



Three Year Florida Natural Weathering

FP-Opacity Pigments™ in Architectural Wood Coatings

September 2021

Paint study

Formulation and TiO₂ products tested

Testing protocol

Colour fade results

Gloss change results

Chalking results

Conclusions

FP-Opacity Pigments™

are a partial replacement for TiO₂

are significantly lower cost than TiO₂

provide significant annual raw material costs savings

give equal to slightly improved performance

FP-460 Durability Evaluation and Formulation

Purpose - To assess the effect of replacing given levels of TiO₂ with FP-460 Opacity Pigment™ in a series of exterior coatings containing various TiO₂ product types is being evaluated.

Standard Formulation					
	%	Material Type	Supplier		
Water	7.27				
Natrosol Plus 330	0.13	Modified Hydroxyethylcellulose	Ashland Inc		
Ammonia (25%)	0.11	Base			
CHP 804	0.21	Anionic Dispersant	CH-Polymers		
Berol 185	0.15	Non-ionic surfactant	AkzoNobel		
DPnB	1.14	Coalescent	DOW		
BYK 037	0.30	Defoamer	BYK		
FP 460	0.00	Opacity Pigment	FP-Pigments		
Titanium Dioxide	20.81	Titanium Dioxide	Huntsman, DuPont, Cristal, Kronos		
Omyacarb 2 GU	4.96	Calcium Carbonate	Omya		
Acticide MV14 1:10 H2O	0.15	Biocide	Thor		
Water	9.58				
DPnB	0.57	Coalescent	DOW		
Acticide MKW 3	1.98	Biocide	Thor		
BYK 037	0.11	Defoamer	BYK		
Emulsion	49.56	Acrylic Co-polymer Emulsion			
Propylene Glycol	1.30	Open Time Solvent			
Ammonia (25%)	0.32	Base			
Acrysol TT 935 : Water 1:2	1.37	HASE Thickener	DOW		
Total:	100.00				
Paint Properties:			Viscosity:		3 days
Solid Content	Weight-%	50.46	-Krebs Stormer	KU	92
	Vol %	35.59	-Brookf. RV4 /1rpm	P	172
PVC	%	23.88	-Brookf. RV4 /10rpm	P	46
VOC	g/l	39.64	-Brookf. RV5 /100rpm	P	17
Density	kg/l	1.300	-ICI	cP	51
pH		8.2			

Evaluation Protocol-TiO₂ Pigments and Testing

TiO₂ products evaluated in this study:

Pigment	Producer	TiO ₂ Content	Coating	Expected Durability	Replacement Ratio
TIOXIDE® R-HD2	Venator	95.0%	Alumina	Low Durability	0%, 5%, 10%, 20%, 50%
TIOXIDE® TR92	Venator	94.0%	Alumina, Zirconia	Moderate Durability	0%, 10% and 20%
TiONA® 595	Tronox	95.0%	Alumina, Zirconia	Moderate Durability	0%, 10% and 20%
Kronos® 2310	Kronos	93.0%	Alumina, Silica, Zirconia	Highly Durable	0%, 10% and 20%
TiPure™ R-706	Chemours	93.0%	Alumina, Silica	Highly Durable	0%, 10% and 20%
Kronos® 2160	Kronos	91.0%	Alumina, Silica	Super Durable	0%, 5%, 10%, 20%, 50%

Testing protocol

White and blue tinted paints produced for each coating and applied to Red Cedar Panels.

The panels have been exposed in Florida, 45° South Facing for 36 months.

Measurements taken: Colour (CIE L*, a*, b*), Gloss (60°) and Chalking value

Colour Fade Evaluation Results

Colanyl Blue B2G 131 was recommended by Clariant for both interior and exterior use and was used at a concentration of 2% in the white paint.

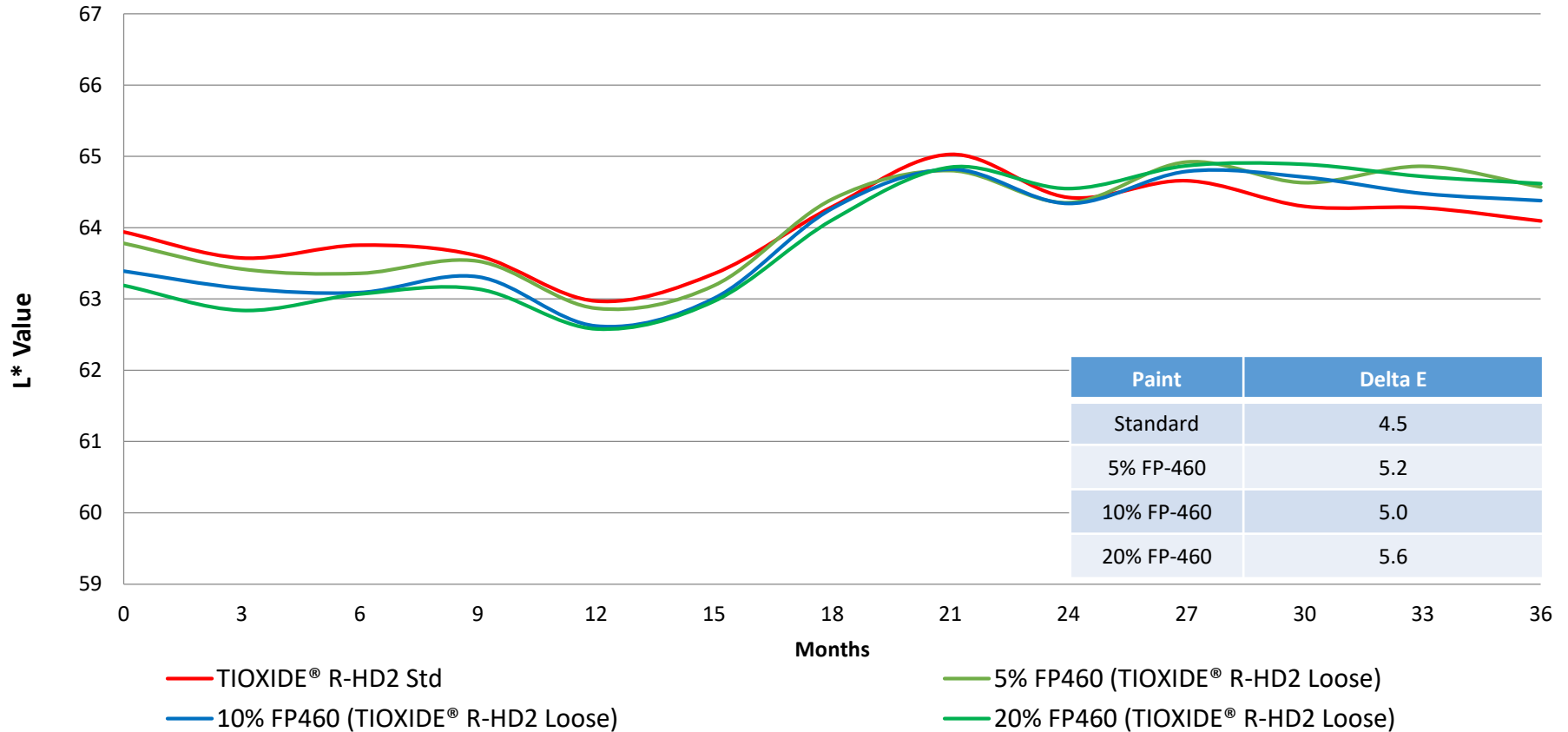
After 36 months - only relatively small changes in colour fade at 10% and 20% FP-460 levels were noted.

