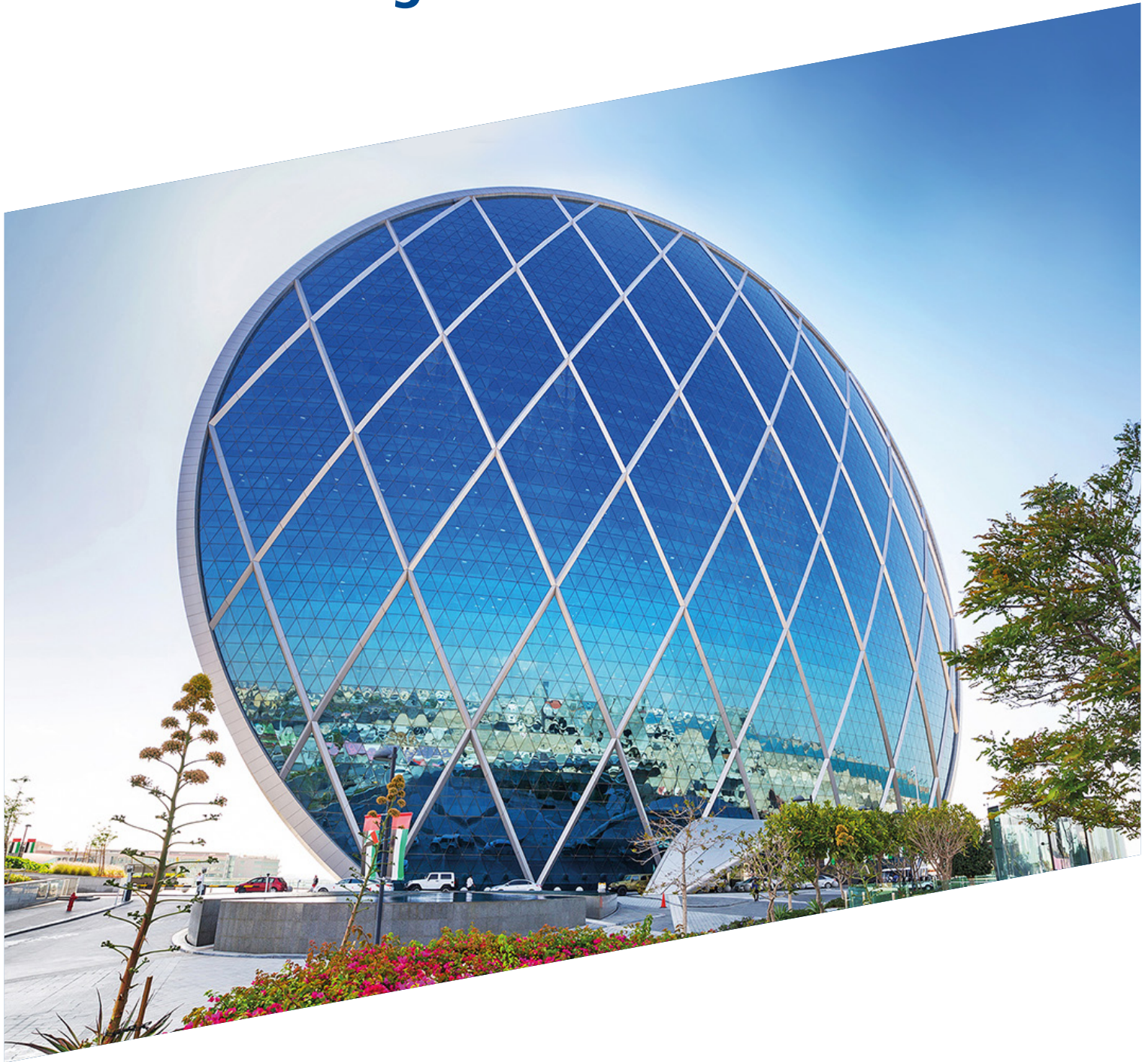




# LF710F: Formulating Hyper Durable Powder Coatings



## 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. Powder coatings based on FEVE resins have found applications in iconic architectural constructions worldwide ensuring long lasting protection against the elements.

## LF710F

LF710F is a powder coating resin produced by AGC. This bulletin presents technical data and advice on formulating the best possible coating systems. The basic properties of the LF710F resin are summarized in Table 1.

