



FP-Opacity Pigment™
Effect on Corrosion Resistance
in
Short Oil Alkyd Drum Coating

September 2021

Drum Coating Case Study

Equal physical properties up to 12% substitution level.
Equal contrast ratio and colour up to 8% substitution level.
Equal corrosion resistance with FP-470 Opacity Pigment™.

Conclusions

FP-Opacity Pigments™

are a partial replacement for TiO_2
are significantly lower cost than TiO_2
provide significant annual raw material costs savings
give equal to slightly improved performance in Corrosion Resistance

Target Applications

Application	TiO ₂ Replacement potential	Typical Commercial TiO ₂ Replacement level
Polyester Gel Coats	5 to 15%	10%
Primers & Undercoats	5 to 20%	10%
Coil Coatings	5 to 15%	10%
DTM topcoats	4 to 12%	6%
Agricultural and Construction Equipment (ACE)	5 to 15%	10%
Industrial Goods OEM	5 to 15%	8%
Automotive OEM & Refinish	5 to 15%	5%
Decorative Alkyds	5 to 10%	7%
Aerospace	5 to 20%	20%†
Road Markings	5 to 20%	15%‡

† One customer

‡ Dependent upon Regulations stipulating minimum TiO₂ Content

Case Study: Drum Coating Short-Oil Alkyd

Material	Weight (g)	Supplier
Setal 142 XX-60	14.80	Allnex Resins
Kronos 2190	28.40	Kronos Worldwide Inc
Durham Nuodex Calcium 10	0.71	Cornelius
Xylene	5.94	
Subtotal		
2000 rpm Grind till <10 µm		
Let down:	0.00	
Setal 142 XX-60	44.41	Allnex Resins
Durham Nuodex Cobalt 10	0.18	Venator
Durham Nuodex Zirkonium 12	0.62	Venator
Exkin 2	0.25	Elementis
Xylene	4.67	
Total	100.00	
Paint	300	
Diluted with Thinner	70	

Drum Coating Short-Oil Alkyd Properties

Standard contains ~23% wt TiO₂

	Standard	FP-470 Opacity Pigment™		
	Kronos® 2190	4%	8%	12%
Viscosity Ford Cup #4 (s)	43	41	44	44
Koenig Hardness (s) 1/7 day	39/78	39/78	38/78	39/77
Pencil Hardness	7H	7H	7H	7H
T Bend Test	2½	1½	1½	2
Adhesion (Tape)	1½	1½	1½	1½
Cross Hatch Test ISO 2409 (0 – 5)	0	0	0	0
Drying Time (mins) 6 hour test	0 -> 8 8 -> 16 16-> 341 341->			0 -> 4 4-> 16 16-> 332 332->

Drum Coating Short-Oil Alkyd Color and Contrast Ratio

	Standard	FP-470 Opacity Pigment™		
	Kronos® 2190	4%	8%	12%
Reflectance over Black 80µm WFT	86.0	85.8	85.8	85.0
Contrast Ratio 100µm WFT	95.4	95.3	95.1	94.9
Color L*	96.1	96.0	96.0	95.9
Color b*	2.3	2.3	2.4	2.5
Gloss 20°	80	81	78	78
Gloss 60°	91	92	91	91
Gloss 85°	97	98	97	98

Standard contains ~23% wt TiO₂



Control



4% FP-470



8% FP-470



12% FP-470

Post Testing Corrosion Resistance Panels

Q-Lab Results Table

Specimen ID	Gen.	Rust Creepage		Adhesion Loss		Scribe Blister		Unscribed Area	
	App.	Max	Mean	Max	Mean	Small	Large	Rust	Blister
P646-1 ,a	6	8	8	5	5	8M	10	10	10
P646-1 ,b	5	7	8	5	5	8M	6F	10	10
P646-2,a	5	7	7	5	5	8M	6F	9-P	10
P646-2,b	6	7	8	5	5	8M	10	10	10
P646-3,a	6	7	8	6	6	8F	6M	9-P	10
P646-3,b	6	7	7	5	5	8F	6F	10	10
P646-4,a	6	7	8	5	5	8M	6F	10	10
P646-4,b	6	7	7	6	5	8M	6F	10	10

Even though FP-470 Opacity Pigment™ test points have slightly better values than control, the results are considered statistically equivalent.