Type of TiO_2 pigment had a larger affect on fade than did the use of FP-Opacity Pigment™.

Broadly, the use of FP-460 Opacity Pigment™ had no impact on fade when used with high and super durable TiO_2 pigments

Colour Fade with TIOXIDE® R-HD2

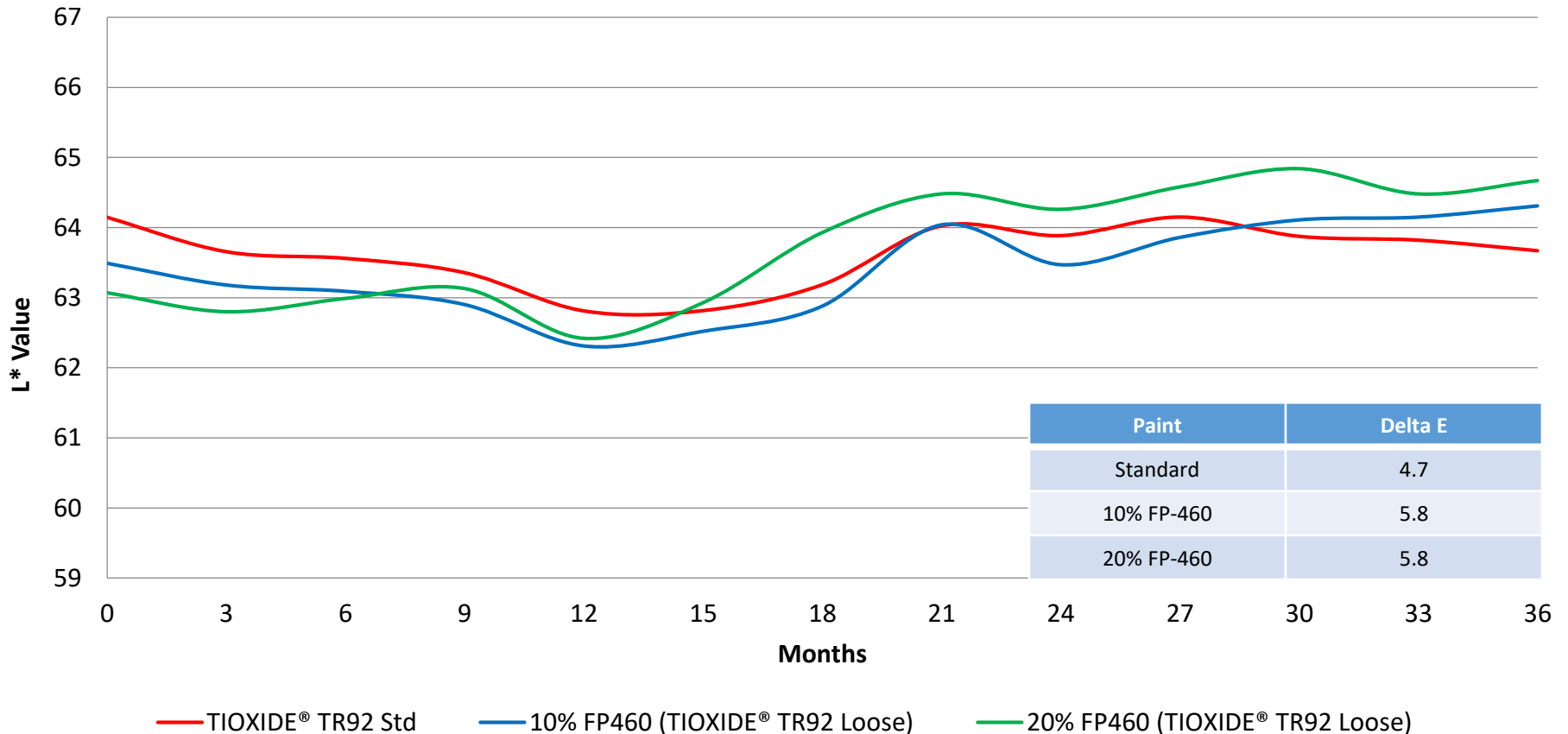
TIOXIDE® R-HD2 (Low Durability)



Up to 20% FP-460 usage had little impact on fade relative to the TiO₂ only standard

