DIRECT TO METAL BALANCING ACT - MINIMIZING APPLIED COST WHILE MAXIMIZING PROTECTIVE PERFORMANCE

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New DTM Resin Platform

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Discussion Topics

1. Trends and performance challenges in direct to metal coatings

2. Market gap analysis on both performance & applied cost

3. Development Performance objectives

4. Results

5. Formulation considerations

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DTM Coating Trends

- Transition from solventborne to waterborne systems for light-duty applications
- Addressing new VOC* regulations to improve environmental and EHS profile
- Minimizing applied costs through 1 coat systems
- Addressing VOC regulations without sacrificing anti-blocking properties
- Balancing multisubstrate adhesion with high corrosion resistance

*__VOC__ = volatile organic compound

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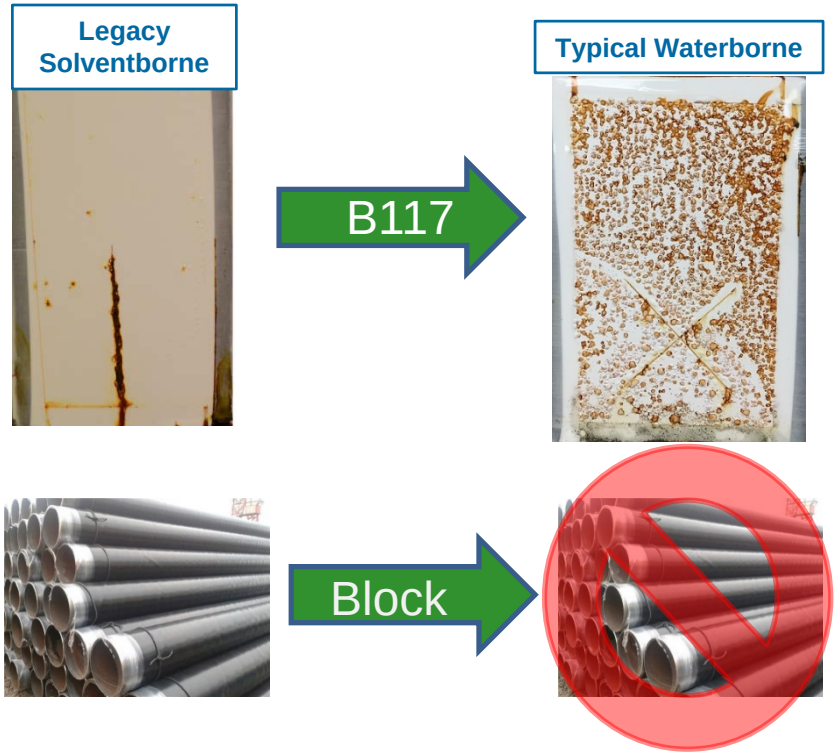
DTM Coating Trends Solvent to Water

- Corrosion resistance typically diminishes when formulators look for waterborne alternatives to solventborne coatings
- Waterborne coatings typically need to be applied at high film build in order to obtain moderate levels of corrosion resistance
- High film builds and relatively slow drying times lead to high applied costs for these materials
- Products coated “in line” with high VOC waterborne systems may have issues stacking after application (blocking resistance), as residual solvents remain trapped in the film.
- Lastly, obtaining suitable adhesion in waterborne systems typically comes at the sacrifice of corrosion performance.



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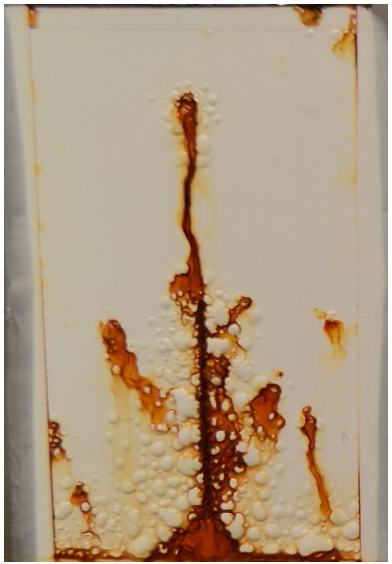
DTM Coating Challenges (Corrosion and Block Resistance)

