Geofortis Functional Extenders

Geofortis Functional Extenders (GFE) Introduction

- Geofortis Industrial applications of fine powdered volcanic ash (SiO2)
  - First applications focused on the Concrete Industry
    - Products make concrete better, greener and less expensive
  - Currently offering GFE to the Coatings Industry
    - GFE are competitive as
      - GeoHide - TiO_2 replacement
      - GeoTuff - Abrasion and scuff resistance
      - GeoSilicate - Economic extender
- Geofortis Background
  - Geofortis develops products and technology for industrial applications
  - Founded in 2015
  - Specialized material sources include naturally occurring volcanic ash
  - Developed mineral sources in California and Utah
  - Built new processing facility near Salt Lake City, Utah in 2021
    - Capacity 300,000 tons/year fine powder

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Geofortis Functional Extenders Introduction

- Built new processing facility near Salt Lake City, Utah in 2021
  - Capacity 300,000 tons/year
  - Powder particle size (D50) = 12 µm
  - Material handling, raw mineral storage, dryer, ball mill, classifier, product silos, bulk truck loadout
  - On-site QA/QC lab – PSD analysis, physical properties, XRD analysis
- Mineral sources
  - Faust Utah
    - Volcanic Tephra ash
    - Fully permitted and operational pit 30 minutes from processing plant
  - Lassen California
    - Volcanic ash and diatomaceous earth deposit
    - Fully permitted mine
  - Sevier County Utah
    - Volcanic pumice deposit
    - In development stage

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Coatings Market Segments

- Geofortis Functional Extenders will provide value in several coatings areas
  - GeoHide - Optical - TiO2 replacement
    - Replaces up to 60% of TiO2 (by volume)
    - Titanium Oxide is one of the most expensive inorganic pigments, replacement ultimately saves money, making the final product more economical
  - GeoTuff - Abrasion and scuff resistance components
    - Geologic mineral is literally “tuff”
    - Toughness as proven coatings compound improves performance
  - GeoSilicate - Functional Extender
    - Provides excellent strength to the existing paint formulations.
    - Improves the dry film characteristics while having no adverse effects on existing properties

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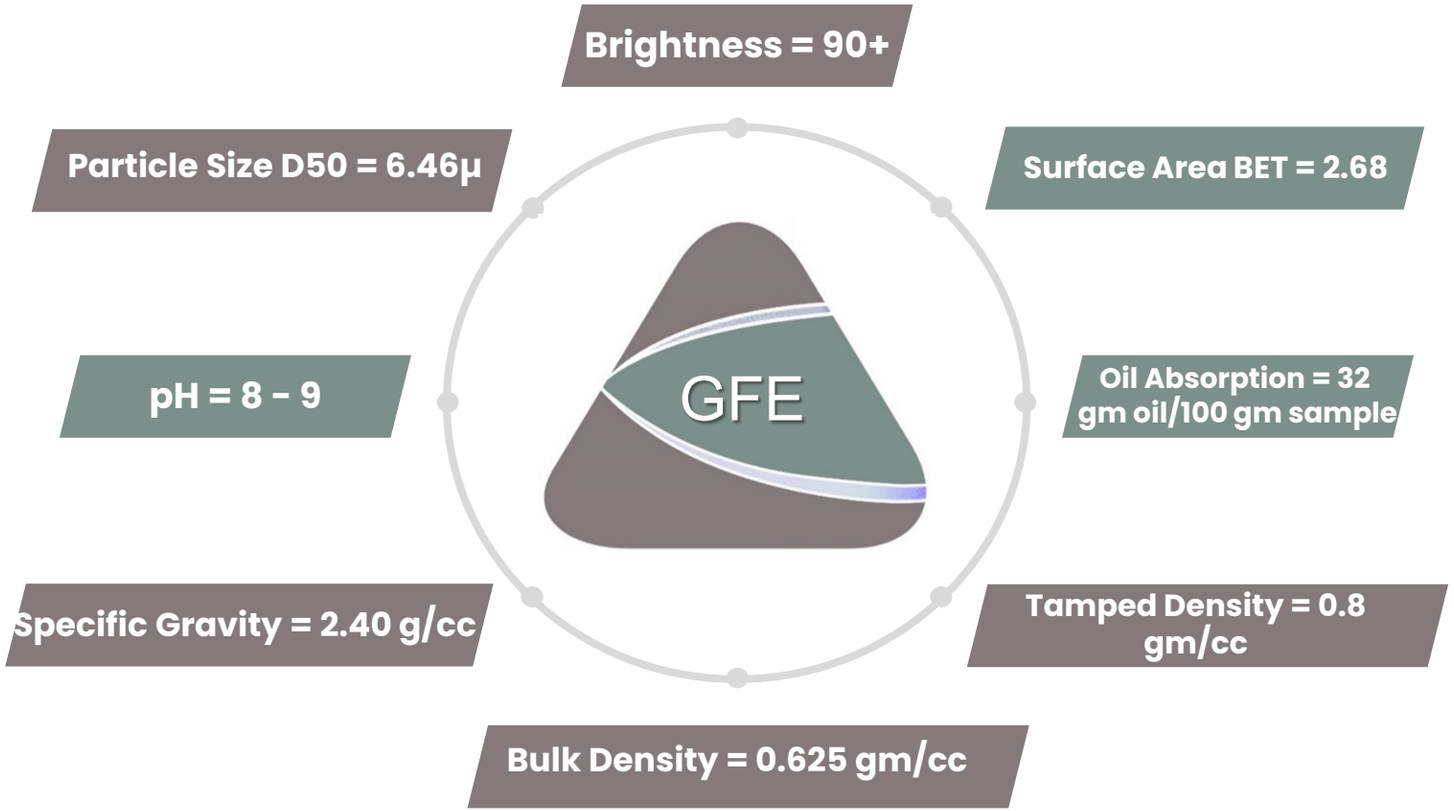
PHYSIOCHEMICAL PROPERTIES



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Benefits of Using Geofortis Functional Extenders

- Wet Properties
  - No adverse effect on the wet properties such as:
    - Viscosity (low, medium & high shear)
    - pH
    - Sag resistance
    - Heat Aged stability
- Optical Properties
  - Up to 60% Replacement of TiO2 (Volume basis) has no adverse impact on Hiding Power / Opacity of the finished paint
- Dry Film Properties
  - Improvement in physical, chemical and mechanical properties include
    - Taber Abrasion
    - Wet Scrub Resistance
    - Dry Scrub / Burnish Resistance
    - Spot Resistance – House Hold Chemicals

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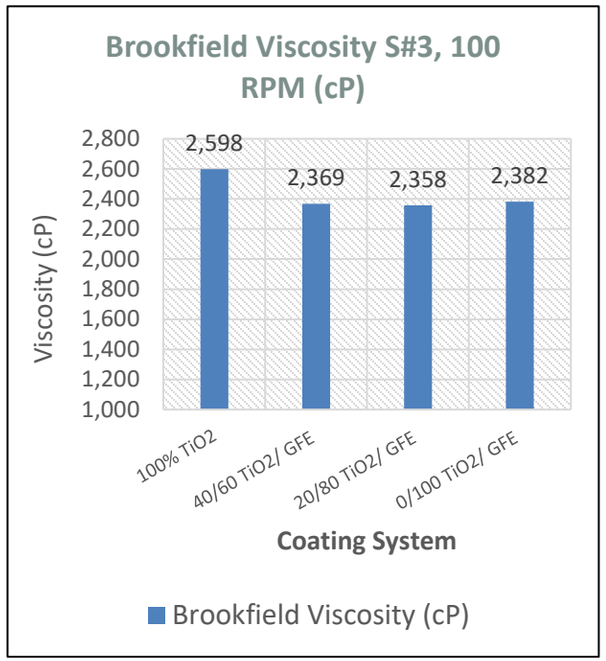
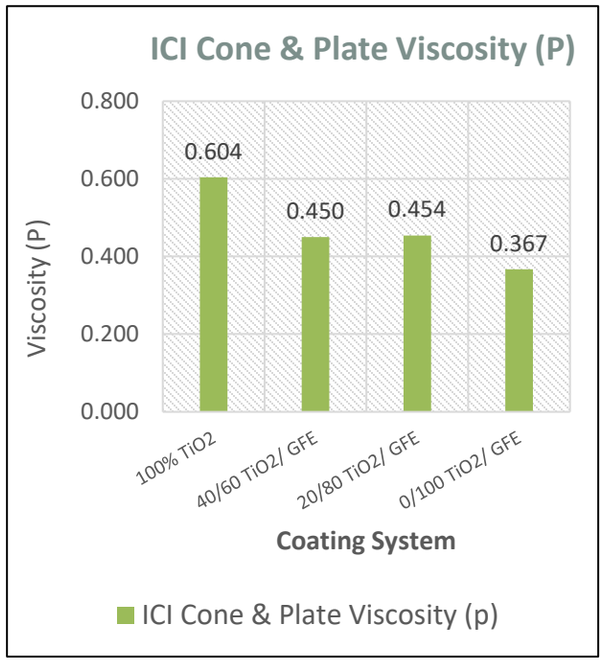
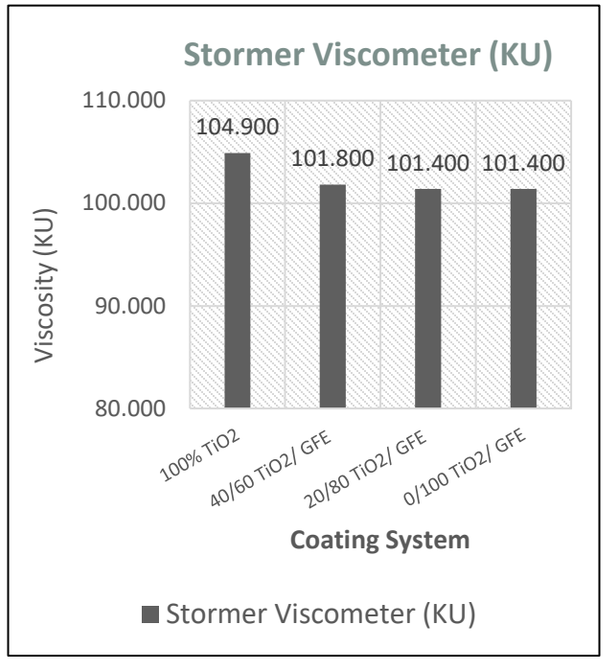
Wet Properties

