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NEW WATER BASED COATING SYSTEM FOR HOLDING & STORAGE TANKS

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ABSTRACT

Traditional tank lining coatings are costly, have high VOC content and generally require a high film thickness of multiple coats. This paper presents the results of testing a new type of coating system applied to the inside of tanks, exposed to corrosive environments. This new coating system has been extensively tested in the laboratory and field applications. The field applications include several holding tanks, where the products for storage vary from hydrocarbon to high salinity solutions. The coating system consists of a low VOC rust converting water based primer and a high solids moisture cure urethane coating which are applied at a much lower film thickness then the traditional tank lining coating systems, yet provides the same or better corrosion protection.

Key Words: corrosion, tank lining, epoxy, moisture cure urethane

INTRODUCTION

Currently the tank lining industry has been using high build tank lining systems made of heavy layers, consisting of several 8-10 mil coats of coal tar epoxies which do not contain corrosion inhibitors. These current systems require sand blasting of the metal to SPCC SP-10 near white metal blast before placing the spray in-liner of the coal tar epoxy at mil thicknesses up to 30 mils.

Using the low VOC rust-converting water-based primer and a high solids moisture-cure urethane coating results in a lower film thickness, a total of 5-7 dry mils (125-175 microns), saving time and money. The VOC of the low VOC rust-converting water-based primer is 0.3-0.4 pounds per gallon (35.9-47.9 g/l) and the VOC of the high solids moisture-cure urethane coating is 3.1-3.2 pounds per gallon (371.5-383.5 g/l).
One comparative epoxy paint system would put out an estimated 44.9 tons per year of VOC compared to the system of a low VOC rust-converting water-based primer and a high solids moisture-cure urethane coating which only puts out an estimated 1.86 tons per year of VOC. This calculation was made by calculating the amount of product used per tank, based on 2 tanks coated per day.

To prove the coating system could withstand the harsh environments, it underwent various accelerated weathering exposure tests in the laboratory and field applications as will be discussed in this paper.

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EXPERIMENTAL PROCEDURE

Test Criteria

The goal of the experimental effort was to replace the existing tank lining systems that are currently used to hold hydrocarbon and/or high salinity solutions with better performing and environmentally sound coating system of the low VOC rust-converting water-based primer and a high solids moisture-cure urethane.

Materials

1. Low VOC rust converting water based primer
2. High solids moisture cure urethane coating
3. Diesel **– Solution A**
4. 10% Diesel and 10% Gear oil in water **– Solution B**
5. 4.5% NaCl and 4.5% $NaSO_4$ with 50ppm $FeCl_3$ in water **– Solution C**
6. Corroded 1010 Carbon Steel Panels
7. Hydrogen Sulfide (H_2S) 1600ppm
8. Carbon Dioxide (CO_2)
9. Sulfur Dioxide (SO_2) 400ppm
10. 1010 carbon steel panels pre-rusted in salt spray and humidity cabinets
11. Minitest 500 (dry film thickness detector)
12. Wet film thickness gauge

Methods

1. Visual Inspection
2. ASTM B117 Salt Spray Testing

Coating Procedures

1. The corroded panels had the low VOC rust-converting water-based primer applied to the pre-rusted panel by brush at a wet film thickness of 3-5 mils (75-125 microns).
2. The panels with the low VOC rust-converting water-based primer were air dried in ambient conditions for 24 hours.
3. Next the panels were coated with the high solids moisture-cure urethane coating at a wet film thickness of 3-4 wet mils (75-100 microns).
4. The wet film thickness was checked by using a wet film gauge.

Immersion Resistance Testing Procedures

1. The coated panels were air dried in ambient conditions for 48 hours and then immersed in two hydrocarbon solutions: 100% Diesel (Solution A) and 10% Diesel and 10% Gear Oil in water (Solution B) as well as the high salinity solution of 4.5% NaCl and 4.5% $NaSO_4$ with 50ppm $FeCl_3$ in water (Solution C).
2. Then the panels were evaluated at various intervals for signs of corrosion and coating deterioration.

Gaseous Environment Testing Procedures

1. The coated panels were air dried in ambient conditions for 168 hours
2. The coated panel was exposed to the various gaseous environments in the following order, for time indicated and evaluated at various intervals:

   CO_2 Testing – The prepared panels were placed inside a jar containing a cup of water and closed. CO_2 was injected into the water for 72 hours.

   SO_2 Testing - The prepared panel where then placed into one-gallon glass jars which contained a solution to create a 400ppm SO_2 environment, per the CC-003 test.

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H_2S Testing – Next the prepared panel was placed into the one-gallon glass jar containing a 50 ml beaker with 0.02g of Iron Sulfide in it. 0.5ml of 1N HCL was added to the 50 ml beaker to create the H_2S environment. The jars were closed and electrical tape was applied around the lid before being placed into a 50°C oven for 24 hours, per the CC-009 test.

RESULTS

In order for the coating system to be accepted as an alternative coating system for tank linings, 1000 hours of immersion testing in the listed chemicals below had to be run and passed.