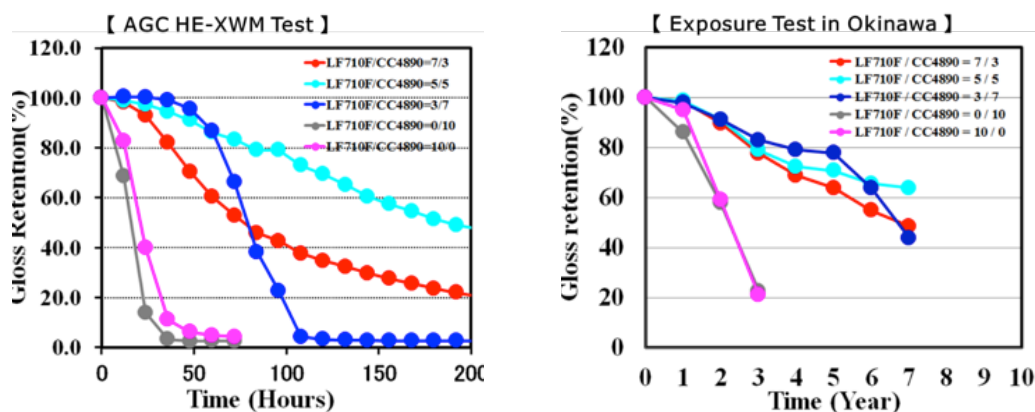
Table 1: LF710F general properties

T <sub>g</sub> (°C)	52
Solid Content (wt %)	>98.5
OH value (mg KOH / g polymer)	46

## Blend with polyesters

In order to formulate powder coatings that can comply with the highest architectural standards with respect to outdoor durability (AAMA 2605, Qualicoat Class 3) it is necessary to blend the LF710F resin with high durable polyesters. This enables a better wetting of the TiO<sub>2</sub> pigments as well as offering improved adhesion. Several blend ratios have been investigated by HE-XWM accelerated weathering testing as well as Florida and Okinawa exposure. Results can be seen below:

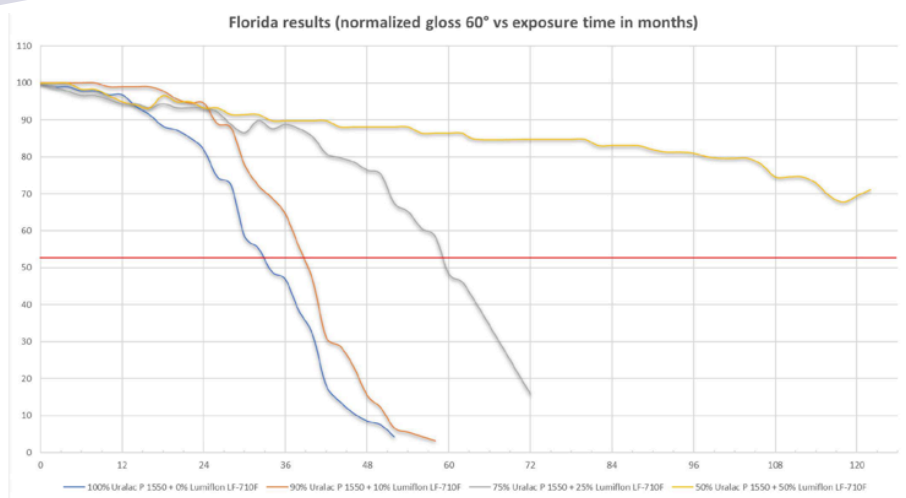
Figure 1: HE-XWM and Okinawa data of LF710F and CC4890 blended systems



(TiO<sub>2</sub> pigment: Dupont R960, Crosslinker: Evonik: Vestagon B1530)

Florida exposure measurements were performed by DSM of blends of LF710F and their high durable polyester grade Uralac P1550. The results are presented below:

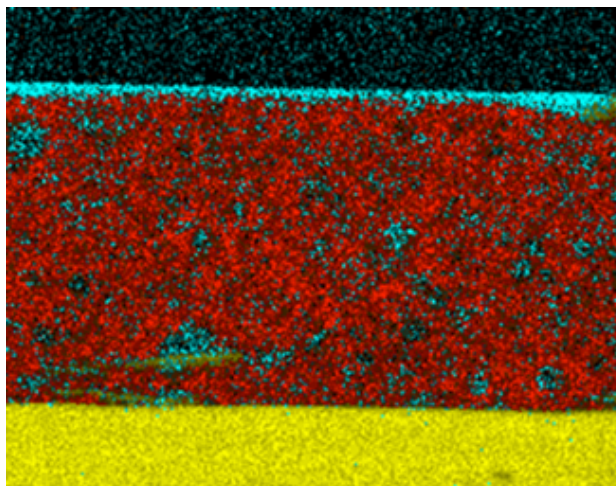
*Figure 2: Uralac P1550 / LF710 Florida Exposure*



Both data sets indicate that blending 30 to 50% of high durable polyester with 70 to 50% of LF710F results in the best performing coatings which are able to endure 10y Florida outdoor exposure while maintaining more than 50% of their original gloss level.