- Viscosity – Low Shear , Medium Shear And High Shear
  - Incorporation of GFE into an existing paint formulation has no significant changes on the viscosity of the finished paint
  - Tests performed with 60%, 80% and 100% TiO2 replacement with GFE **GeoHide** Product







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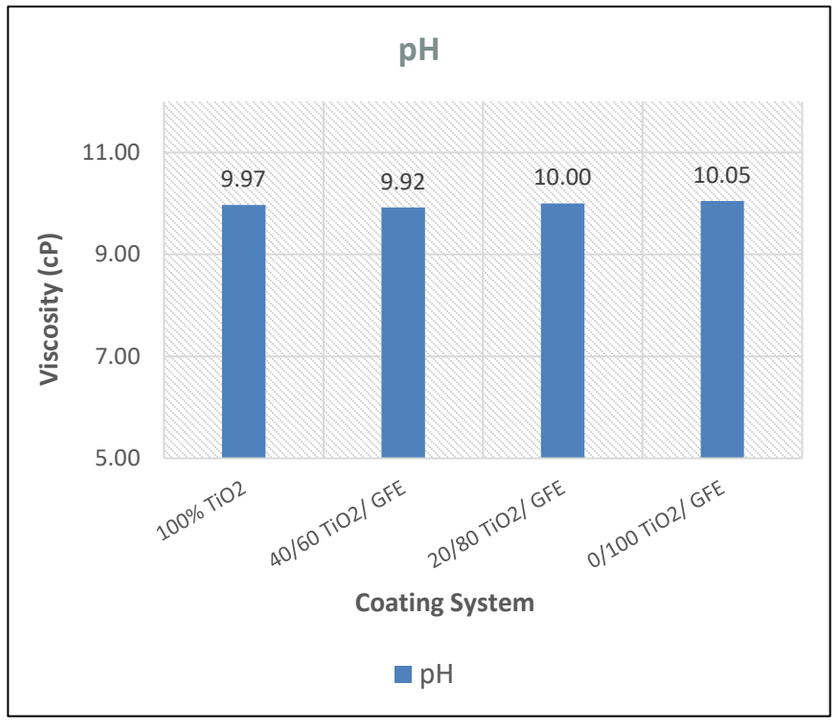
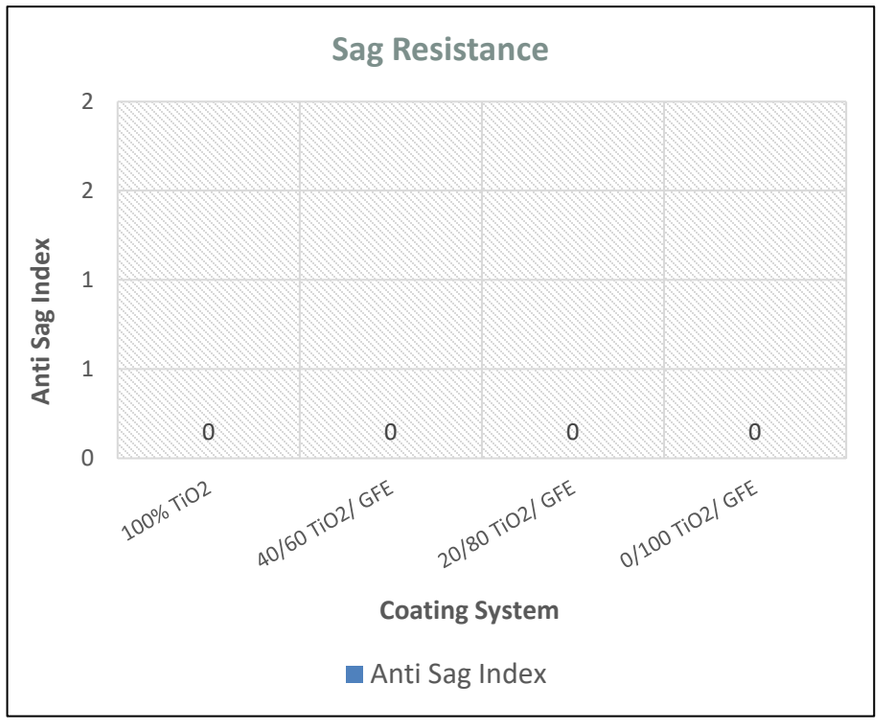
Wet Properties

- pH & Sag Resistance
  - Incorporation of GFE into an existing paint formulation has no significant changes on the pH or the sag resistance of the final product.
  - Tests performed with 60%, 80% and 100% TiO2 replacement with GFE **GeoHide** Product





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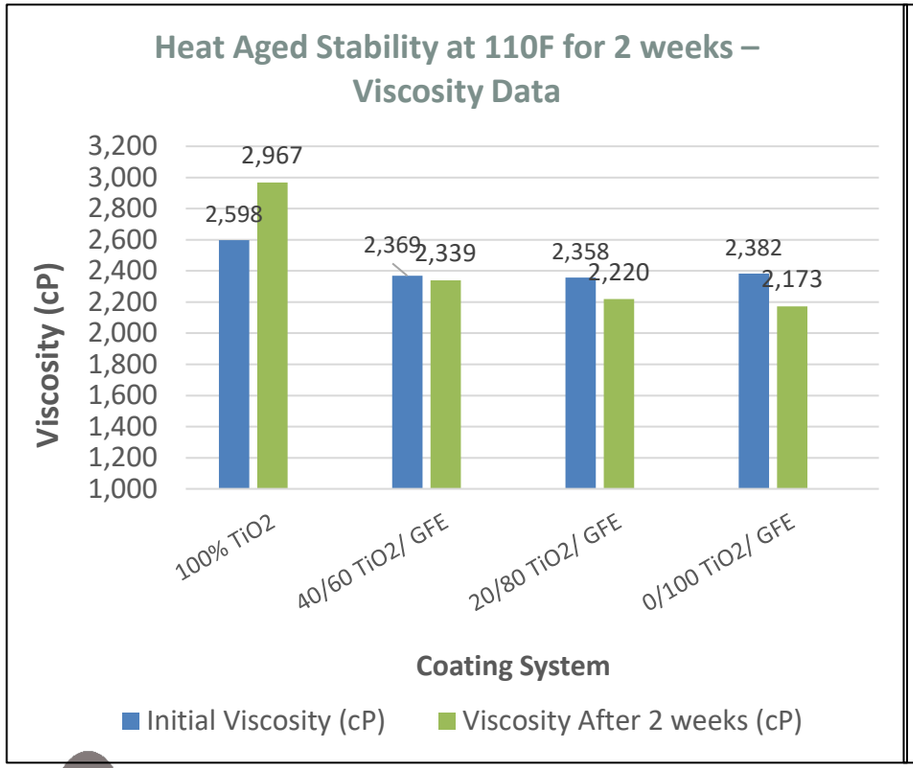
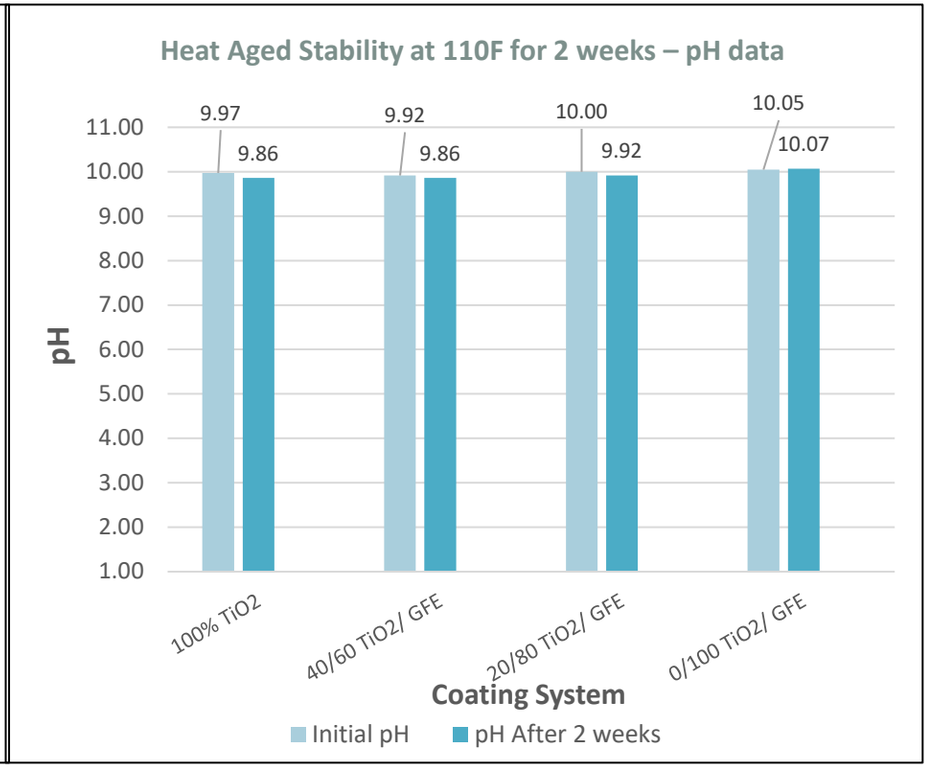
Wet Properties

