CORTEC Laboratories, Inc.

LABORATORY ACCREDITATION BUREAU a division of A2LA ACCREDITED ISO/IEC 17025 Certificate # L2267 Testing

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CorrVerter vs. Corroseal

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Project #:17-127-1525

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Background:

Corroseal Rust Converting Metal Primer is a coating which claims to convert rust into magnetite to control surface corrosion while priming the affected surface for further coating. This is very similar to Cortec's CorrVerter Rust Primer which makes similar claims, but comes in at a significantly higher price point. While Corroseal uses gallic acid to chelate rusted surfaces, CorrVerter utilizes a proprietary chelating agent. Furthermore, the resins in both CorrVerter and Corroseal are proprietary, so no initial hypotheses of the products' comparative performances can be formed. The purpose of this test is to examine the performance of CorrVerter and Corroseal side-by-side in ASTM B117 (salt spray) conditions and to evaluate the rheological properties of both coatings.

Sample Received:

A new 1 quart container of CorroSeal was purchased and sent to Cortec Laboratories. This container arrived in good condition with no signs of damage.

Method:

- Salt Fog Testing, ASTM B117
- Paint Rheology Testing, ISO 3219*

*Cortec Laboratories, Inc. is not ISO 17025 accredited for the test(s) marked.

Materials:

- CorrVerter (B# 089817)
- 4"x12" 1010 steel panels
- Deionized water
- Lint-free tissues (Kimwipes)
- Wet film thickness (WFT) gauge
- 1" paintbrushes
- Paraffin wax

Procedure:

Salt Fog Testing

1. Place bare steel panels in ASTM B117 (salt spray) chamber for 24 hours to pre-rust for converter coating application.
2. Remove panels from chamber and rinse with tap water while rubbing loose rust off with a gloved hand.
3. Rinse cleaned surface with lab DI water to further ensure impurities and chlorides have been removed.
4. Dab the panel surfaces with lint-free tissues to remove excess moisture and allow the panels to dry completely at room temperature (<1 hour)
5. Place panels horizontally and apply the coatings with a 1" paintbrush
    a. Check the coating thickness at three locations down the length of the panel with a WFT gauge to verify the coating thickness conforms to intended test values.
6. Allow the panels to remain horizontal and undisturbed for the curing duration (≥7 days)
    a. All panels were verified to form a uniform black/dark purple colored film which is indicative of proper application for rust converting coatings.
7. Melt paraffin wax in a container with a hot plate and quickly dip the coated panel edges into the wax to prevent edge corrosion during testing.

8. Once wax has cooled (0.5 - 1 hour), place the coated panels into the ASTM B117 chamber and run to failure.
9. Remove the panels from the chamber and evaluate the surface condition.

Paint Rheology Testing

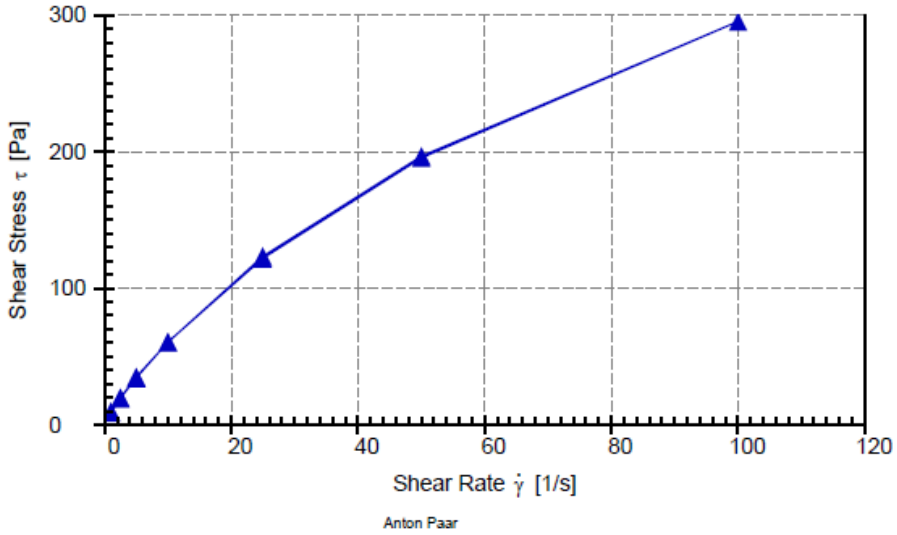
1. Loaded Sample into Anton Paar MCR-72 Rheometer and perform ISO 3219 via the automated protocol.
    - Test Conditions/Variables:
        i. Measurement System: 2° Cone and plate
        ii. Temperature: 25 ± 0.05 °C
        iii. Shear rates tested (1/s): 1, 2.5, 5, 10, 25, 50, 100