8	4	0	Block Rating
			300hr B117 @ 2mil DFT

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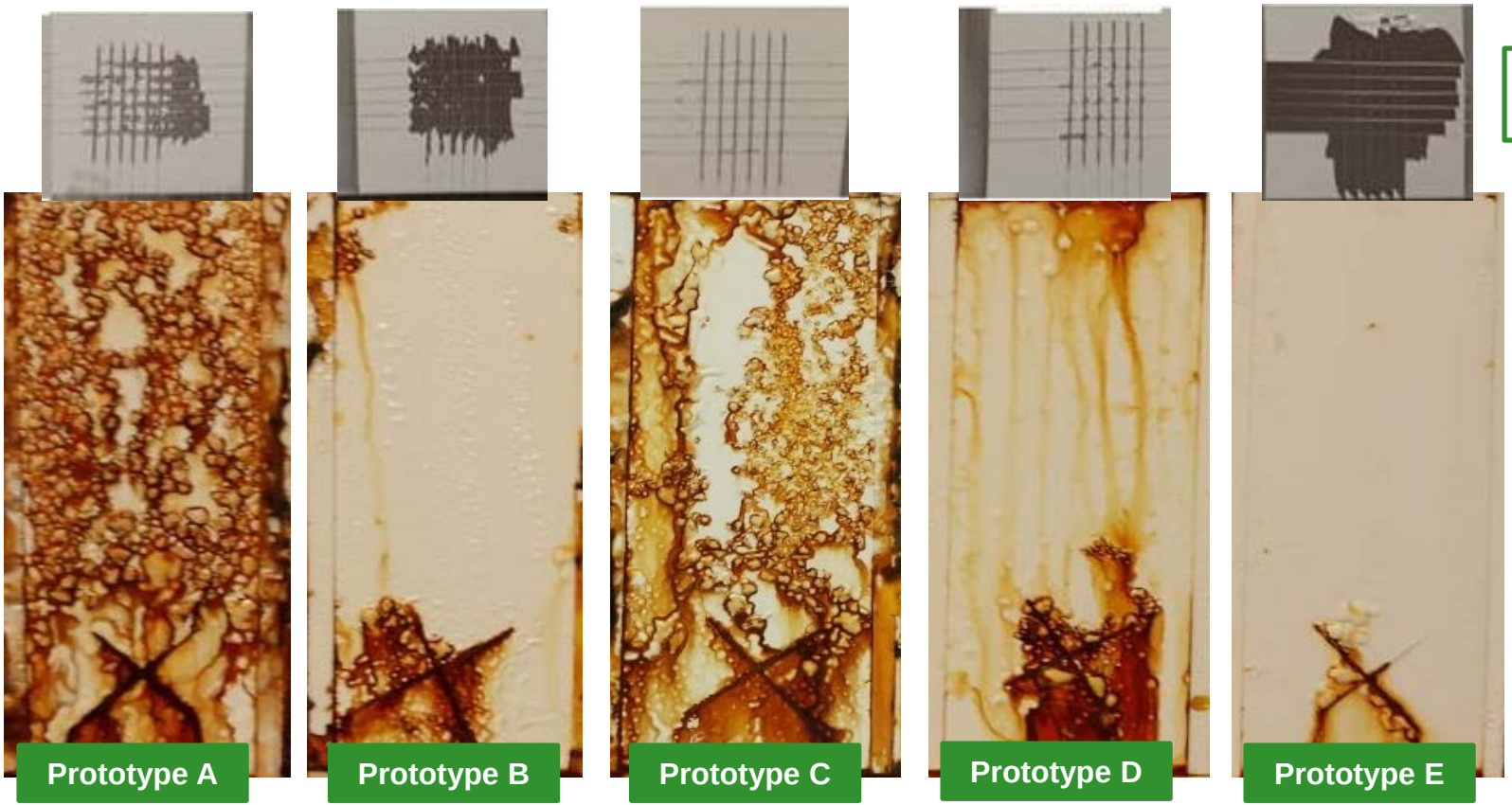
DTM Coating Challenges (Corrosion and Adhesion)



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DTM Coating Challenges (Corrosion and Wet Adhesion)