Table 1 and Figures 1-3 show the results of the Immersion Resistance Testing. No negative effects were seen on the coating during this testing.

TABLE 1

Immersion Resistance Results

Products	**Chemical Immersed**	**Comments**
Low VOC rust-converting water-based primer with high solids moisture-cure urethane coating (Figure 1)	**Solution A 1000 hours**	**No effect to the coating**
Low VOC rust-converting water-based primer with high solids moisture-cure urethane coating (Figure 2)	**Solution B 1000 hours**	**No effect to the coating**
Low VOC rust-converting water-based primer with high solids moisture-cure urethane coating (Figure 3)	**Solution C 1000 hours**	**No effect to the coating**

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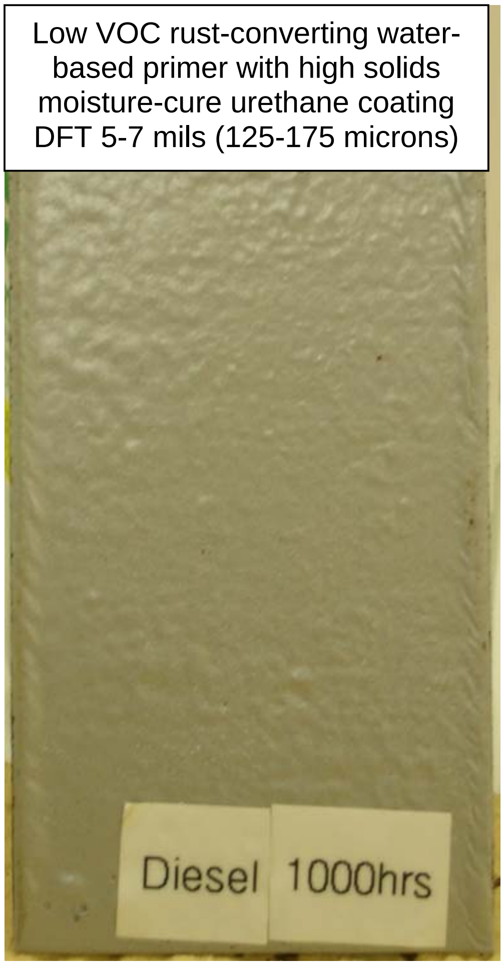

Figure 1 - Panel Immersed in Diesel

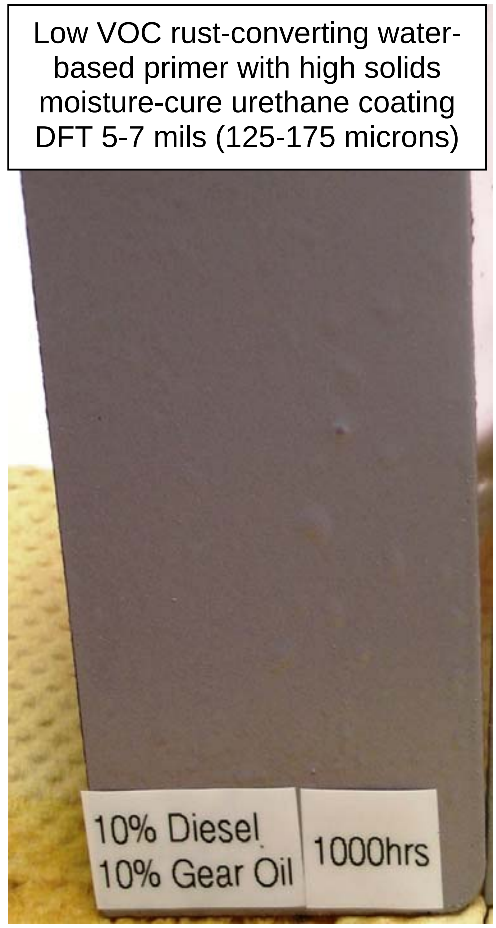

Figure 2 - Panel Immersed in10% Diesel and 10% Gear oil in water

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Low VOC rust-converting water-based primer & high solids moisture-cure urethane coating DFT 5-7 mils (125-175 microns)

Figure 3 - Panel Immersed in 4.5% NaCl and 4.5% $NaSO_4$ with 50ppm $FeCl_3$ in water

After passing the immersion resistance testing, another test was requested for this new tank lining coating system. It was requested to create different gaseous environments; these environments consisting of carbon dioxide, sulfur dioxide and hydrogen sulfide were made at higher levels as to accelerate the testing.
Table 2 and Figure 4 show the results of the Gaseous Environment Testing.

TABLE 2
Gaseous Environment Test Results

PRODUCTS	DFT	GAS	COMMENTS
Low VOC rust-converting water-based primer with high solids moisture-cure urethane coating	4.2-4.5 mils (105-112.5 microns)	72hr CO_2 24hr SO_2 400ppm 24hr H_2S 1600ppm	Panel has slight condensation and the color darkened after H2S

FIGURE 4 - Gaseous Environment Test Panel

Field Applications

Tanks Coated in Texas. In August 2006, holding tanks containing either the high salinity solution or a hydrocarbon solution were coated with the Low VOC rust-converting water-based primer and the high solids moisture-cure urethane coating system according to the following procedure:

STEP 1 Remove man-way hatch and bolts and ensure for proper ventilation before entering.