- HEAT AGED STABILITY
  - GFE formulation shows good heat aged stability at 110° F over 2 weeks with no phase separation, pigment flooding, or floating, syneresis
  - All the variations showed soft settling were easily re-dispersible
  - Tests performed with 60%, 80% and 100% TiO2 replacement with GFE **GeoHide** Product





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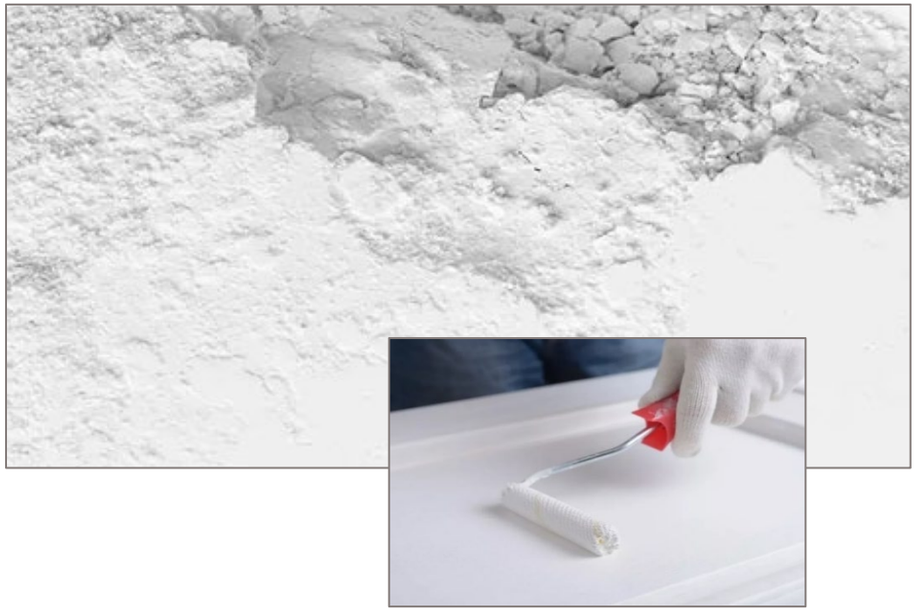
Optical Properties

- Titanium dioxide (TiO_2) is the par excellence in the industry and the world's best-selling inorganic pigment. However, titanium is a product whose high price is subject to large variations due to product availability.

- These price increases affect the competitiveness of finished products, so the search for an alternative to titanium dioxide has generated a variety of possibilities to optimize its use.

- GFE's excellent optical properties provide both technical and economic advantages in the substitution of TiO_2, which includes up to 60% replacement of TiO2 for non-optimized formulations on weight basis.



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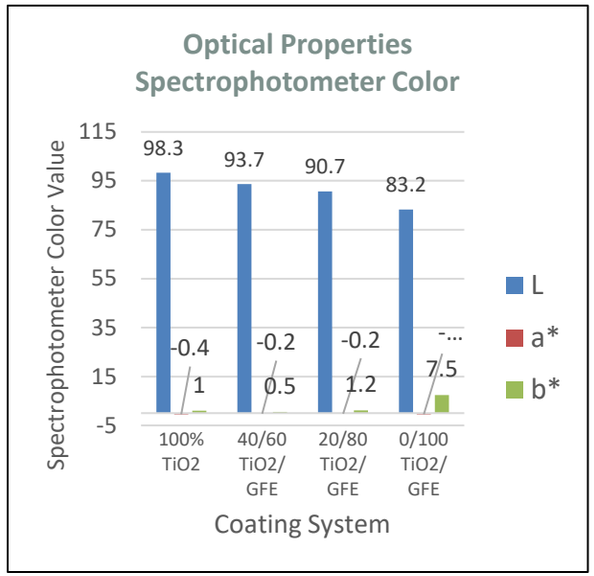
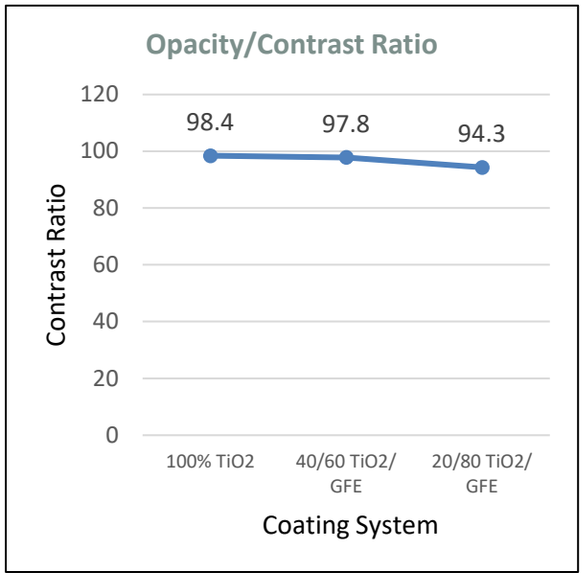
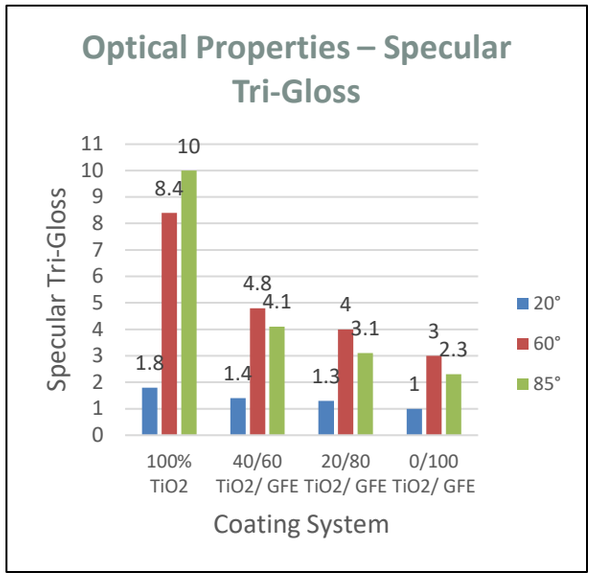
Optical Properties

- Opacity, Spectrophotometer Color, Specular Gloss
  - Formulation containing 60% GFE have similar Opacity/Hiding and color characteristics of the formulation containing 100% TiO_2







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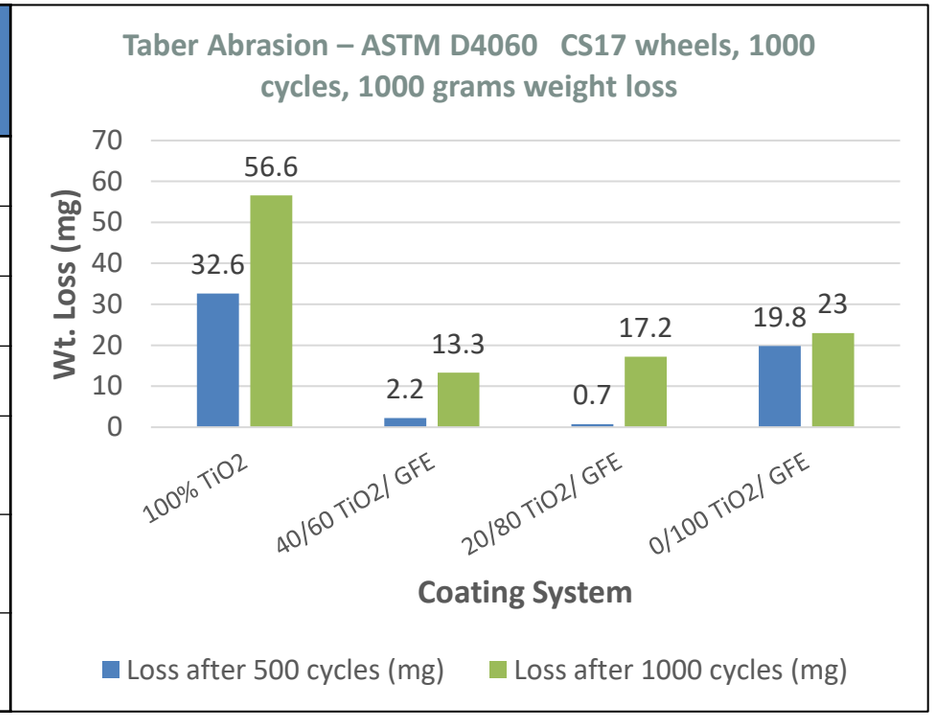
Dry Film Properties

- Improved Taber Abrasion
  - Formulation containing GFE have significant improvement in the Taber abrasion and lower weight loss after 1,000 cycles, compared to those containing TiO2.