300hr B117 @ 2mil DFT

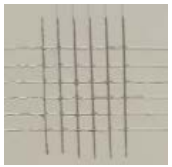
Prototype F

CRS Dry

CRS Wet

Prototype G

CRS Dry



CRS Wet

Prototype H

CRS Dry

CRS Wet

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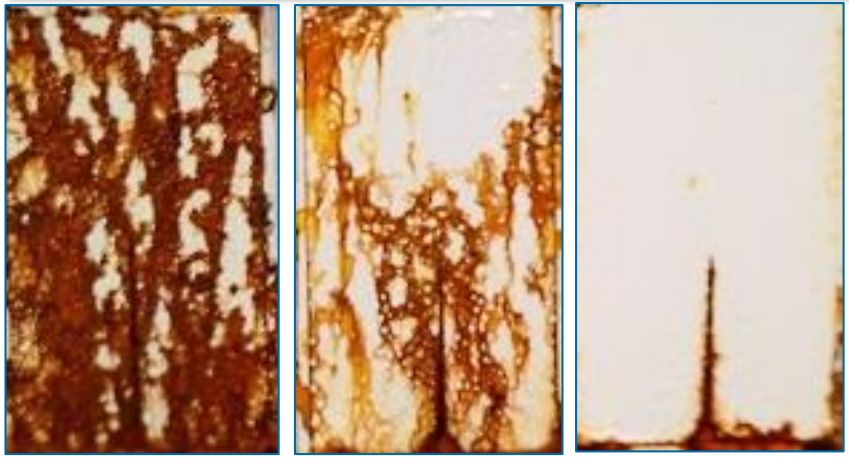
DTM Coating Challenges (Thin Film Corrosion)

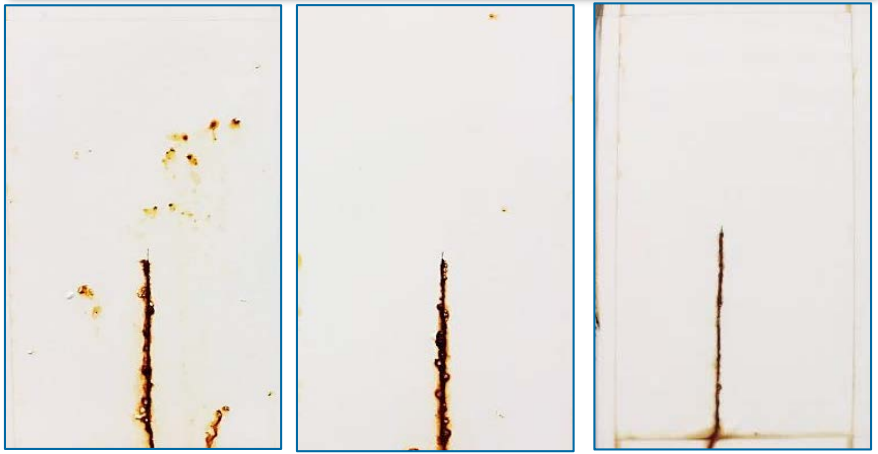
Corrosion resistance at 300hrs in B117

Benchmark 50g/L product



1mil | 2mil | 3mil

New EPS 50g/L product



1mil | 1.5mil | 2mil

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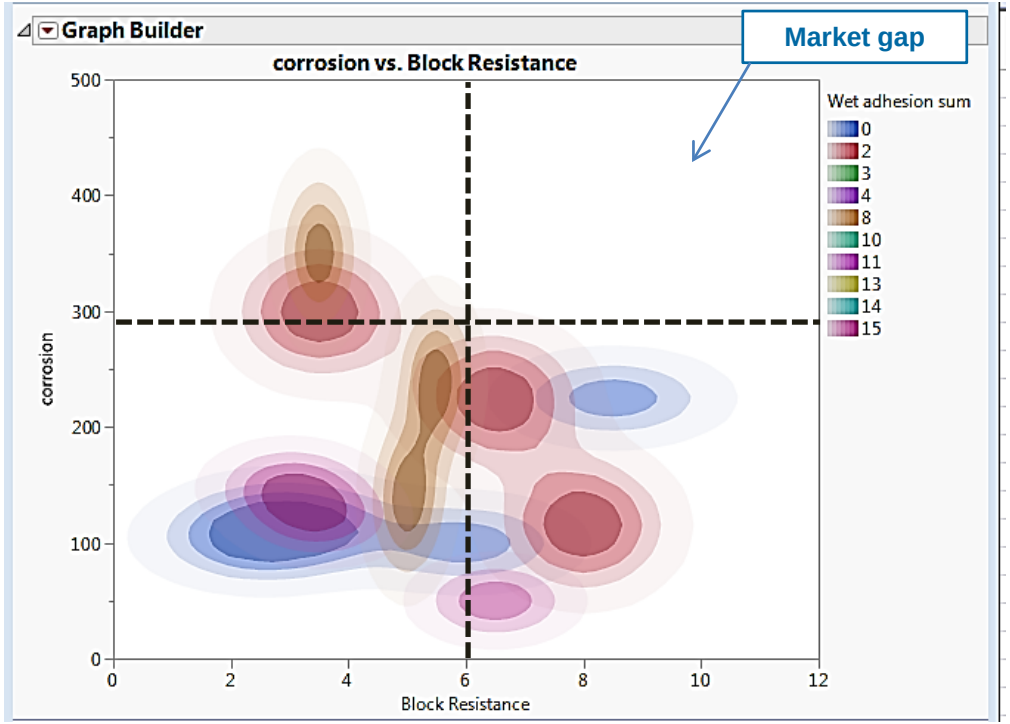
Market Gap Analysis - Performance