Colour Fade with TIOXIDE® TR92

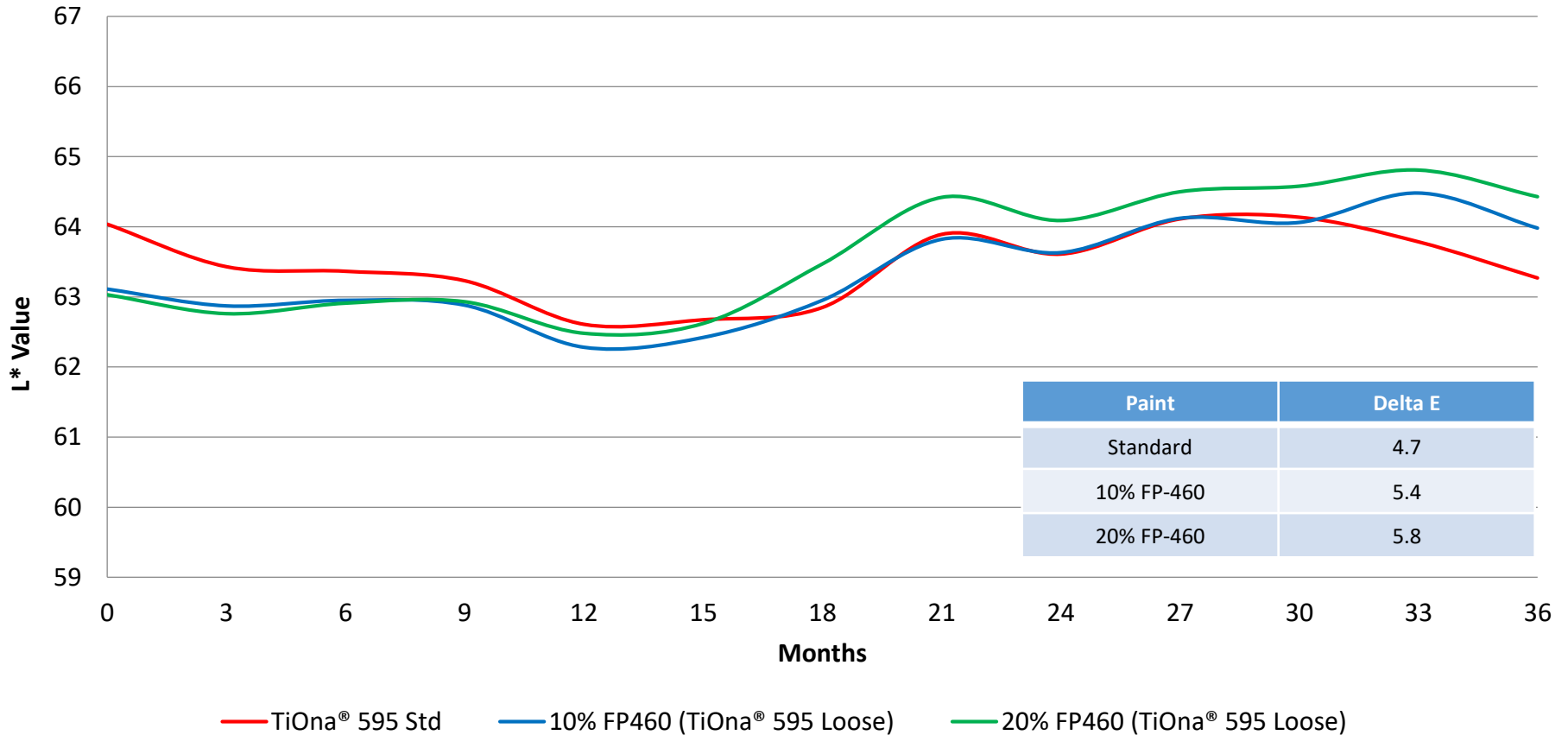
TIOXIDE® TR92 (Moderate Durability)



Up to 20% FP-460 usage had little impact on fade relative to the TiO₂ only standard

Colour Fade with TiONA[®] 595

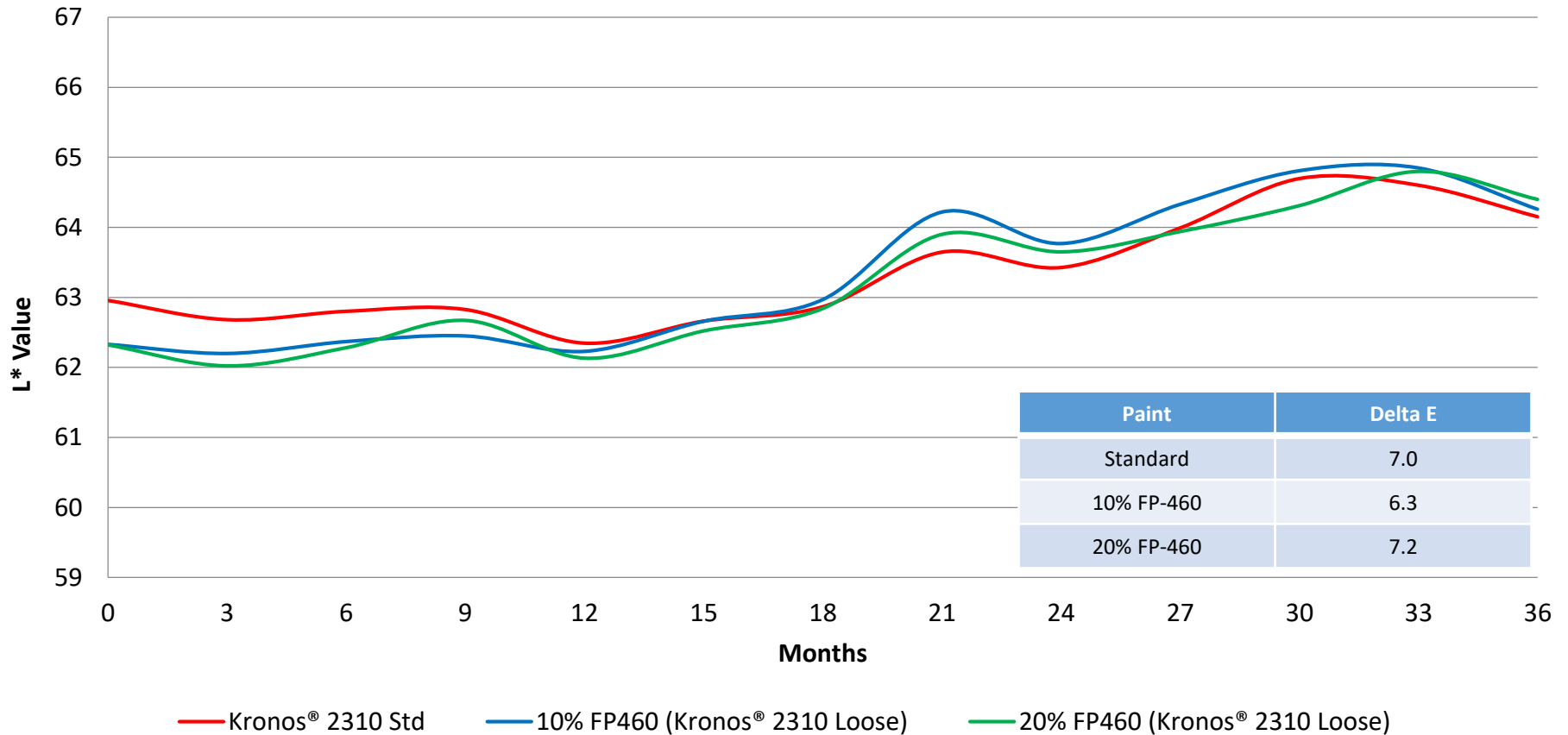
TiONA[®] 595 (Moderate Durability)



Up to 20% FP-460 usage had little impact on fade relative to the TiO₂ only standard