Formulations	Panel initial wt. (g)	Panel wt. after 500 cycles (g)	Panel wt. after 1000 cycles (g)	wt. loss after 500 cycles (mg)	loss after 1000 cycles (mg)
100% TiO2	72.6671	72.6345	72.6105	32.6	56.6
40/60 TiO2/ GFE	72.1887	72.1865	72.1754	2.2	13.3
20/80 TiO2/ GFE	72.0662	72.0655	72.049	0.7	17.2
0/100 TiO2/ GFE	68.33	68.3102	68.307	19.8	23
40/60 TiO2/nepheline syenite	70.3546	70.3525	70.3391	2.1	15.5
20/80 TiO2/nepheline syenite	65.8104	65.8071	65.7958	3.3	14.6
0/100 TiO2/nepheline syenite	69.9737	69.9699	69.9627	3.8	11



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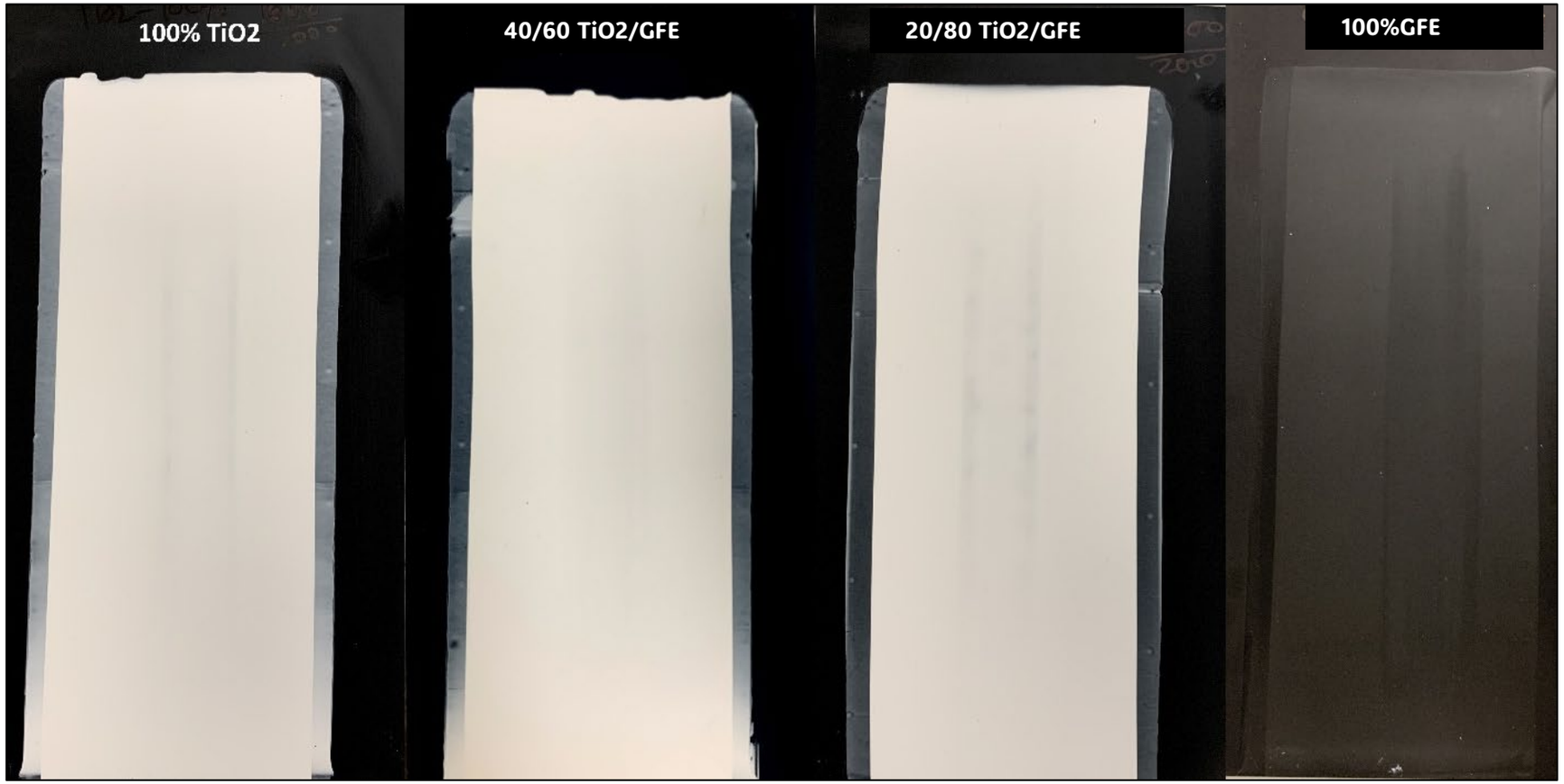
Dry Film Properties

- Wet Scrub Resistance - TiO2 vs GFE formulation
  - 40/60 ratio of TiO2/GFE has better wet scrub resistance compared to variation with 100% TiO2



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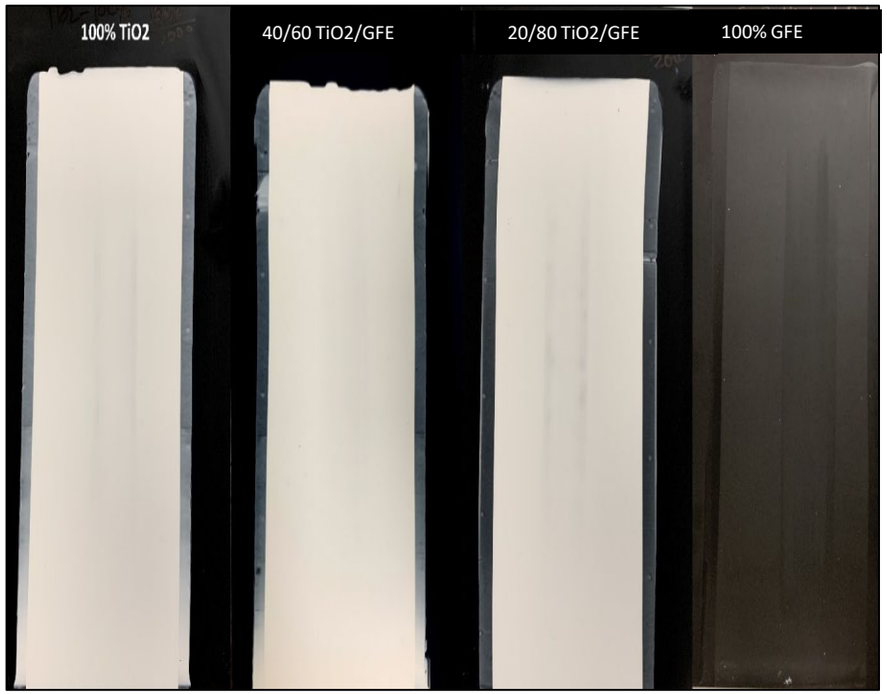
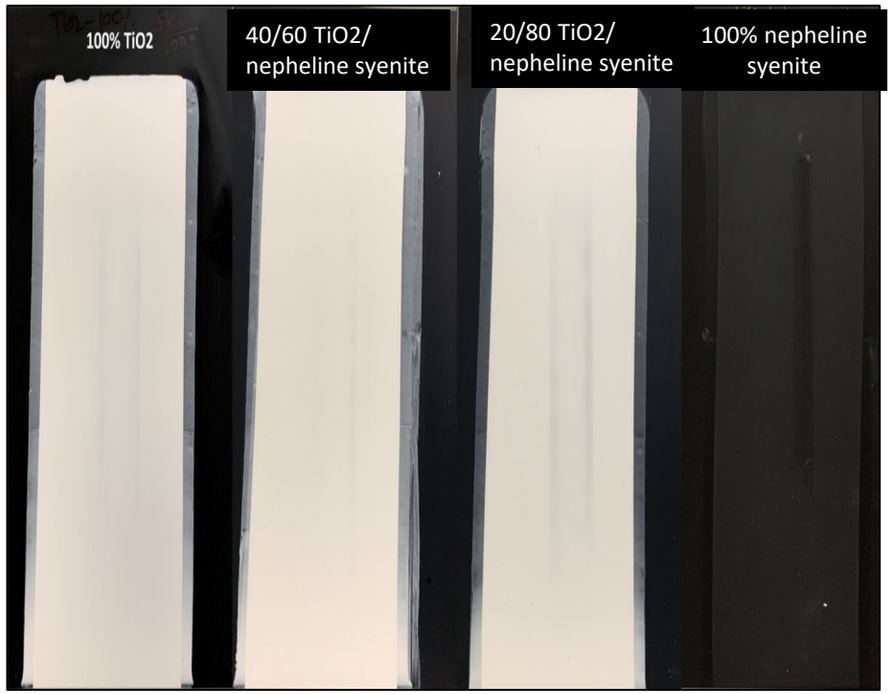
Geofortis