Results:

Results relate only to the items tested

Panel	Product	WFT (mil)	DFT (mil)	Result
1	CorrVerter	6-7	2.1-2.4	No Corrosion
2	CorrVerter	6-7	2.1-2.4	No Corrosion
3	Corroseal	8-9	2.5-2.8	Failure
4	Corroseal	8-9	2.5-2.8	Failure
5	Corroseal	15-16	4.7-5.0	Initiation
6	Corroseal	15-16	4.7-5.0	Initiation
Panels Coated: 9/26/17				
Chamber Start: 10/16/17				
Chamber Stop: 10/31/17 (360 hours)				

Figure 1: ASTM B117 Test Results. Dry film thicknesses (DTFs) were calculated from the products' solids by volume (31.3 % for Corroseal; 34.5 % for CorrVerter)



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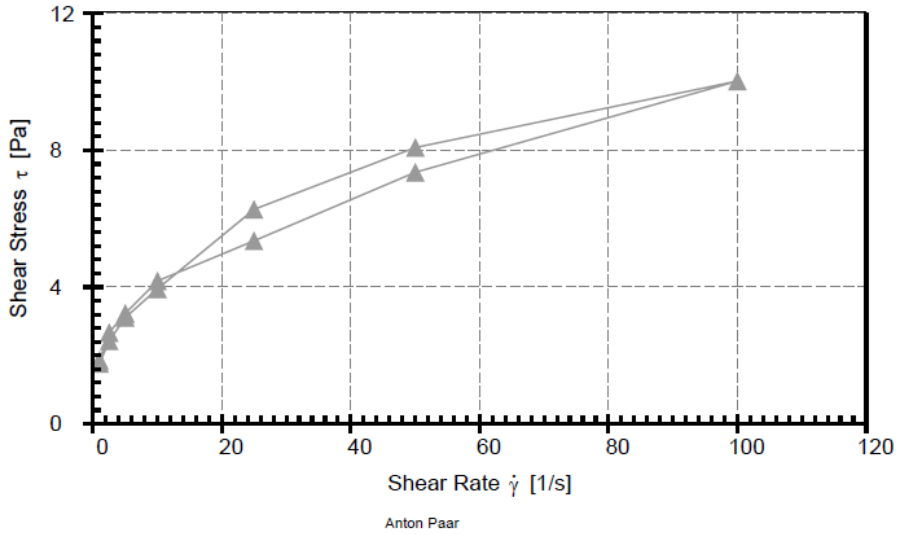
Point No. №	Shear Rate γ̇ [1/s]	Shear Stress τ [Pa]	Viscosity η [mPa·s]	Torque M [mN·m]
1	1	9.5726	9575.4	0.31388
2	2.5	19.811	7928.8	0.6496
3	5	35.029	7003.8	1.1486
4	10	60.43	6039.1	1.9815
5	25	123.32	4937.3	4.0436
6	50	196.73	3932.3	6.4506
7	100	295.36	2952.9	9.6849
8	50	195.4	3906.8	6.4072
9	25	121.85	4879.4	3.9955
10	9.99	60.55	6058.7	1.9854
11	5	34.324	6864	1.1255
12	2.5	19.402	7762.6	0.6362
13	1	8.9486	8949.8	0.29342