Colour Fade with Kronos 2310

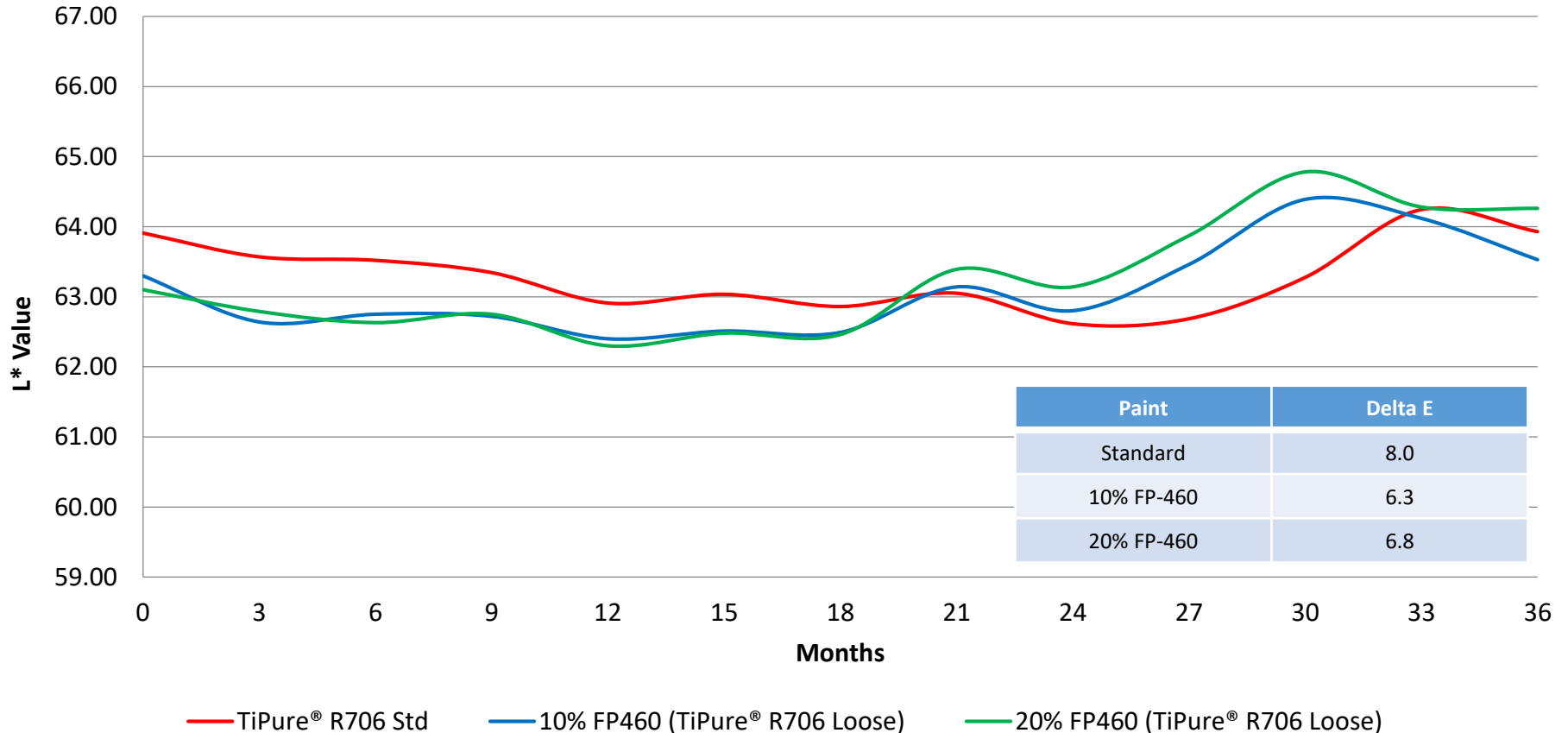
Kronos® 2310 (Highly Durable)



- **Up to 20% FP-460 usage had little impact on fade relative to the TiO₂ only standard**

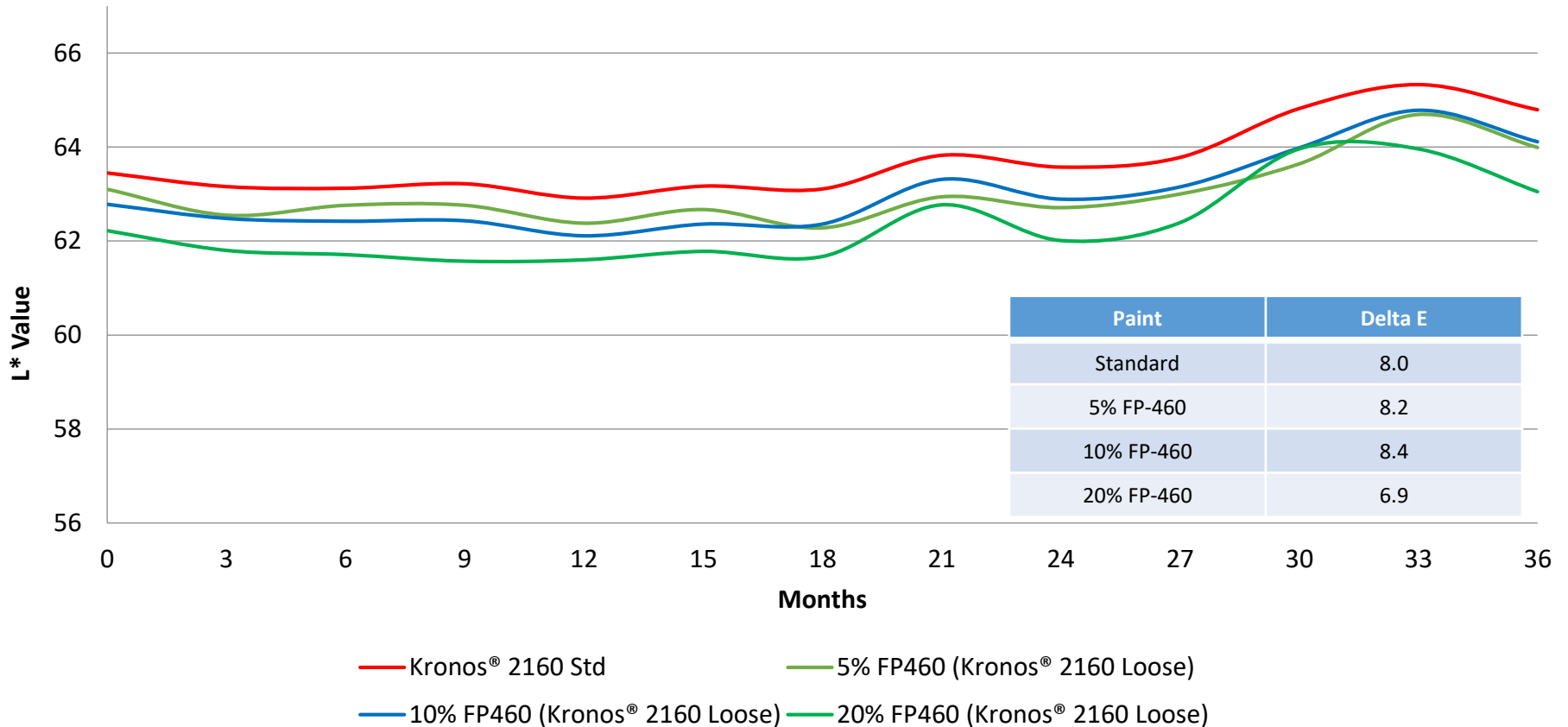
Colour Fade with TiPure™ R-706

TiPure™ R-706 (Highly Durable)