Dry Film Properties

- Wet Scrub Resistance - TiO2 vs GFE vs nepheline syenite
  - 40/60 ratio of TiO2/GFE has better wet scrub resistance compared to variations containing 100% TiO2 and nepheline syenite.





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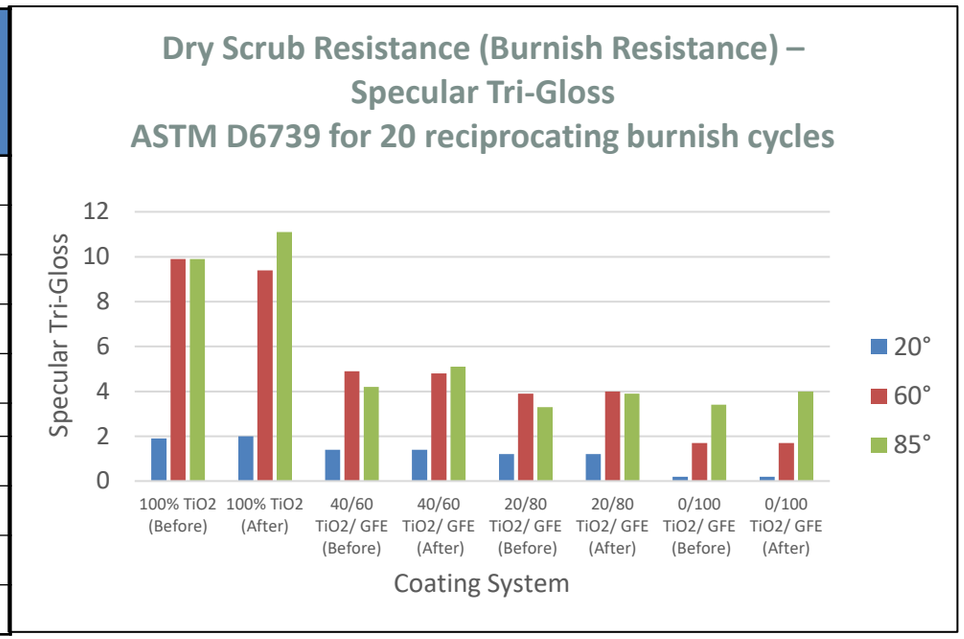
Dry Film Properties

- Dry Scrub // Burnish Resistance – Specular Tri Gloss
  - 100 TiO2, 40/60 and 20/80 ratio of TiO2/GFE has better burnish resistance compared to 40/60 and 20/80 ratio of TiO2/ nepheline syenite

Formulations	Dry Film Thickness (Mil)	Initial Tri-Gloss			Tri-Gloss (After burnish resistance test)			85° % gloss change
		20°	60°	85°	20°	60°	85°	
TiO2/GFE								
100/0	2	1.9	9.9	9.9	2	9.4	11.1	12.12
40/60		1.4	4.9	4.2	1.4	4.8	5.1	21.43
20/80		1.2	3.9	3.3	1.2	4	3.9	18.18
0/100		0.2	1.7	3.4	0.2	1.7	4	17.65
TiO2/nepheline syenite								
40/60	2	1.5	4.7	4.3	1.5	4.8	5.3	23.26
20/80		1.3	3.9	4.6	1.3	4.1	5.7	23.91
0/100		0.2	1.7	3.2	0.2	1.7	3.7	15.63



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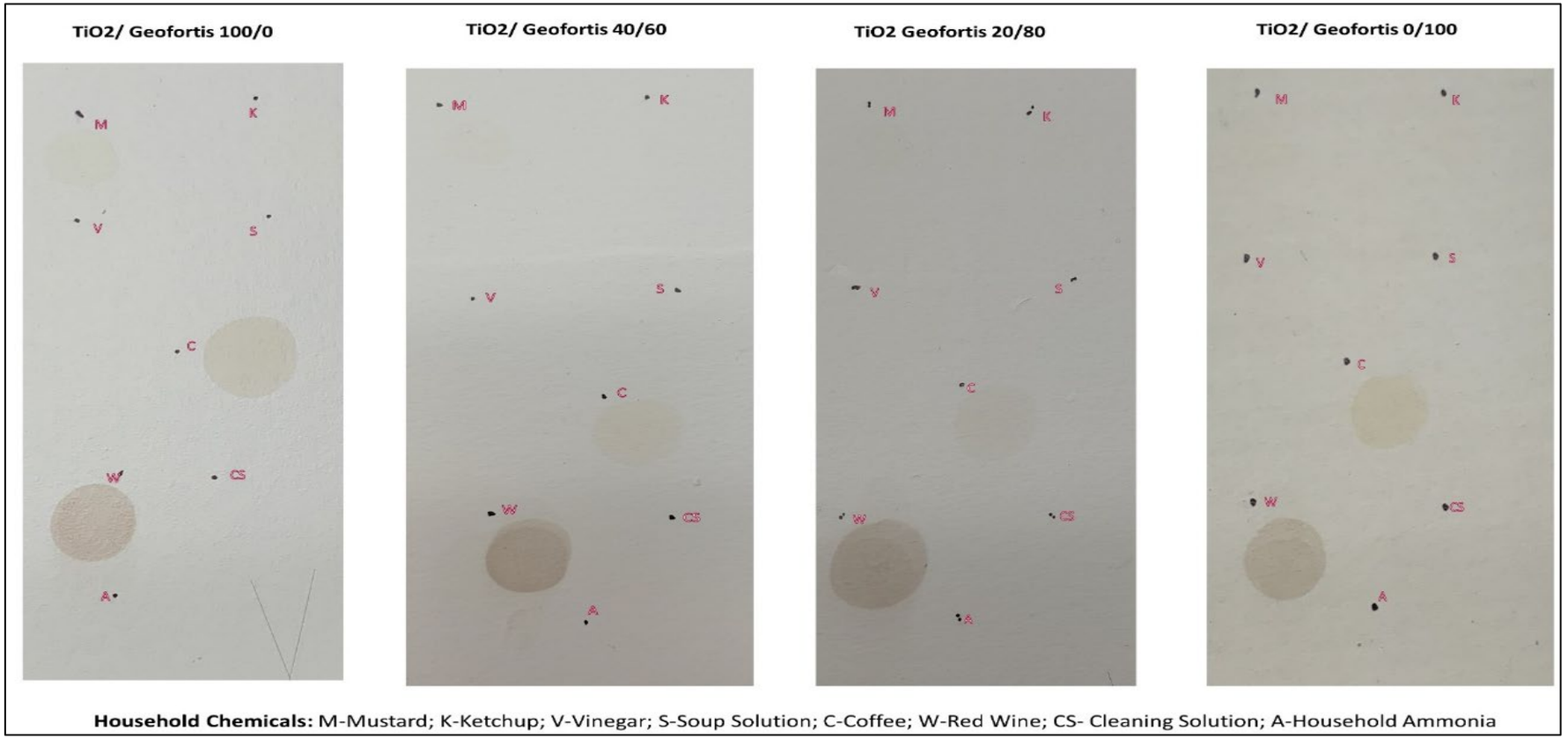
Dry Film Properties

- Stain Resistance – Household Chemicals
  - There's no adverse effect on resistance to household chemicals or spot test that is visible for GFE vs that of TiO2. **15 Minutes**



Household Chemicals: M-Mustard; K-Ketchup; V-Vinegar; S-Soup Solution; C-Coffee; W-Red Wine; CS- Cleaning Solution; A-Household Ammonia