Test Protocol

- Block Resistance tested after 24-hr cure at 50°C
- Corrosion tested at 1.5mil DFT after B117hrs
- Colors represent crosshatch wet adhesion on three substrates

Analysis

- Benchmarked 21 resins
- No polymer could achieve 300hrs B117 and pass the rapid block development test

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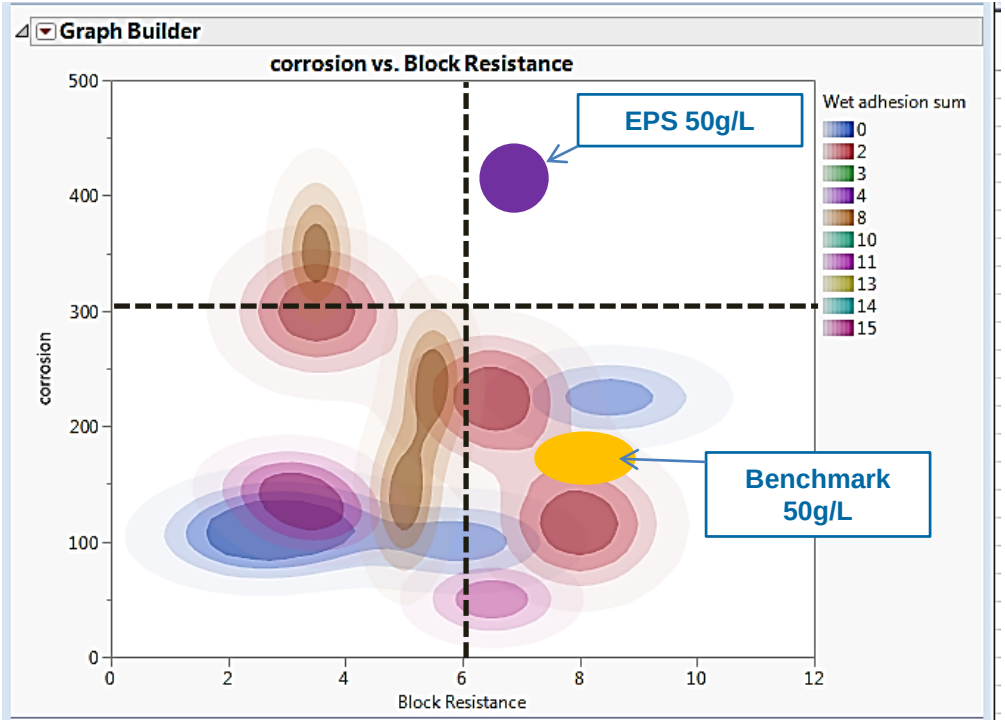
Market Gap Analysis - Performance



Through careful polymer design and rigorous formulation work EPS was able to fill the market need.

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Performance Objectives for 16PVC high gloss white

Performance Targets

Performance Category	Testing Protocol	Target Range
Corrosion resistance	B117	500-1000hr with minimal rust/blistering
Adhesion composite (aluminum, galvanized, CRS)	Crosshatch	4B – 5B wet/dry on 3 substrates
Block resistance	24hr 50°C on a scale of 1-10	6-8
Gloss Retention	QUV A	1,000-2,000hr 90% gloss retention
Humidity	Cleveland	500-800hr no rusting 50% gloss retention
Hardness	Konig oscillations	15-20

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Performance Results for 16PVC high gloss white

Results

Performance Category	Testing Protocol	Target Range	EPS Product Results
Corrosion resistance	B117	500-1000hr with minimal rust/blistering	600-750hrs @ 1.5-2 mild DFT
Adhesion composite (aluminum, galvanized, CRS)	Crosshatch	4B – 5B wet/dry on 3 substrates	4B on 3 substrates @ 7 day
Block resistance	24hr 50°C on a scale of 1-10	6-8	6-7
Gloss Retention	QUV A	1,000-2,000hr 90% gloss retention	2000hrs +80% gloss retention
Humidity	Cleveland	500-800hr no rusting 50% gloss retention	800hrs no rusting 75-85% gloss retention
Hardness	Konig oscillations	15-20	18