Figure 2: ISO 3215 rheology testing results for CorrVerter



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Point No.	Shear Rate	Shear Stress	Viscosity	Torque
№	$\dot{\gamma}$	τ	η	M
	[1/s]	[Pa]	[mPa·s]	[mN·m]
1	1	1.7645	1762.9	0.057856
2	2.5	2.4262	970.9	0.079553
3	5.01	3.1076	620.89	0.1019
4	10	3.9472	394.66	0.12943
5	25	6.2714	251.01	0.20564
6	50	8.0807	161.56	0.26496
7	100	10.024	100.24	0.32869
8	50	7.3559	147.08	0.2412
9	25	5.3519	214.17	0.17549
10	10	4.1773	417.9	0.13697
11	5	3.2273	645.22	0.10582
12	2.5	2.6661	1066.9	0.087421
13	0.999	1.8566	1858.1	0.060876

Figure 3: ISO 3215 rheology testing results for Corroseal

Photos:

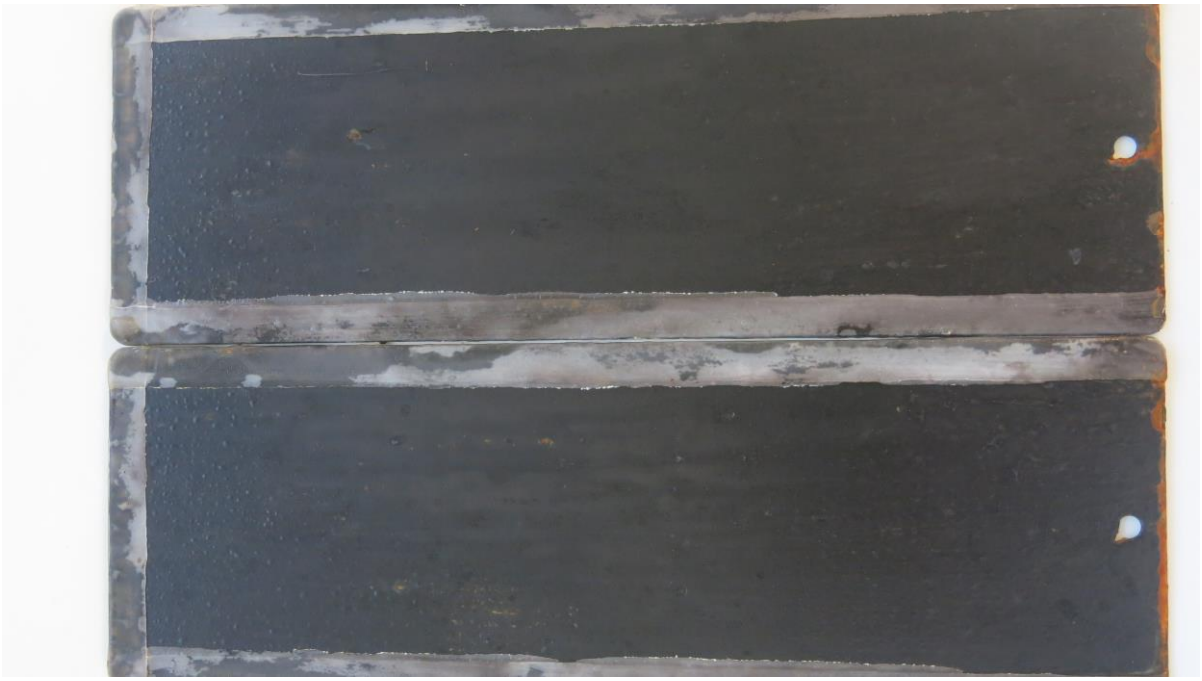

Figure 4: CorrVerter panels after 360 hours in salt spray chamber (2.1-2.4 mil DFT)

Figure 5: Corroseal panels after 360 hours in salt spray chamber (2.5-2.8 mil DFT)