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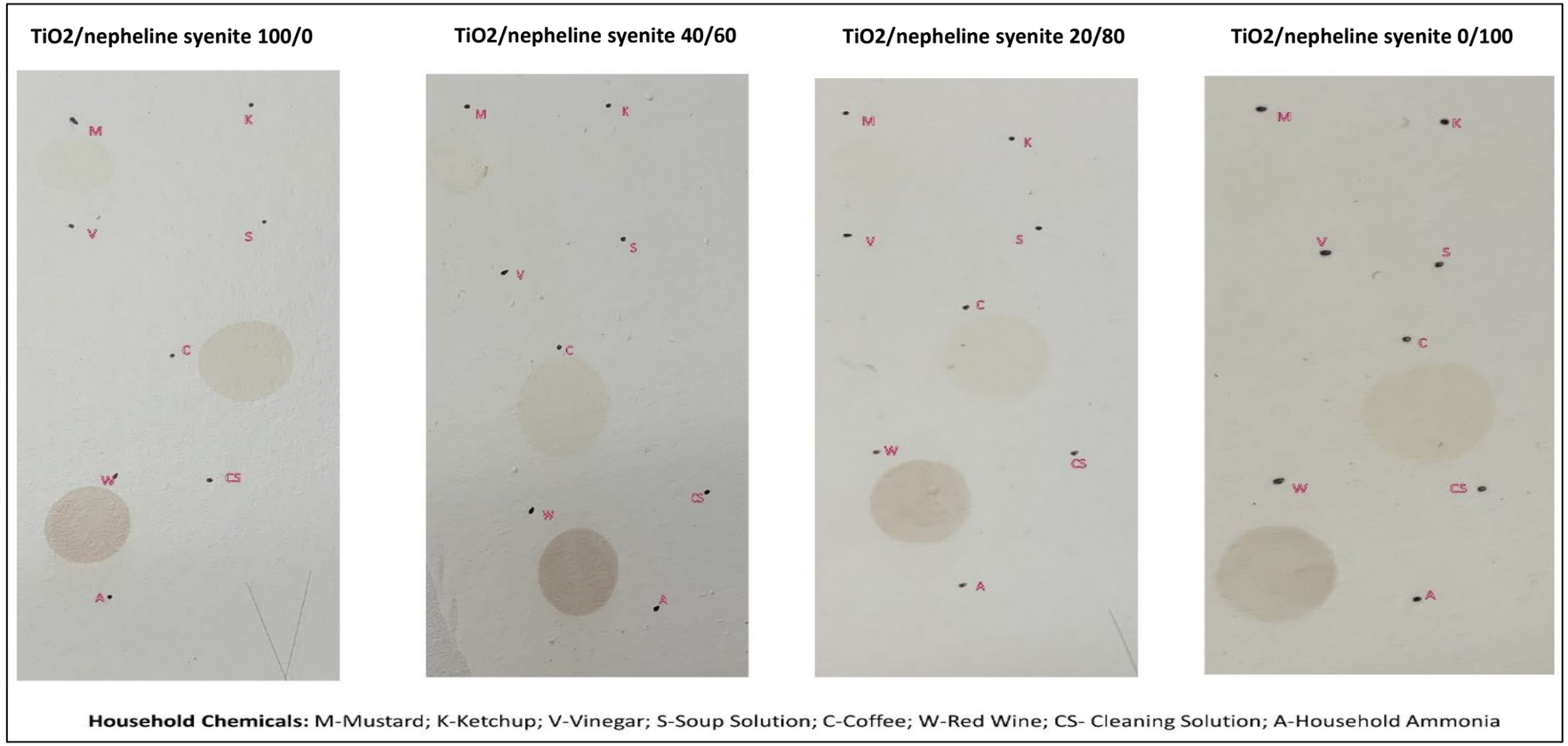
Dry Film Properties

- Stain Resistance – Household Chemicals
  - There's no adverse effect on resistance to household chemicals or spot test that is visible for GFE vs that of nepheline syenite formulation. **15 Minutes**



Household Chemicals: M-Mustard; K-Ketchup; V-Vinegar; S-Soup Solution; C-Coffee; W-Red Wine; CS- Cleaning Solution; A-Household Ammonia

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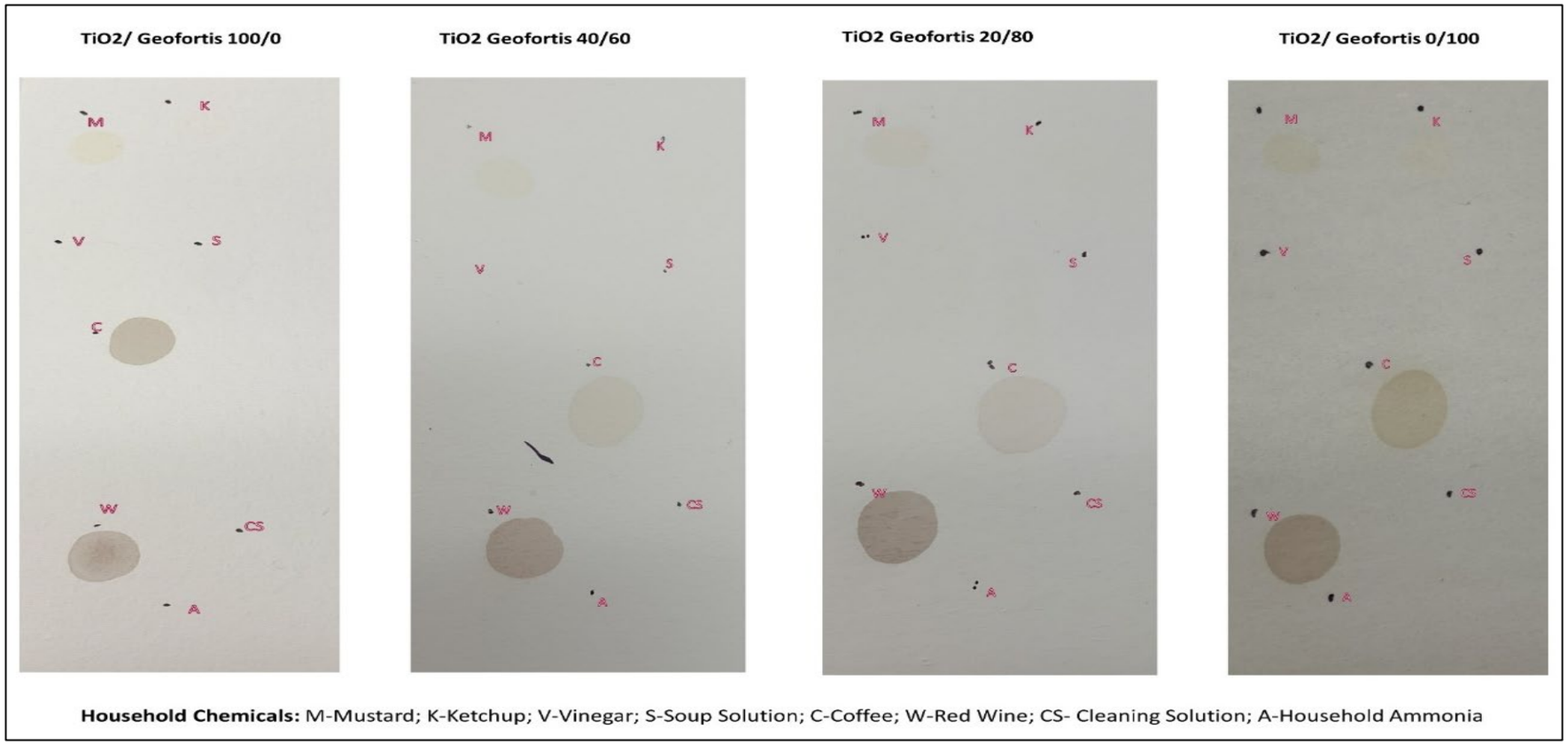
Dry Film Properties

- Stain Resistance – Household Chemicals
  - There's no adverse effect on resistance to household chemicals or spot test that is visible for GFE vs that of TiO2.