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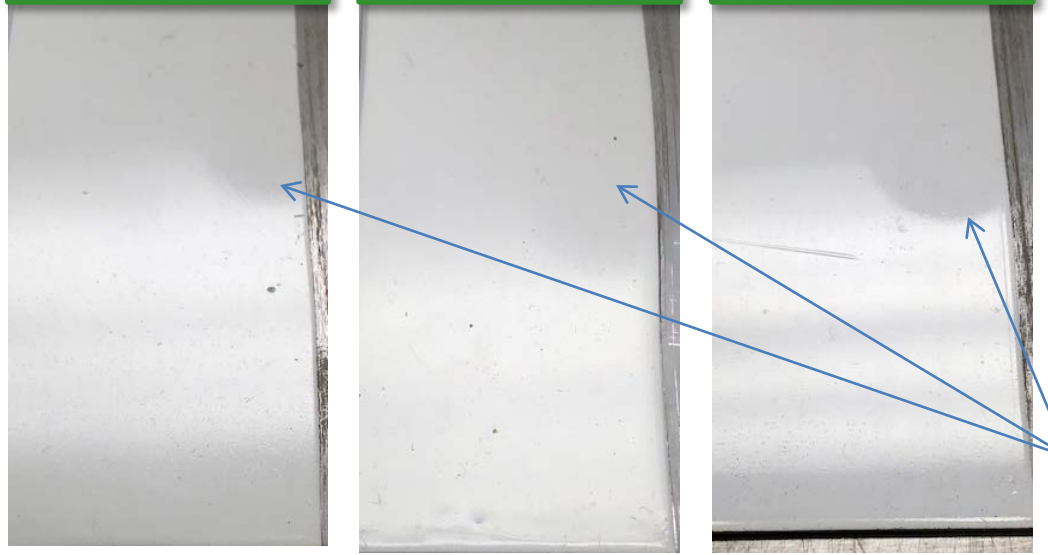
Performance Overview *(Cleveland humidity)*



EPS 50g/L maintains excellent DOI after exposure to humidity for 30 days

High contrast of objects in film vs benchmarks

Coatings applied on aluminum and exposed to humidity for 30 days

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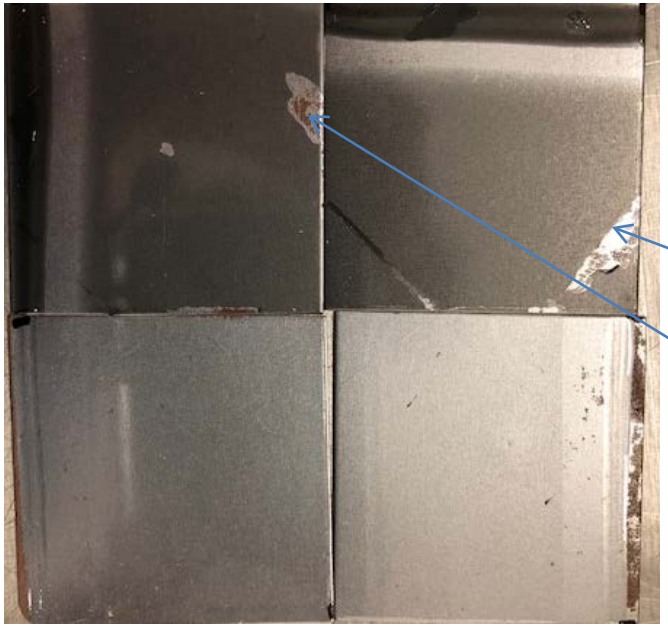
Performance Overview *(High Temp. Blocking)*



Benchmark

Delamination indicating film failure

EPS 50g/L

Procedure

Formulations applied (10mil WFT) and dried for 24hrs. Films were then placed in 60°C Oven for 30min with 1kg weight applied. After 30min, specimens were removed from oven and left at room temp. for 30min with weight still applied. After this the films were separated and assessed for blocking.