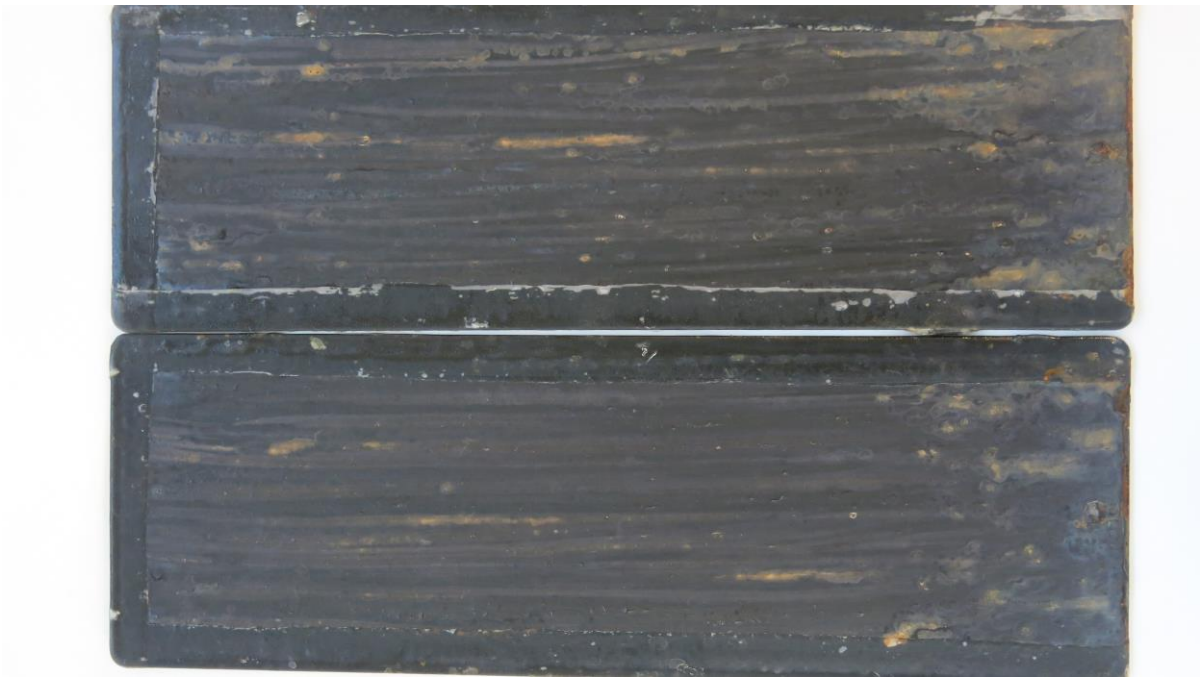

Figure 6: Corroseal panels after 360 hours in salt spray chamber (4.7-5.0 mil DFT)

Interpretations:

CorrVerter provided much better corrosion protection than the Corroseal material in ASTM B117 salt spray testing. As can be seen in the photos above, Corroseal panels (at the recommended application rate) showed complete failure after 360 hours in ASTM B117 salt spray conditions. When used at roughly twice the recommended application rate, Corroseal panels began to show failure after 360 hours of testing as corrosion became visible through the coating in several locations. According to a note on the Corroseal label, converting heavy rust will require a 23-30 mil wet film thickness (WFT) application, three times the recommended dosage. The Corroseal TDS notes that the coating is 31.30 % solids by volume, so a 23-30 mil WFT will result in a 7.2-9.4 mil DFT.

CorrVerter performed extremely well at a much thinner film thickness. As seen in figure 4, the surface remained consistent and presented no field failure with a 2.1-2.4 mil DFT after 360 hours of testing.

Understanding the rheological properties of a coating is particularly crucial because they inform how a coating flattens on a surface, hangs on a surface, and even how easy it is to apply with a brush. A typical, thixotropic coating will have a low viscosity under shear (e.g. spraying, rolling, and brushing) and will quickly build viscosity when under low shear (e.g. while sitting on a surface). When a coating is formulated correctly, this results in a product that is easy to apply, and hangs on the surface after application, allowing for a thick, even build.

As seen in the viscosity column of figure 2, Corrverter possesses a viscosity of almost 10,000 mPa·s (centipoise) under low shear, a viscosity of 3000 mPa·s under high shear, and quickly recovers its viscosity as the shear is reduced. This makes it very easy to apply a thick build of CorrVerter to vertical surfaces that will not run. In contrast, Corroseal (figure 3) possesses a viscosity of less than 2,000 mPa·s at low shear, and a viscosity of only 100 mPa·s under high shear. With such low viscosities, Corroseal would be exceedingly difficult to apply to a vertical surface at its recommended rate, much less the 23-30 mil thickness it recommends for heavily corroded areas. To reach these heavier application rates, it would likely take 4-5 separate applications of the product to prevent it from draining from the surface.