STEP 2 Spray heavy duty alkaline cleaner/degreaser diluted with water on all the weld seams, as well as all collars and hatches.

STEP 3 Power-wash the entire tank from ceiling to floor, including the man-way hatch. Continue by mopping and drying out the tank for the next step.

STEP 4 Apply the low VOC rust-converting water-based primer by brush, pushing it into all weld seems, collars, doors and openings.

STEP 5 Roll out the ceilings, walls, and floor, starting from the top and finishing with the floor, back rolling to ensure even application. The coating should be applied at 3-5 wet mils thickness. Allow the coating to dry for 12 hours. It should appear black and glossy. If the coating does not appear black and glossy apply a second coat.

STEP 6 Apply the high solids moisture-cure urethane by brush, pushing it into all weld seems, collars, doors and openings.

STEP 7 Roll out the ceilings, walls, and floor, starting from the top and finishing with the floor, back rolling to ensure even application. The coating should be applied 3-4 wet mils (75-100 microns) thick. Allow the coating to dry for 12 hours. It should appear dull silver.

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FIGURE 5 - Holding Tank Yard in Texas

FIGURE 6 - Inside of Uncoated Holding Tank

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FIGURE 7 – Uncoated Holding Tank Hatch

FIGURE 8 - Inside of Coated Tank

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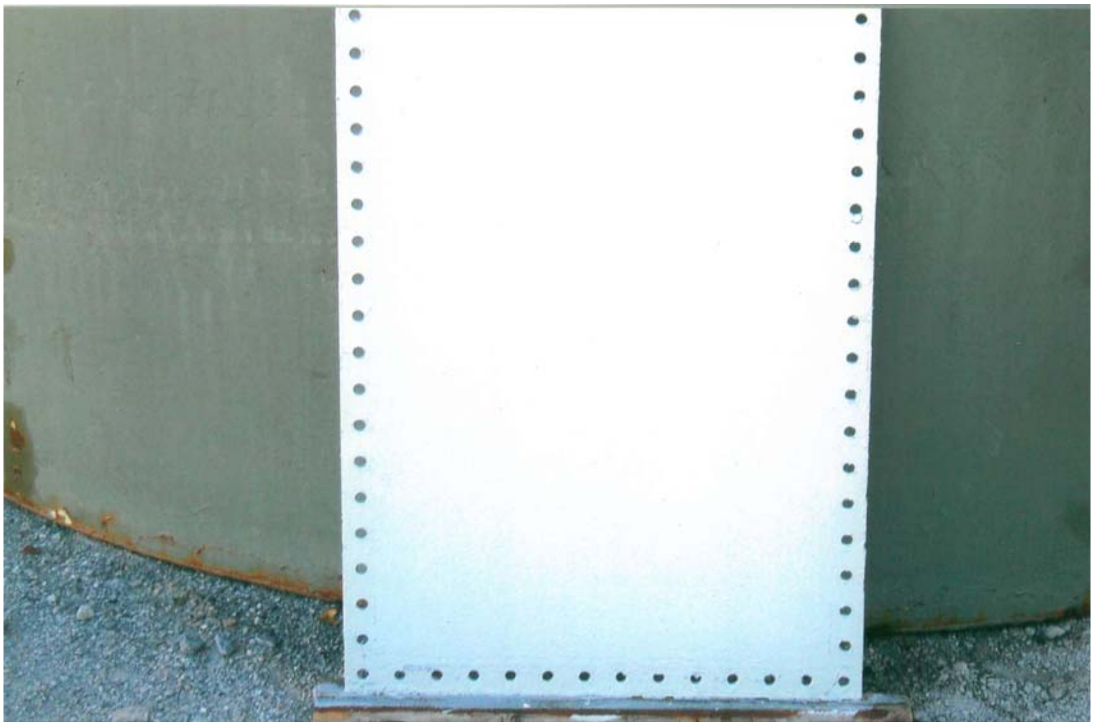

FIGURE 9 - Coated Tank Hatch

CONCLUSION

1. Laboratory and field measurements show that the coating system of a low VOC rust -converting water-based primer and a high solids moisture-cure urethane coating conforms to the performance criteria for tank lining systems containing hydrocarbon and/or high salinity solutions.

2. The observations made of the field applications have shown that the coating system is protecting the tanks from corrosion for the last 2 years. There were minimal signs of corrosion observed at the 2 year point.

REFERENCES

1. ASTM B-117-85; Standard Method of Salt Spray (Fog) Testing.
2. SSPC-SP 10/NACE No. 2, Near-White Blast Cleaning
3. Cortec Corporation Work Instruction, SO_2 Test Method: CC-003
4. Cortec Corporation Work Instruction, H_2S Test Method: CC-009