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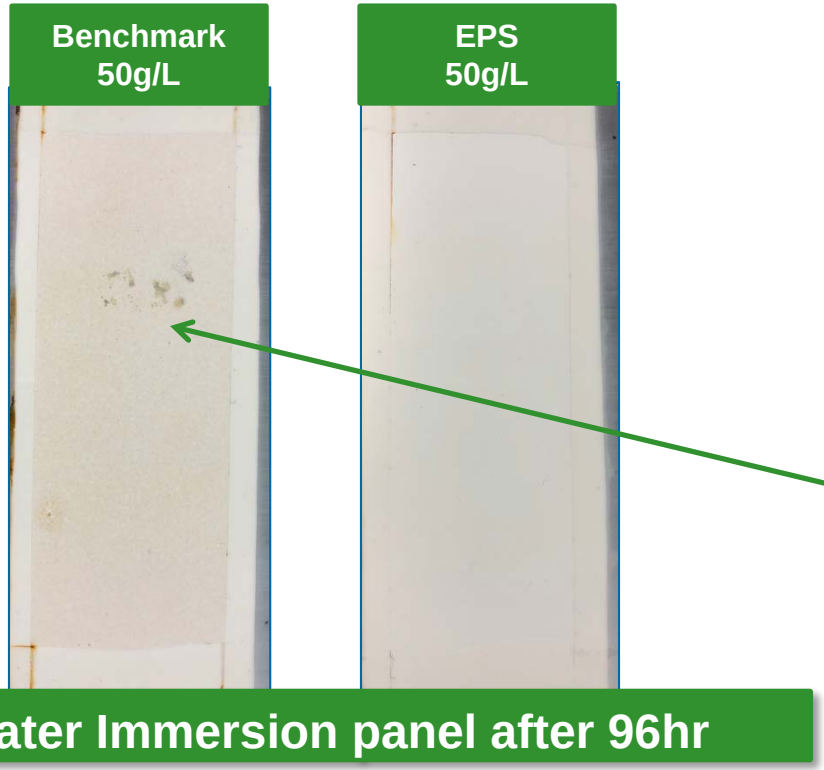
Performance Overview *(Water Immersion)*



Water Immersion panel after 96hr

- Water immersion resistance is critical to protective coatings performance
- Benchmark materials not only blister during immersion but also allow the substrate to corrode

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Maximizing Performance Leads to Reduced Applied Cost

Tech	Quantity 1 coat	Quantity 2 coat	Hypothetical paint price	Labor cost + Paint cost 1 coat	Labor cost + Paint cost 2 coat	Contractor Price to consumer	Margin $	Margin %
EPS 50g/L	3 gallons	6 gallons	$50	(50*3)+(100*1)=$250	(50*6)+(100*2) =$500	$625	$375	60
Benchmark	3 gallons	6 gallons				$725	$225	31

Assumptions

- Labor calculated at $100/hr
- 1hr labor/coat
- Paint price for benchmark obtained through market research
- Paint volumes assume same spread rate
- All raw materials in paint formulas assumed to be equivalent

Cost to achieve long term corrosion protection on steel

Being able to apply thin films and maintain protective performance allows end users to maximize profitability

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Formulation Considerations

- Pigmentation type and properties
  - Particle size
  - Oil adsorption
- Dispersant choice
  - Polyacid vs Hydrophobically modified
- Coalescent selection
  - Water miscible vs polymer miscible

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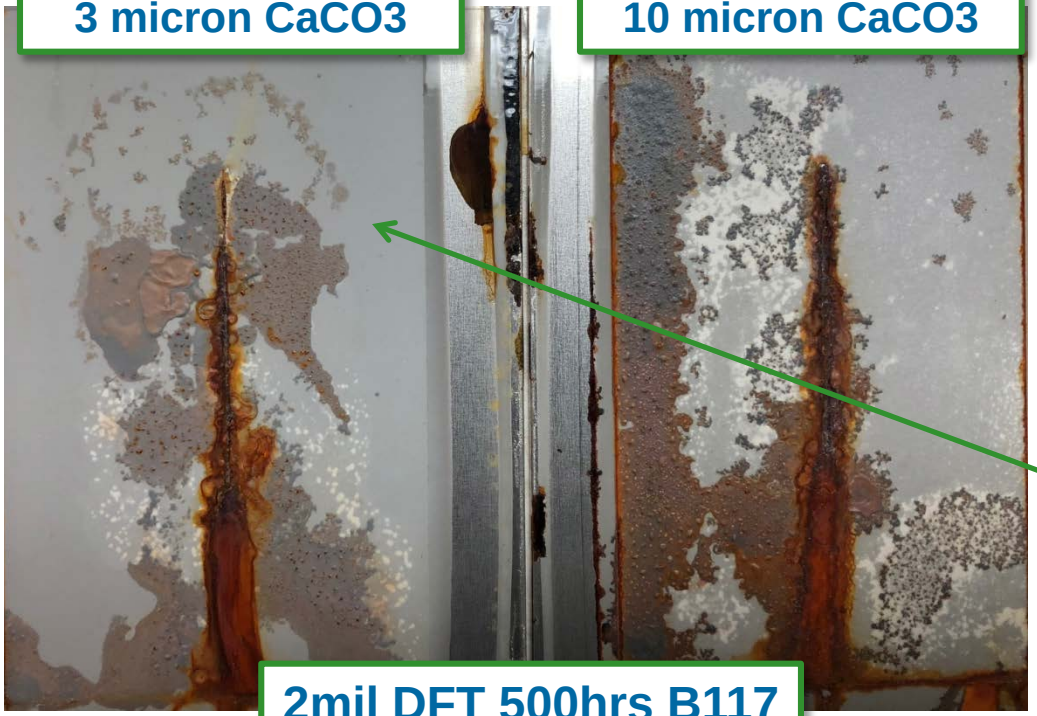
Formulating at High PVC – extender particle size considerations