Up to 20% FP-460 usage had no impact on fade relative to the TiO₂ only standard

Kronos® 2160 (Superdurable)



Up to 20% FP-460 usage had no impact on fade relative to the TiO₂ only standard

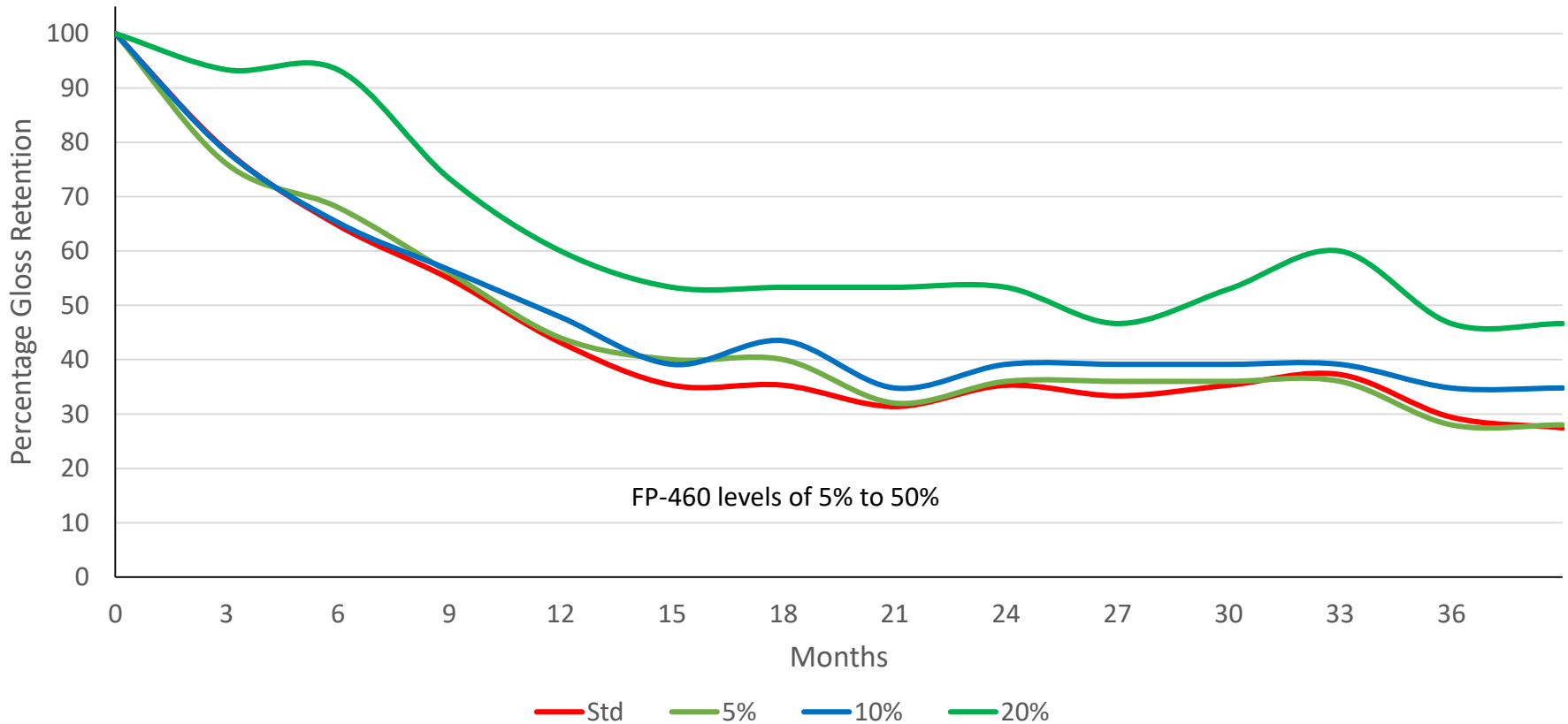
As the original gloss levels of each paint varied due to the different TiO₂ types and FP-Opacity Pigment™ levels used, the gloss retention was evaluated as the time in months for each paint to reach 50% of its original 60° gloss value.

The following charts show the 60° gloss value expressed as a percentage of original gloss over time.

Conclusion – Compared to the standards, no significant changes in gloss retention were seen when using FP-Opacity Pigments™ to replace TiO₂.