60 Minutes



Household Chemicals: M-Mustard; K-Ketchup; V-Vinegar; S-Soup Solution; C-Coffee; W-Red Wine; CS- Cleaning Solution; A-Household Ammonia

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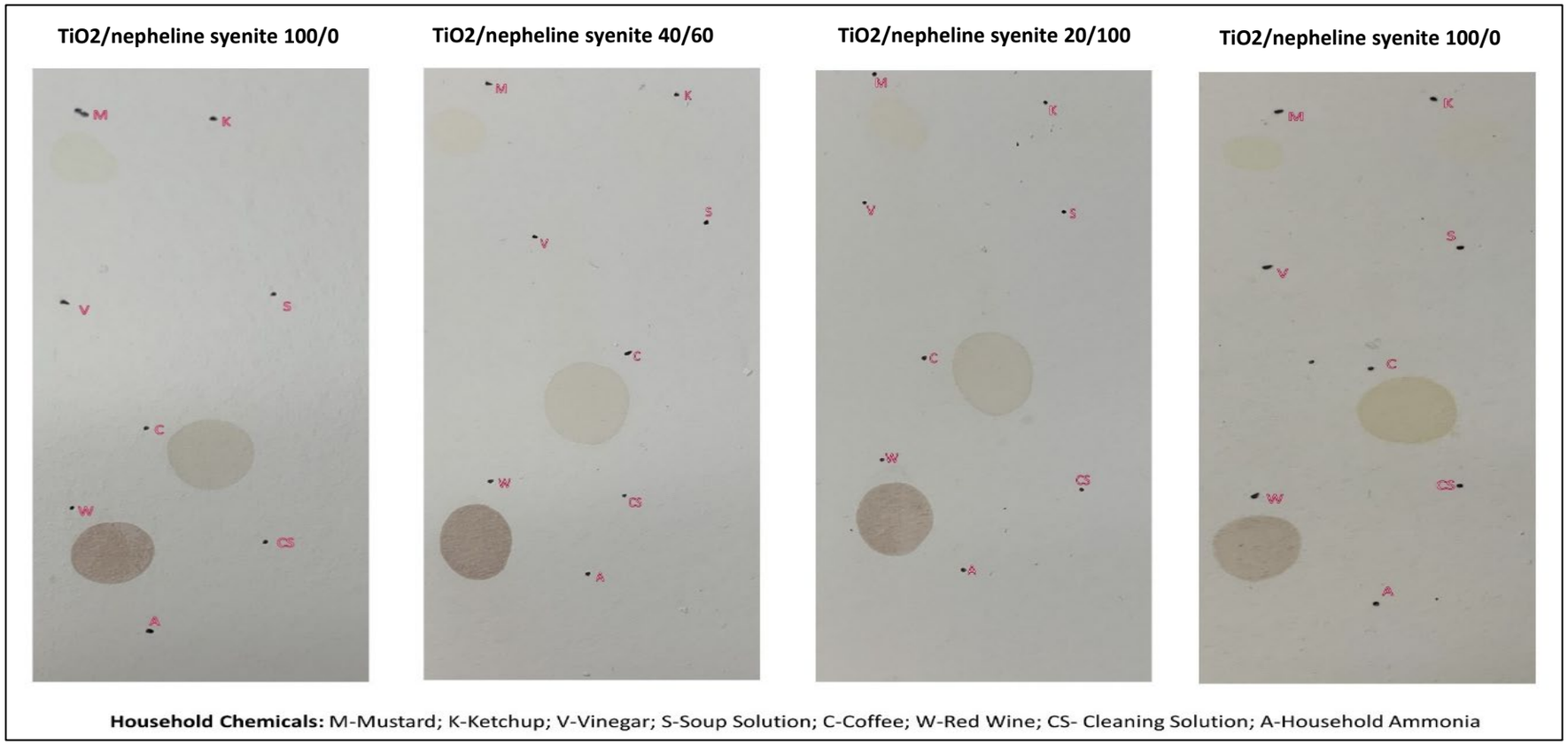
Dry Film Properties

- Stain Resistance – Household Chemicals
  - There's no adverse effect on resistance to household chemicals or spot test that is visible for GFE vs that of nepheline syenite formulation. **60 Minutes**



Household Chemicals: M-Mustard; K-Ketchup; V-Vinegar; S-Soup Solution; C-Coffee; W-Red Wine; CS- Cleaning Solution; A-Household Ammonia

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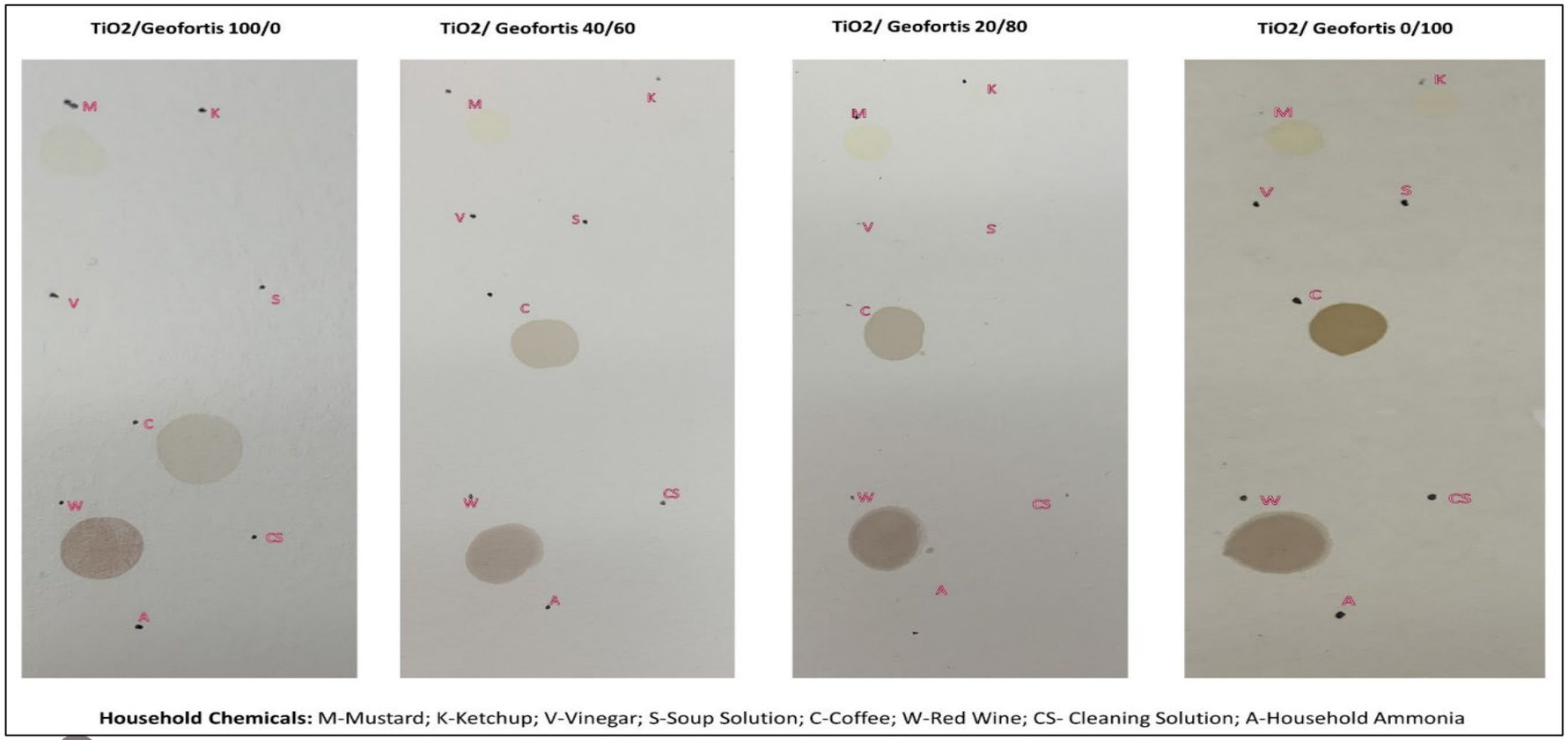
Dry Film Properties

- Stain Resistance – Household Chemicals
  - There's no adverse effect on resistance to household chemicals or spot test that is visible for GFE vs that of TiO2.

20 Hours



Household Chemicals: M-Mustard; K-Ketchup; V-Vinegar; S-Soup Solution; C-Coffee; W-Red Wine; CS- Cleaning Solution; A-Household Ammonia