Blending at these levels results in a self-stratifying effect producing a thin clear coat of LUMIFLON™ in the coating. We believe this is one of the main reasons for the good weatherability. Below an STM image that shows the phase separation clearly.

*Figure 3: STM image of an LF710F / polyester blended white coating*



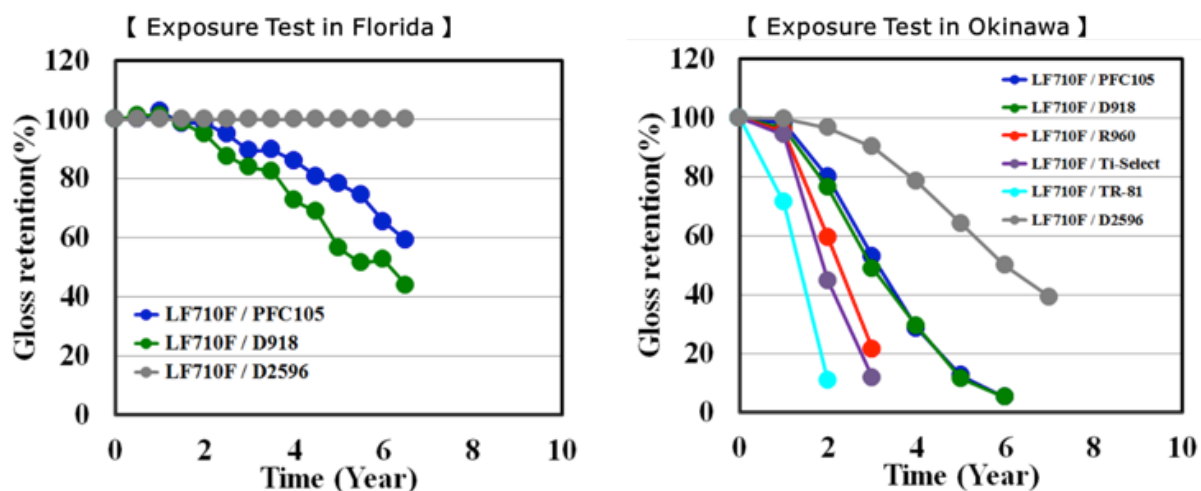
*Blue: Fluorine, Red: Titanium, Yellow: Aluminium*

## TiO<sub>2</sub> grades

The choice of titanium dioxide pigment can be of crucial importance in optimizing the weathering performance. Below depicted graphs show a comparison of TiO<sub>2</sub> grades in a 100% LF710F powder coating. A clear difference can be seen. The D2596 made by Sakai performs the best but is not commercially available. Of the commercially available grades the PFC105 made by Ishihara would be the recommended grade.



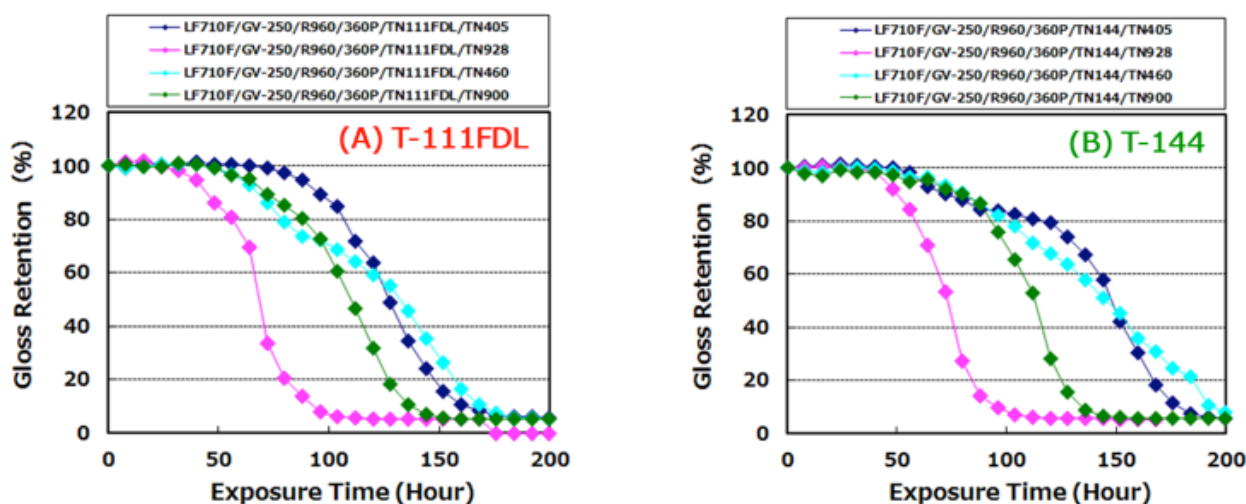
Figure 4: TiO<sub>2</sub> comparison in 100% LF710F systems in Florida and Okinawa exposure