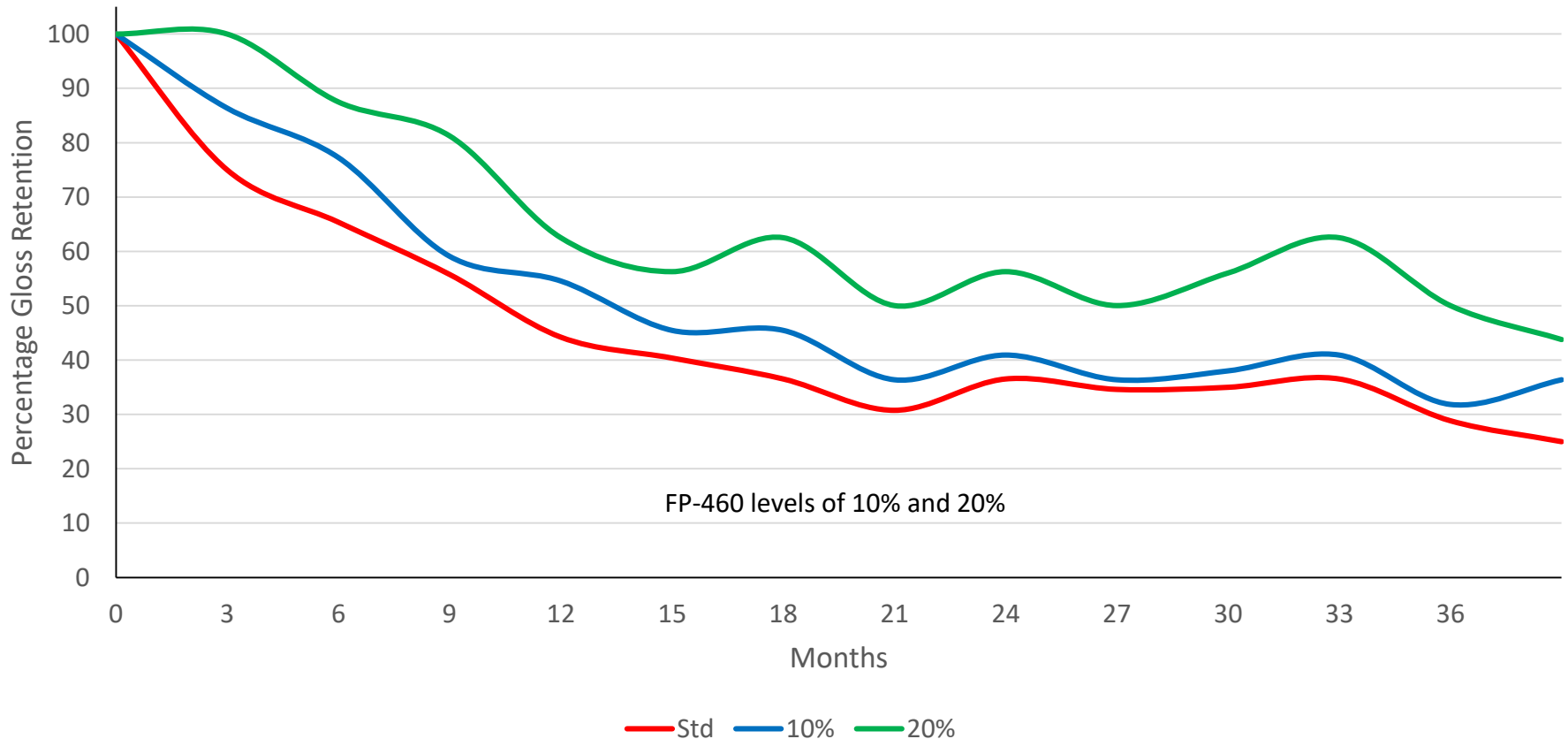
TIOXIDE® R-HD2 Gloss Retention

TIOXIDE® R-HD2 (Low Durability)



Up to 20% FP-460 usage had no impact on gloss retention

TIOXIDE® TR92 (Moderate Durability)

