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Metaltec TC
USA

Re: Summary of Corrosion Tests Performed by Shell on TC Ceramic

Dear Mike,

Earlier this year, Mr. Howard Mitschke of Shell Global Solutions (a division of Royal/Dutch Shell) performed a five-month study of the corrosion properties of TC Ceramic insulating coating. The purpose of the testing was to force corrosion of a carbon steel substrate onto which the TC Ceramic had been applied to identify if the TC Ceramic would support corrosion under insulation (CUI).

Test Samples

Three carbon steel Q-panels were each abrasive blasted to an SSPC SP-5 white-metal blast and then coated with TC Ceramic (TCC) insulating coating. Test Panel I had one coat of approximately 20-25 mils dry film thickness (DFT) of TCC; Test Panel II has two coats applied to it, with an approximate total thickness of 35 mils dft; and Test Panel III had three coats of TCC, totaling between 50-55 mils dft. The samples were each prepared by spray application, with 24 hours of cure in an oven allowed between coats. Each of the samples was cured in an oven for 24 hours, prior to beginning the tests.

Test Apparatus and Protocol

The test apparatuses employed for this testing included a QUV Accelerated Aging Cabinet, an industrial oven and a salt-water bath. One cycle lasted 24 hours and consisted .of the following: 23 hours in the QUV cabinet at 113°F with regular tap water (no salt addition), followed by approximately one hour in an oven at 190°F and lastly 5-10 minutes in an ambient temperature 3% NaCl solution bath. The QUV cabinet is an accelerated aging unit, which exposes the sample to alternating cycles of UV light and moisture at elevated temperatures. The primary goal of the QUV unit is to simulate the effect of sunlight and rain/dew on paint and coating systems. The damage that typically occurs to paints and coating as a result of several years of ambient environmental exposure can be simulated in only a few weeks in a QUV cabinet. In the case of the test completed by Shell, the goal of the QUV unit was to facilitate corrosion of the unprimed steel substrate onto which the TC Ceramic had been applied.

Test Results

As the goal of the tests was to identify if the TC Ceramic insulating coating would facilitate or support corrosion underneath its film (CUI), the tests were operated until blistering and/or rust bleedthrough was noticeable on all three samples. This took approximately five months of exposure time. Over the course of the exposure time, a visual examination of the samples was made after each cycle and the habits of each sample were noted. Once all of the samples had demonstrated noticeable corrosion, the samples were removed for full corrosive evaluation.

Test Sample I: the thinnest of the three samples, with between 20-25 mils dft of TCC, Sample I demonstrated areas of rust bleedthrough within 2-3 weeks of the start date of the test. After five months of exposure, Sample I had many areas of rust bleedthrough, but did not demonstrate any blistering. An evaluation of the substrate with the TCC removed showed that almost all of it had experienced corrosion.

Test Sample II: this sample had approximately 35 mils dft of TCC on it. Sample II demonstrated a small amount of rust bleedthrough after approximately 5-6 weeks. The five-month evaluation on Sample II showed spotty bleedthrough and a small amount of blistering. The blisters were slightly visible, but easily identifiable by tapping the surface of the TCC with a metal rod. Removal of the TCC from Sample II showed that over 80% of the substrate had corroded.

Test Sample III: with between 55-60 mils dft of TCC on it, Sample III took the longest to demonstrate any corrosion – approximately four months. Evaluation of Sample III after five months of exposure showed a couple spots of rust bleedthrough. The sample also had several areas of blistering and uplifting. The blisters were only slightly raised at ambient temperature (no evaluation was made at elevated temperatures), but were easily identifiable by tapping the sample with a metal rod and listening for the sound change. Evaluation of the substrate with the TCC removed showed that approximately 60% of the area was corroded.

Test Summary

A few key points were observed as a result of the corrosion tests on the TCC.

- TCC does not support or facilitate corrosion under insulation, as corrosion occurring underneath the TCC was identifiable either by rust bleeding through the TCC or by blistering of the TCC.

- At lower millages (thinner coating levels), the primary method of corrosion identification is via rust bleedthrough.
- At higher millages, rust bleedthrough becomes less common and the primary mechanism of corrosion identification is blistering of the film.
- At ambient temperature the blisters in the TCC are slightly raised for visual identification and are also identifiable through audible testing (tapping the substrate with a metal rod and listening for sound changes).
- The TCC provided a more corrosion resistance than was expected.
- Additional tests should be run to identify corrosion mechanism at thicknesses greater than 80 mils.
- Appearances of the blisters at elevated temperatures should be better evaluated and visually noted.

The initial tests completed by Shell provided the information that was intended – whether or not TCC supports CUI. The tests were run longer than anticipated due to the better-than-expected corrosion resistance of the TCC. A second set of tests is in the process of being completed. These tests are designed to evaluate how the TCC will respond to substrate corrosion at high coating thicknesses – greater than 80 mils dft – with the goal again being to identify if TCC supports CUI and if it does not, how the corrosion mechanism can be visually identified.

I hope this information is helpful. I will keep you informed as to the progress made on the second set of tests and will get you a report soon after they are completed. Please do not hesitate to contact me should you have any questions.

Sincerely,
Jeff Buratto
Jeff Buratto