## UV/HALS combinations

Further optimization of the formulation is possible by the incorporation of UV absorbers and HALS (hindered amine light stabilizers). The type/grade to be used depends a lot on the polyester which is used in the hybrid formulation with LF710F. To illustrate the difference in performance that can be found we show in the figure below two different types of HALS (T-111FDL and T-144) combined with 4 different types of UV absorber (TN405, TN928, TN460, and TN900) in a LF710F / GV-250 hybrid system.

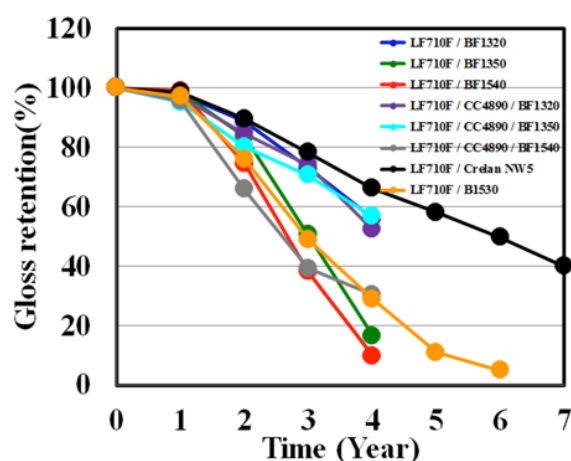
Figure 5: HE-XWM data of different UVA / HALS combinations in hybrid powder coating formulations



## Hardeners

The LF710F resin can be cured with isocyanate hardeners. Many different types are available from a variety of suppliers. As can be seen in the graphs below the hardener has a clear impact on the weathering properties of the final coating. In our studies we found the best performance with Crelan NW5, Vestagon BF1350 and BF1320.

Figure 6: Okinawa exposure with different hardeners



## Conclusion

In order to formulate a powder coating fulfilling the highest industrial standards there are many parameters to be considered. As a starting point the LF710F resin needs to be blended with a high durable polyester of which several examples were presented. Next, the choice of titanium dioxide (or other pigments) is of great importance. Finally, the formulations can be further fine-tuned by choosing the right hardener and UV/HALS combination.

## Guideline Formulation and processing conditions

Formulation	LF710F/polyester	Pre-mixing	Strand S102DS Lab Grinder 5 sec
LF710F	140.0	Extrusion conditions	MP24PC Integra
CC4890	140.0	%feed	20
B1530	65.0	RPM	250
BYK360P	10.0	Zone 3: F	197
Benzoin	2.0	Zone 4: F	230
R960	175.0	Zone 5: F	248
Tinuvin 144	2.6	Zone 6: F	248
Tinuvin 405	5.2	Torque (%)	
DBTDL 1/100	1.1	Grinding	Retsch Ultra Centrifugal Mill ZM200
<b>Total</b>	<b>541</b>	Screen	250 µm
		Cure	20 min @ 200 C



Masdar Institute, Abu Dhabi

# AGC

## European Office

AGC Chemicals Europe, Ltd.  
Commercial Centre  
World Trade Center  
Zuidplein 80  
1077 XV Amsterdam  
Netherlands  
Tel: +31 (0) 20 880 4170  
Email: [lumiflon@agcce.com](mailto:lumiflon@agcce.com)  
[www.agcce.com](http://www.agcce.com)

## Russian Office

AGC Chemicals RUS  
Russian Federation  
121596 Moscow  
Gorbunova Street 2  
Grand Setun Plaza, Building 204, BC  
5th Floor, Block B, Office B 504  
Tel: +7 495 4116566  
[www.agcce.com/главная](http://www.agcce.com/главная)

## Head Office and Manufacturing Site

AGC Chemicals  
AGC Inc.  
Shin-Marunouchi Building  
1-5-1, Marunouchi  
Chiyoda-ku, Tokyo  
100-8405  
Japan  
Tel: +81-3-3218-5875  
[www.agc.com](http://www.agc.com)

REF: LF POW COAT 05-2019