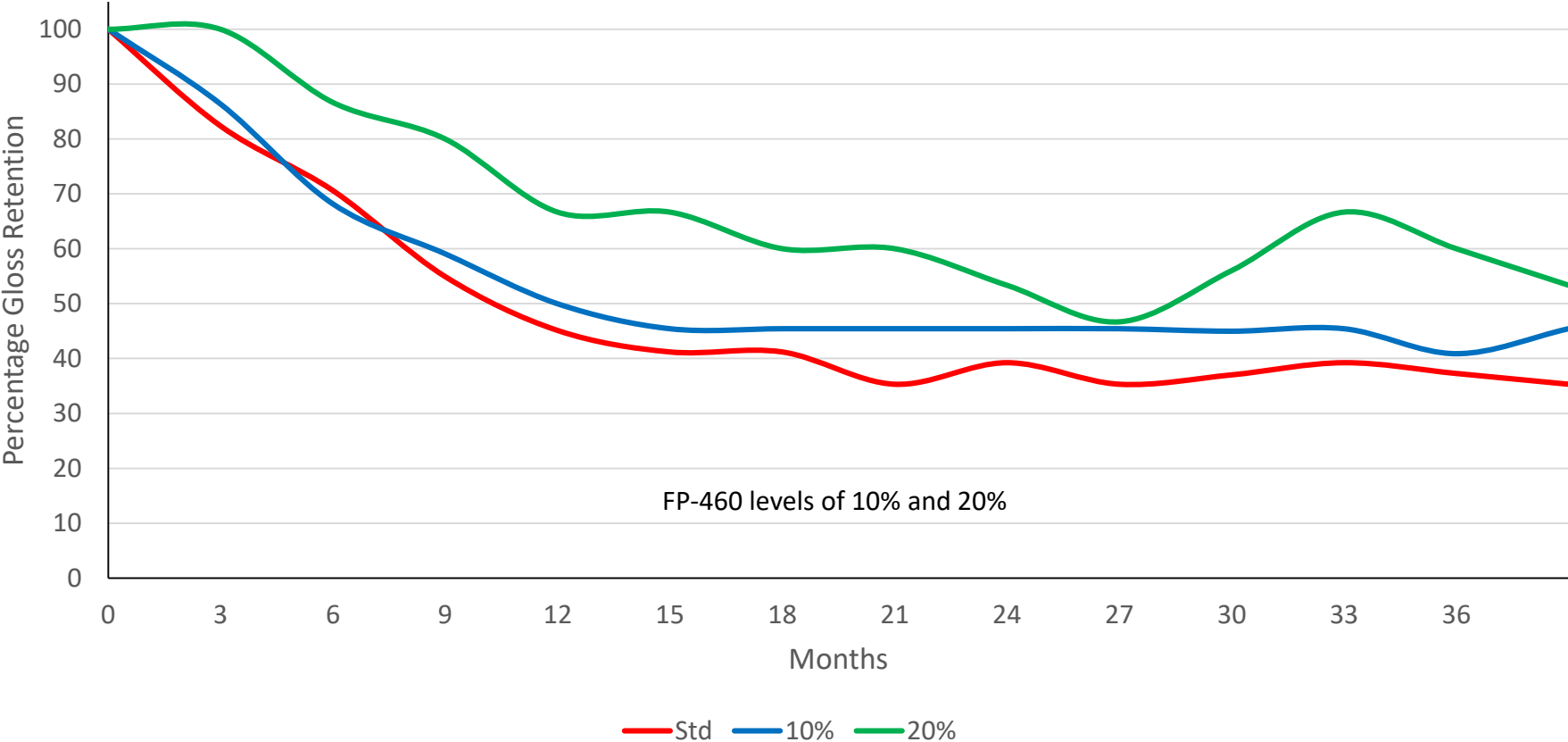


Up to 20% FP-460 usage had no impact on gloss retention

TiONA[®] 595 Gloss Retention



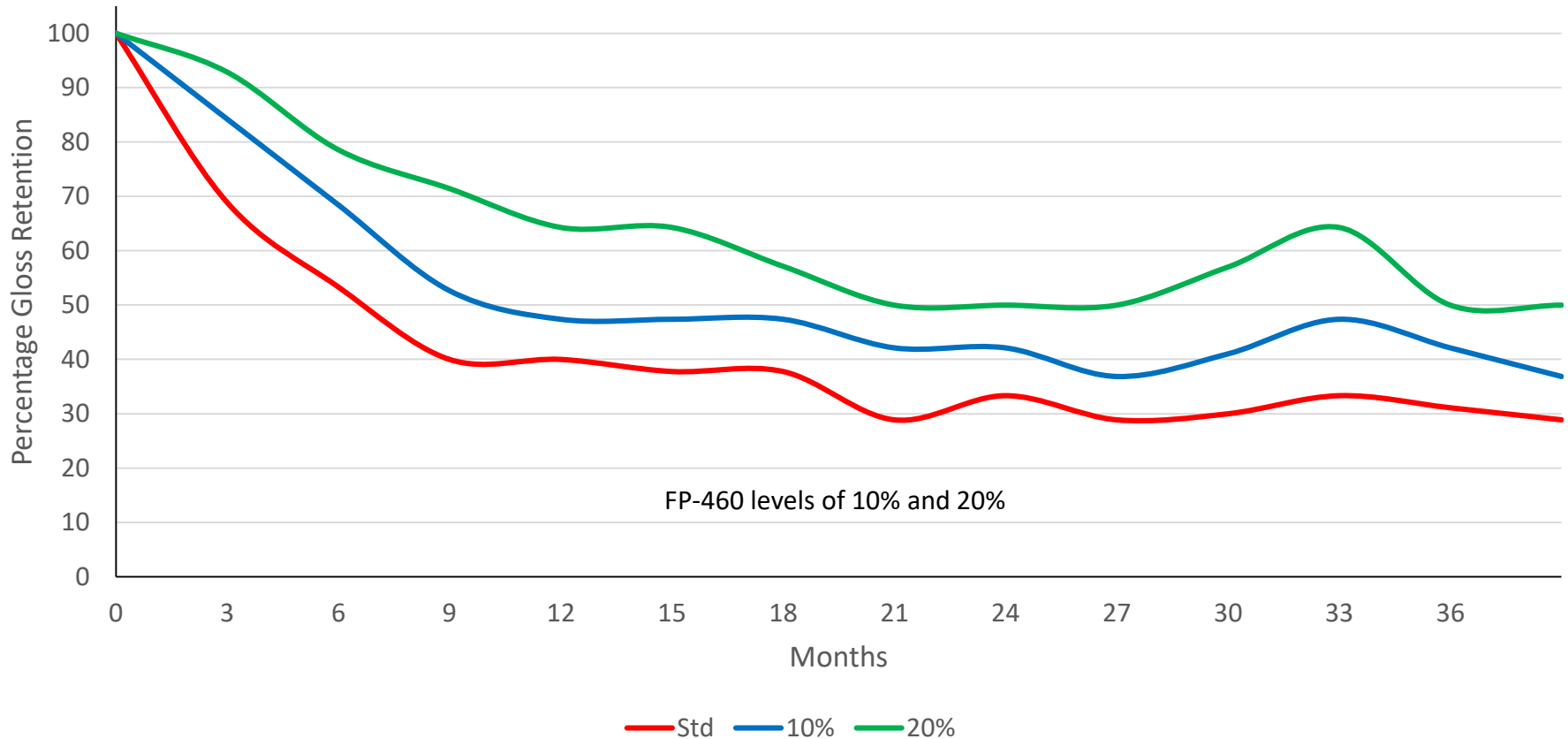
TiONA[®] 595 (Moderate Durability)



Up to 20% FP-460 usage had no impact on gloss retention

Kronos® 2310 Gloss Retention

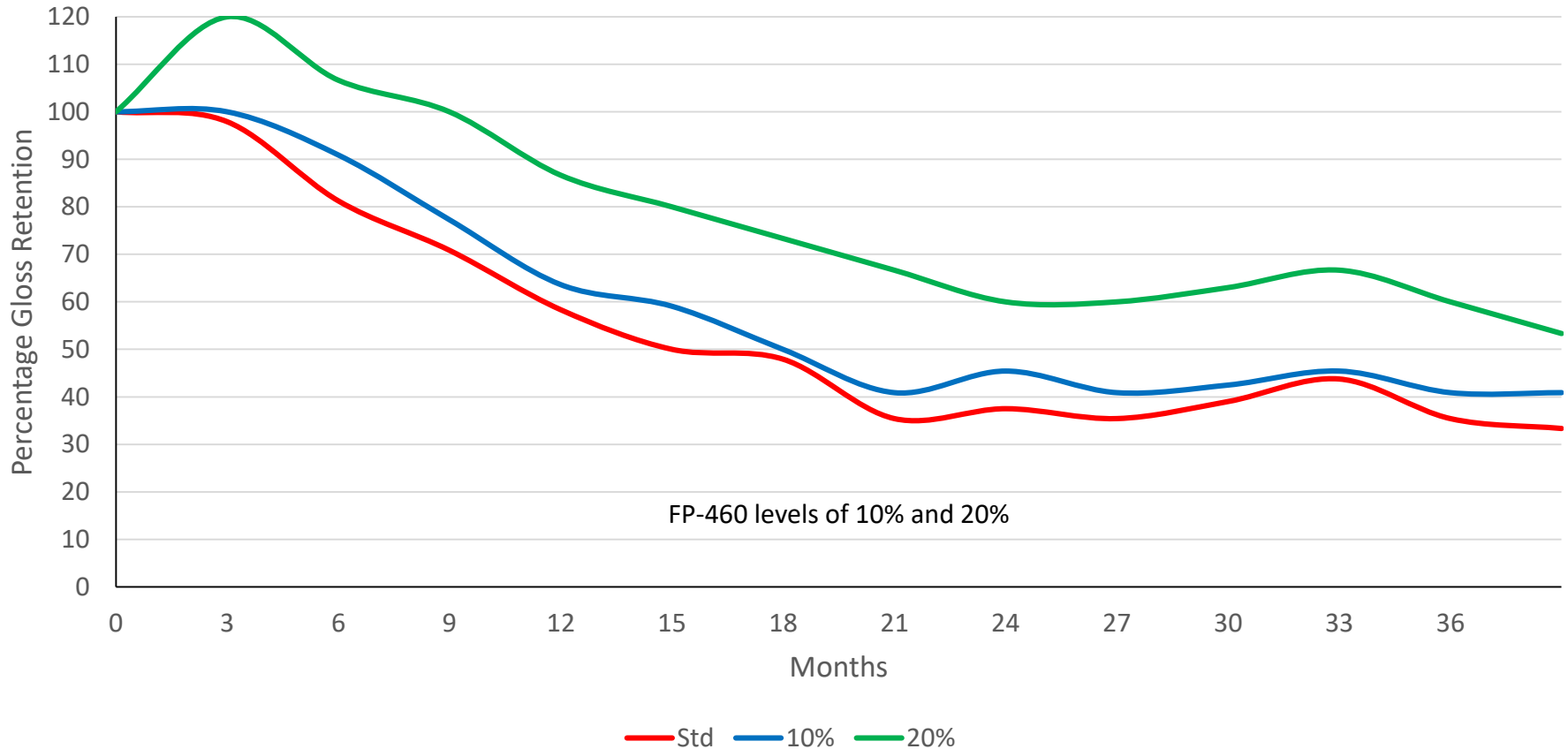
Kronos® 2310 (Highly Durable)