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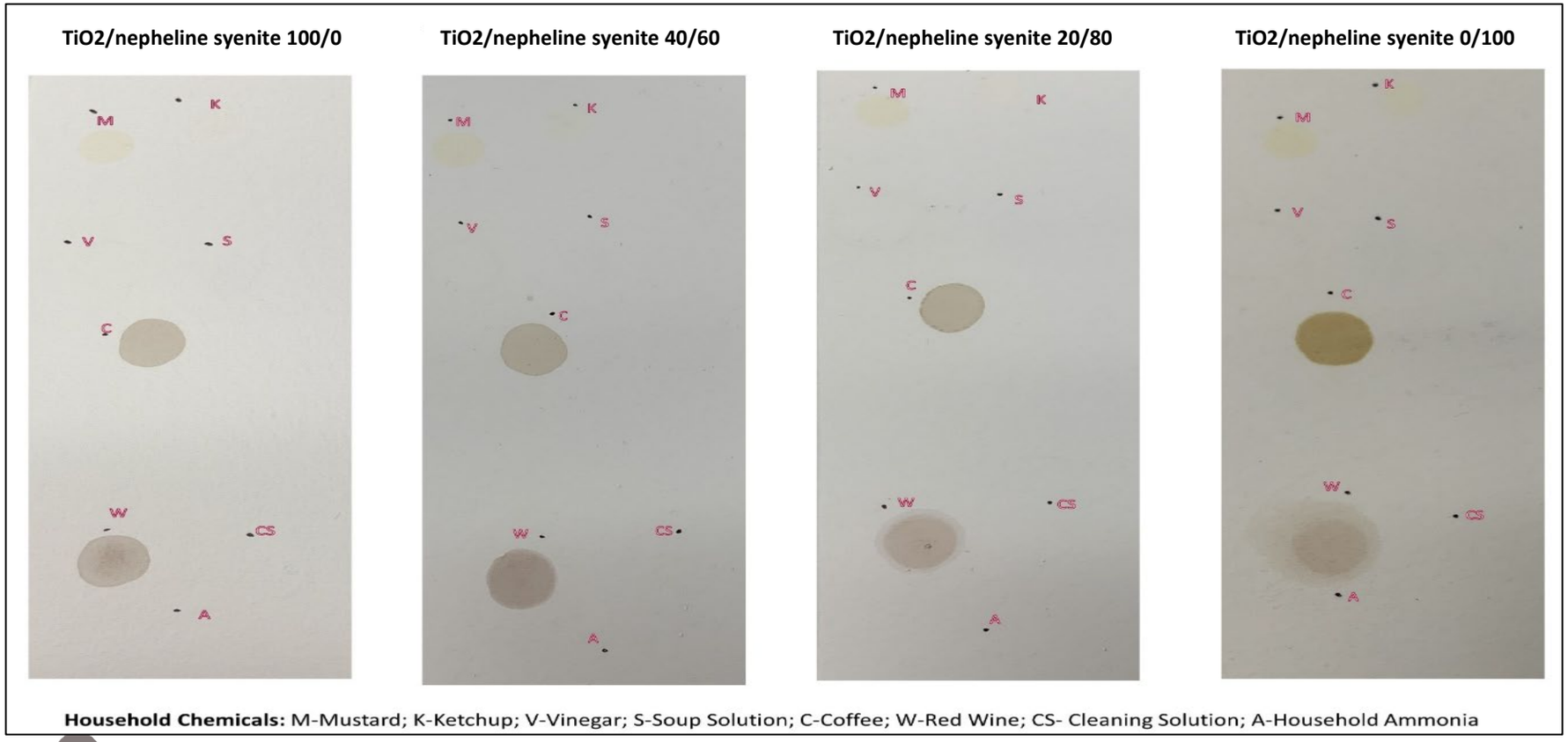
Dry Film Properties

- Stain Resistance – Household Chemicals
  - There's no adverse effect on resistance to household chemicals or spot test that is visible for GFE vs that of nepheline syenite formulation. **20 Hours**



Household Chemicals: M-Mustard; K-Ketchup; V-Vinegar; S-Soup Solution; C-Coffee; W-Red Wine; CS- Cleaning Solution; A-Household Ammonia

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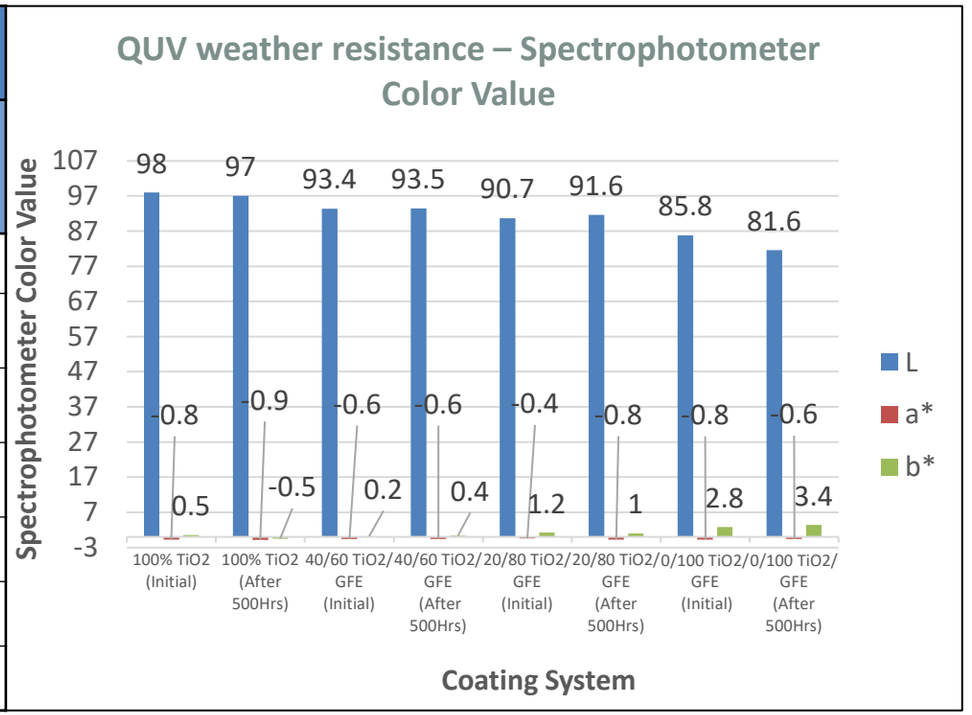
Dry Film Properties

- QUV Accelerated Weather Resistance – Spectrophotometric Color
  - No adverse effect on the color, gloss or weather resistance for GFE vs that of TiO_2 or nepheline syenite formulation
  - The test was done in accordance with ASTM D4329 for 500 hours

Formulations	Spectrophotometric Color, ASTM D2244							
	Initial Reading			After 500 Hours			ΔE	
	L*	a*	b*	L*	a*	b*		
100% TiO2	98	-0.8	0.5	97	-0.9	-0.5	1.4	
40/60 TiO2/ GFE	93.4	-0.6	0.2	93.5	-0.6	0.4	0.2	
20/80 TiO2/ GFE	90.7	-0.4	1.2	91.6	-0.8	1.0	1.0	
0/100 TiO2/ GFE	85.8	-0.8	2.8	81.6	-0.6	3.4	4.2	
40/60 TiO2/nepheline syenite	96.2	-0.8	0.1	95.8	-1	0.2	0.5	
20/80 TiO2/nepheline syenite	95.2	-1	0.3	94.4	-1	-0.5	1.1	
0/100 TiO2/nepheline syenite	92.2	-1.3	1.3	92.8	-1.3	0.1	1.3	



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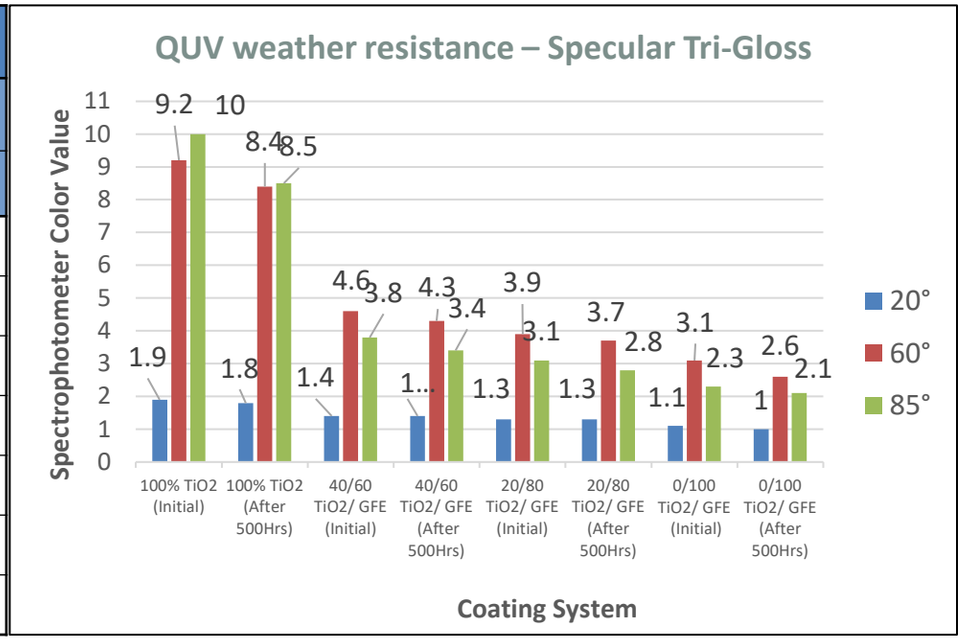
Dry Film Properties

- QUV Accelerated Weather Resistance – Specular Tri Gloss
  - No significant loss in gloss after 500 Hours of QUV–A Exposure.
  - The test was done in accordance with ASTM D4329 for 500 hour.

Formulations	Gloss readings					
	Initial Reading			After 500 Hours		
	20°	60°	85°	20°	60°	85°
100% TiO2	1.9	9.2	10	1.8	8.4	8.5
40/60 TiO2/ GFE	1.4	4.6	3.8	1.4	4.3	3.4
20/80 TiO2/ GFE	1.3	3.9	3.1	1.3	3.7	2.8
0/100 TiO2/ GFE	1.1	3.1	2.3	1	2.6	2.1
40/60 TiO2/nepheline syenite	1.5	4.8	4.1	1.4	4.2	3.6
20/80 TiO2/nepheline syenite	1.4	4	3.2	1.3	3.6	2.7
0/100 TiO2/nepheline syenite	1.3	3.2	2.5	1.3	2.8	2.2



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Contact Information

- For more information about how Geofortis Functional Extenders can help improve the performance of coatings formulations, contact your Geofortis representative
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