Code Key:

P646-1 – Control

P646-2 – 4% of FP-470

P646-3 – 8% of FP-470

P646-4 – 12% of FP-470

With FP-Opacity Pigment™ replacement levels up to 8%:



- There was no noticeable contrast ratio or colour difference in the samples tested.
- Equal 20° & 60° gloss.
- Maintained mechanical properties.
- Q-lab accelerated corrosion tests show no difference between samples.
- 60% reduction in carbon footprint over the TiO₂ achieved.
- The use of FP-470 Opacity Pigment™ in coil coatings provides significant cost savings that will improve your profit margin and reduce your carbon footprint.



Q-Lab Weathering Research Service

CORROSION

Q-Lab exposure reports use standard rating scales, primarily ASTM or ISO. This legend provides basic information on the rating scales used in your report.

Acid Etch Ratings (ASTM D7356)

Accelerated chamber test or outdoor Jacksonville-type exposure.

Rating	Description	Skill Level
0	No Damage	N/A
1	Slight pitting damage	Trained Observer
2	Moderate pitting - no acid etch spots	Trained Observer
3	Few full or partial acid etch spots start	Trained Observer
4	Full acid etch spots start to appear (light)	Untrained Observer
5	Full acid etch spots, inc. frequency, few deeper spots	Untrained Observer
6	Inc. frequency, inc. depth, borderline paint repair	Untrained Observer
7	Frequency and depth would require repaint	All Observers
8	Start to see acid etch spots overlap previous spots	All Observers
9	Inc. frequency, depth of spots, overlap	All Observers
10	High % area damaged, spots overlap, discoloration	All Observers

Definitions

Acid Etch: The marking of a surface due to the action of acid rain or solution. The effect is to produce large water spots that cannot be removed with washing.

Combined Weathering/Corrosion Test: An exposure that alternates between a purely weathering chamber and a strictly corrosion chamber. Test is designed to examine the increase in corrosion rates that exposure to UV causes.

Complex Corrosion: A test where more than one exposure condition is combined into a cycle. Typically salt fog, high humidity, and dry off are included.

Corrosion: The chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties.

Face Rust: Surface effect that is measured by the size and number of spots.

Filiform Corrosion: Special type of corrosion that occurs under the coating and is characterized by a definite thread like structure with directional growth.

Pitting: Corrosion of a metal surface, confined to a point or small area, that takes the form of cavities.

Rust: A corrosion product consisting primarily of hydrated iron oxide. (This is a term properly applied only to ferrous alloys).

Rust Creepage: Occurs normally along a scribe, at the edges of a specimen, or at some other blemish that extends through to the metallic substrate.

Scab Corrosion: usually found at the edge of a scribe or other blemish. This type of corrosion is a combination of scab corrosion, blistering, and undercutting.

Corrosion Effects on Painted Surfaces

a. Surface Rust (ASTM D610, ISO 4628-3)

ASTM	Description	Spot	Gen.	Pinpoint	ISO*
10	< 0.01%	10	10	10	Ri 0
9	> 0.01% and < 0.03%	9S	9G	9P	Ri 1
8	> 0.03% up to 0.1%	8S	8G	8P	
7	> 0.1% up to 0.3%	7S	7G	7P	Ri 2
6	> 0.3% up to 1%	6S	6G	6P	Ri 3
5	> 1% up to 3%	5S	5G	5P	
4	> 3% up to 10%	4S	4G	4P	Ri 4
3	> 10% up to 16%	3S	3G	3P	
2	> 16% up to 33%	2S	2G	2P	
1	> 33% up to 50%	1S	1G	1P	Ri 5
0	> 50%	---	None	---	

*Note: The ISO rating Ri 5 is equivalent to between ASTM 1 and 2 rating.

b. Blistering (ASTM D714, ISO 4628-2)

Rating for blistering is a size/frequency composite.

No	Descriptive	Size	Rating	Density
10	None	0	0	None
8	Pinpoint	0-1 mm	F	Few
6	Small	1-2 mm	M	Medium
4	Medium	2-3 mm	MD	Medium Dense
2	Large	3-5 mm	D	Dense
0	Very Large	> 5 mm	VD	Very Dense

Example: 4D = Medium size, dense frequency

c. Scribe Rust and Corrosion (ASTM D1654, ISO 4628-8)

Rating	Size mm	Size inch
10	0	0
9	>0 to 0.5	0 to 1/64
8	>0.5 and <1.0	1/64 to 1/32
7	>1.0 and <2.0	1/32 to 1/16
6	>2.0 and <3.0	1/16 to 1/8
5	>3.0 and <5.0	1/8 to 3/16
4	>5.0 and <7.0	3/16 to 1/4
3	>7.0 and <10.0	1/4 to 3/8
2	>10.0 and <13.0	3/8 to 1/2
1	>13.0 and <16.0	1/2 to 5/8
0	>16.0	> 5/8