Up to 20% FP-460 usage had no impact on gloss retention

TiPure® R-706 Gloss Retention

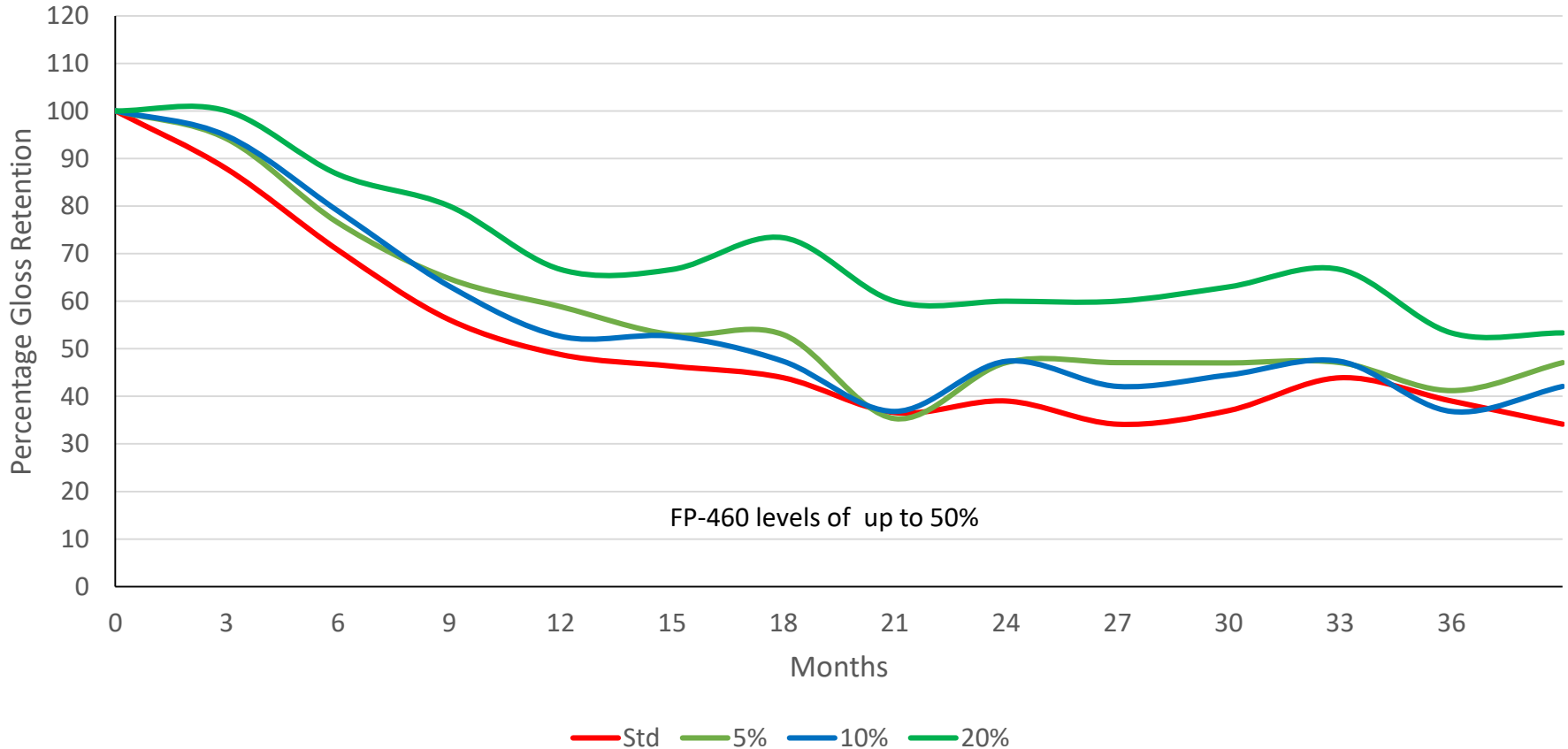
TiPure® R-706 (Highly Durable)



Up to 20% FP-460 usage had no impact on gloss retention

Kronos® 2160 Gloss Retention

Kronos® 2160 (Superdurable)



Up to 20% FP-460 usage had no impact on gloss retention

Summary - Chalking after 36 Months

Pigment	Durability Class	Chalking Level	5% FP-460	10% FP-460	20% FP-460	50% FP-460
TIOXIDE® R-HD2	Low Durability	5	7	5	6	7
TIOXIDE® TR92	Moderate Durability	5	N/A	5	6	N/A
TiONA® 595	Moderate Durability	5	N/A	5	5	N/A
Kronos® 2310	Highly Durable	7	N/A	7	7	N/A
TiPure™ R-706	Highly Durable	8	N/A	7	7	N/A
Kronos® 2160	Super Durable	9	9	7	7	7

Chalking scale – a subjective test here higher value indicates better performance; 10 is the maximum value indicating no chalking.

FP-460 used with low durability TiO₂ shows no impact on chalking values.

FP-460 used with medium durability TiO₂ products shows no impact on chalking values.

FP-460 used with high and super-durable TiO₂ products shows a very small decrease in chalking at higher replacement levels

After 36 months of south Florida outdoor exposure, the use of FP-460 in paints has shown to have minimal or no impact on the natural weathering of the paint.

For Colour Fade - the use of FP-460 had no impact on fade when used with high and super durable TiO₂ pigments.

For Gloss Retention – usage of up to 20% FP-460 usage had no impact on gloss retention.

For Chalking – the use of FP-460 showed chalk values similar to TiO₂ only formulations across the different TiO₂ types.

There is no evidence of any change in photocatalytic activity.

In general, we can say that the use of FP-Pigment at up to 20% TiO₂ replacement levels has a neutral effect on durability performance regardless of TiO₂ type replaced.