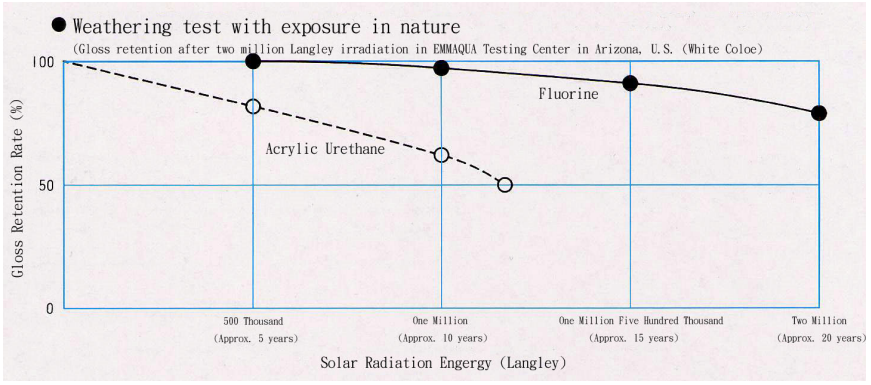

Surface Properties of Bonnflon SR

Testing Fluid (Testing Conditions)	Contact Angle (Degree)			Comments
	Bonnflon SR	Conventional	Other Acrylic	
Water (static)	70 ~ 75	85 ~ 90	85 ~ 90	Hydrophilic ratio heightens with reduction in size
Water (flowing)	85 ~ 88	93 ~ 95	91 ~ 93	When 90° or lower, fluidity is increased accordingly
Nujol (in the air)	30 ~ 45	15 ~ 20	15 ~ 20	The lipophilicity increases with size
Octane (in water)	95 ~ 97	75 ~ 78	53 ~ 57	When in excess of 90°, pollution becomes more difficult to adhere and fluidity increases

Physical Properties of Bonnflon SR

Testing Item	Bonnflon SR	Conventional Bonnflon	Comments
1. Appearance	No change	No change	JIS-K 5658 4.6
2. Relative-specular glossiness (60°)	80	80	JIS-K 5658 4.8 60° – 60° Relative-specular glossiness
3. Adhesion	10 points	10 points	JIS-K 5658 4.10 Crosscut test 5mm x 4
4. Impact resistance	No change	No change	JIS-K 5658 4.9 Weight 400g, Height 500mm
5. Acid resistance	No change	No change	JIS-K 5658 4.12 5% sulfuric acid, 7 days
6. Alkaline resistance	No change	No change	JIS-K 5658 4.13 5% sodium hydrate, 7 days
7. Repeated warming and cooling moisture resistance	No change	No change	JIS-K 5658 4.14 10 cycle
8. Accelerated weathering test	No change	No change	JIS-K 5658 4.16 SWOM 4000 hrs

Note on Storage of Materials

1. Storage with Disaster Prevention Measures

   The materials include hazardous objects such as solvent base paint, thinner, main agents, hardener. Make sure to ● indicate danger signboard and ● install fire extinguishers in the storage. The delivery of solvent base materials to sites should be within the designated number under the Fire Prevention Law.

2. Note on Quality Control of Materials

   Store the materials indoors as far as possible for quality control such as to ● prevent impurities being mixed and for ● anti-freeze at low temperature. If storage outdoors is unavoidable, place them on decking and cover them with sheet.

	Product Name		Package (kg)		Tone	Product Type
Undercoat	Bonnzinc #20Z	Paint Hardener Thinner	22.25 2.75 } 25 15	4.45 0.55 } 5 5	Gray	Organic zinc rich paint
	Bonnzinc #20ZHB	Paint Hardener Thinner	22.25 2.5 } 25 15	4.45 0.5 } 5 5	Gray	Thick coating film type, Organic zinc rich paint
	Bonn Epocoat #30HB	Paint Hardener Thinner	12.8 3.2 } 16 15	3.2 0.8 } 4 5	White gray	Epoxy resin Zinc phosphate paint
	Bonn Epocoat #35HB	Paint Hardener Thinner	12.8 3.2 } 16 15	3.2 0.8 } 4 5	White gray	Epoxy resin Zinc phosphate paint
	Bonn Epocoat #10MP	Paint Hardener Thinner	17.6 2.4 } 20 15	4.4 0.6 } 5 5	Rubiginous	Epoxy resin Zinc red lead paint
	Bonn Epocoat #55MP	Paint Hardener Thinner	12.8 3.2 } 16 15	3.2 0.8 } 4 5	White gray	Epoxy resin Red lead paint
	Bonn Eporust R	Paint Hardener Thinner	16.4 3.6 } 20 15	4.1 0.9 } 4 5	Red lead color	Epoxy resin Red lead paint
Intermediate coat	Bonn Eporime MIO	Paint Hardener Thinner	16.0 4.0 } 20 15	4.0 1.0 } 5 5	Brown	Epoxy resin MI0 paint
	Bonn Eporime MC	Paint Hardener Thinner	11.2 4.8 } 16 15	2.8 1.2 } 4 5	Gray Cream color	Epoxy resin Mica paint
	Bonn Eporust SC	Paint Hardener Thinner	16.0 4.0 } 20 15	4.0 1.0 } 5 5	Rubiginous	Epoxy resin Red lead paint
	Bonnflon #2000 Surfacer	Main agent Hardener Thinner	15 1 } 16 16L	3 0.2 } 3.2 4L	Standard color	Thick coating film type Acrylic urethane resin paint
Topcoat	Bonnflon #2000 Topcoat	Main agent Hardener Thinner	13 1 } 14 16L	3.72 0.28 } 4 4L	Standard & Tailor made	Thick coating film type fluororesin paint
	Bonnflon #2000SR Topcoat	Main agent Hardener Thinner	12.5 2.5 } 15 16L	3.3 0.7 } 4 4L	Standard & Tailor made	Low pollution type fluororesin paint

AGC Coat-Tech Co., Ltd.

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