performance of two, 35 PVC, deep base formulations with different particle size extender pigments.

Significant improvements in field rust and blistering

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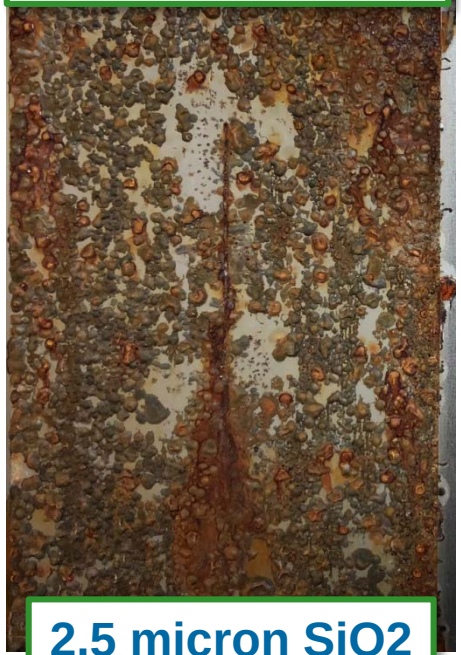
Formulating at High PVC – extender oil adsorption considerations

Oil Adsorption = 13

1 micron BaSO4

Oil Adsorption = 20



2.5 micron SiO2

- Oil Adsorption of extender is critical for optimal corrosion performance

35 PVC Formulas

2mil DFT 500hrs B117

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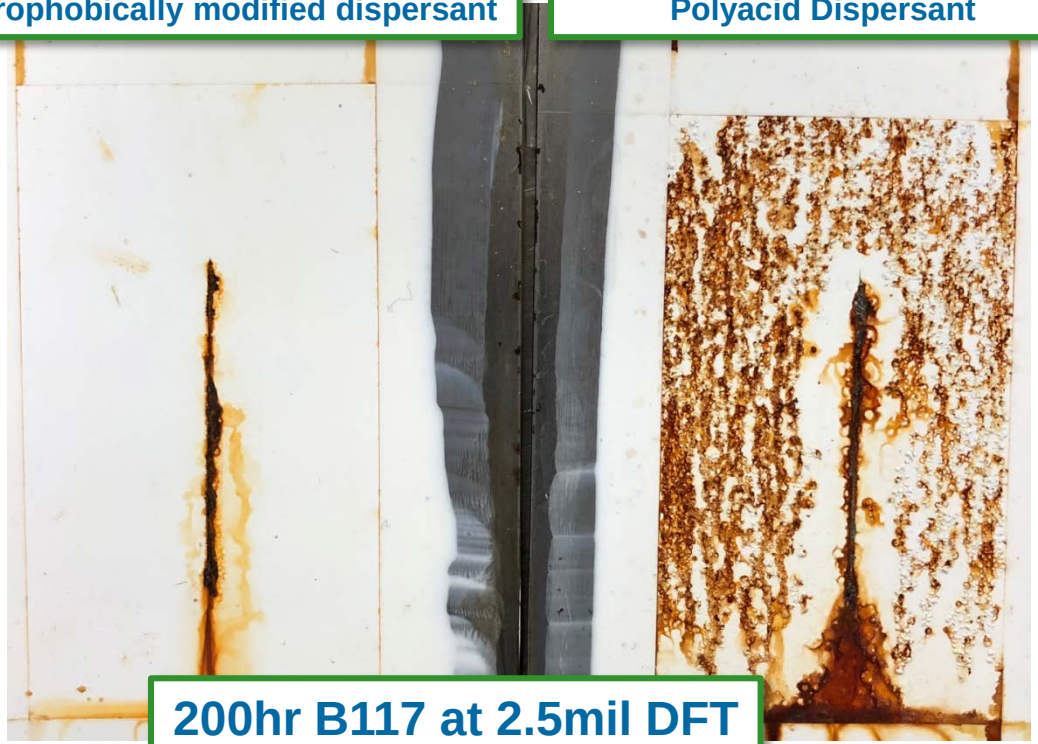
Formulating at High PVC – dispersant choice

Hydrophobically modified dispersant

Polyacid Dispersant



200hr B117 at 2.5mil DFT

Care should be taken when selecting a dispersant for high PVC coatings.

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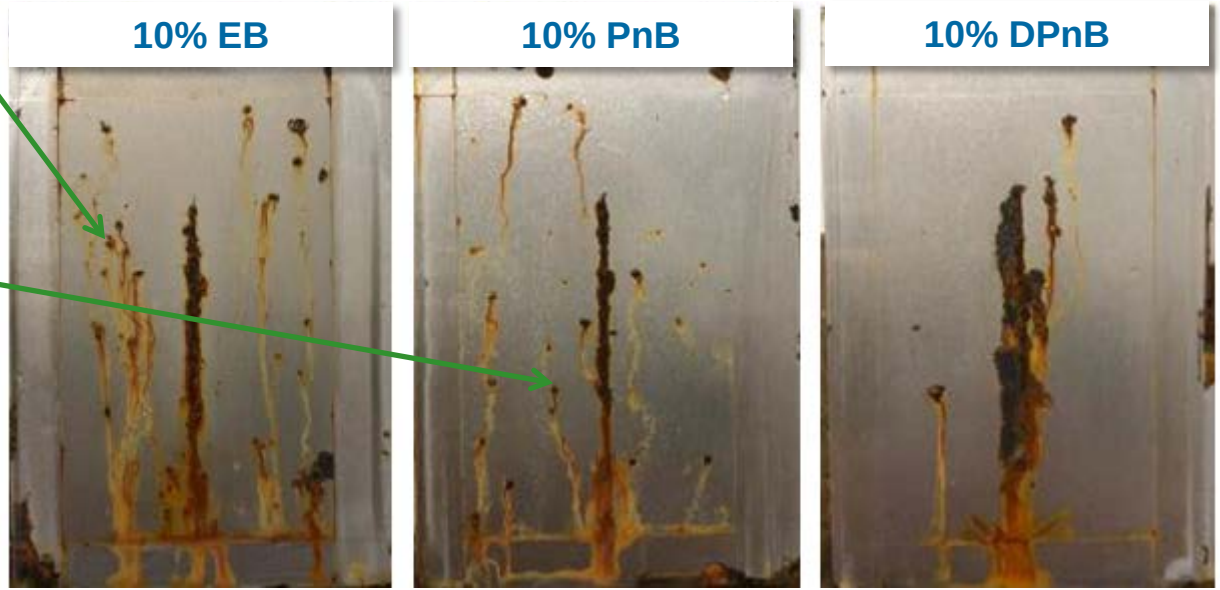
Coalescent Impact

Use of Hydrophilic coalescents can impact field rusting



The use of hydrophobic solvents is recommended. For example (DPnB/PPh/Tex)

EPS 50g/L Self-Crosslinking Styrene Acrylic Emulsion

WPG: 8.63

Solids: 48% NVM

pH: 8-9

MFFT: 8-12°C

Recommended coalescent: 5.5% DPnB or Texanol on resin solids

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Key Takeaways

- There is a market gap in corrosion/adhesion and block resistance balance
- The thin film corrosion resistance of the polymer allows coatings suppliers to minimize applied costs in order to maximize profitability
- Formulation is critical to maximizing the resin performance:
  - Select low particle size/low oil adsorption extender pigments for primers and flats
  - Choosing the appropriate dispersant (Hydrophobically modified vs Polyacid)
  - Utilizing the right coalescent (Polymer miscible vs Water miscible)
- EPS's 50g/L DTM product provides a regulatory compliant solution, and market leading performance for low VOC direct-to-metal coatings

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In Conclusion

Our new technology provides a low-VOC emulsion capable of providing the performance necessary for demanding applications.

- 50g/L VOC capable
- Passes extended wet adhesion tests
- Withstands thin film corrosion testing
- Rapidly develops anti-blocking properties

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