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Evaluation of ArmorGalv® under Salt Fog Exposure and Partial Immersion in Saltwater

Background

ArmorGalv® is a coating achieved through a thermal diffusion galvanizing process similar to sherardizing that reportedly provides corrosion protection, wear resistance, and anti-galling properties. It is applied in accordance with ASTM A1059. The vaporized zinc penetrates the surface of the steel to become integrated with the substrate material. The process provides a consistent thickness which can be applied between 0.4 to 6 mils. The ArmorGalv®coating is hard, non-magnetic, and can be welded. In addition, the treated product can be bent without causing damage to the coating.

Methodology

Thirteen pieces of steel reinforcement conforming to ASTM A615 were sent to Chem-Plate Industries to receive the ArmorGalv® process and thirteen pieces were sent to be hot dipped galvanized. Steel reinforcement was used because it is readily available, low cost steel and not because FDOT has plans to use this coating in reinforcement. Three test specimens of each type were subjected to two different exposure conditions and visually evaluated periodically. The first condition was partial immersion in 3.5% saltwater at room temperature (approximately 73F) and the second was in a 5% salt fog at 95F. After 1,500 and 3,000 hours of salt fog exposure a specimen of each type was cross sectioned and mounted for metallographic analysis.

Results

Partial immersion in the 3.5% saltwater revealed performance differences between the two specimen types. There was some visible steel corrosion occurring on the hot dipped galvanized bars at the water line, with no visual corrosion in the submerged portion. (Figure 1.) In addition, copious amounts of zinc oxide was visible just above the water line indicating that as expected,

the zinc served as a sacrificial coating. The ArmorGalv® process showed no visual signs of steel corrosion. (Figure 2.)

Figure 1 Traditional Hot Dipped galvanizing after 3700 hours partial immersion

Figure 2 Armorgalv® process after 3700 hours of partial immersion

The salt fog exposure revealed large differences between the two specimen types. The hot dipped galvanized bars had visible corrosion over large portions of the bar surfaces. (Figure3.) The

ArmorGalv® process showed limited visual signs of corrosion. (Figure 4.) There were a couple of rust colored spots that are most likely the result of surface contamination.

In addition to the visual observations, a specimen that was exposed to the salt fog environment

Figure 3 Traditional Hot Dipped galvanizing after 3000 hours in salt fog exposure

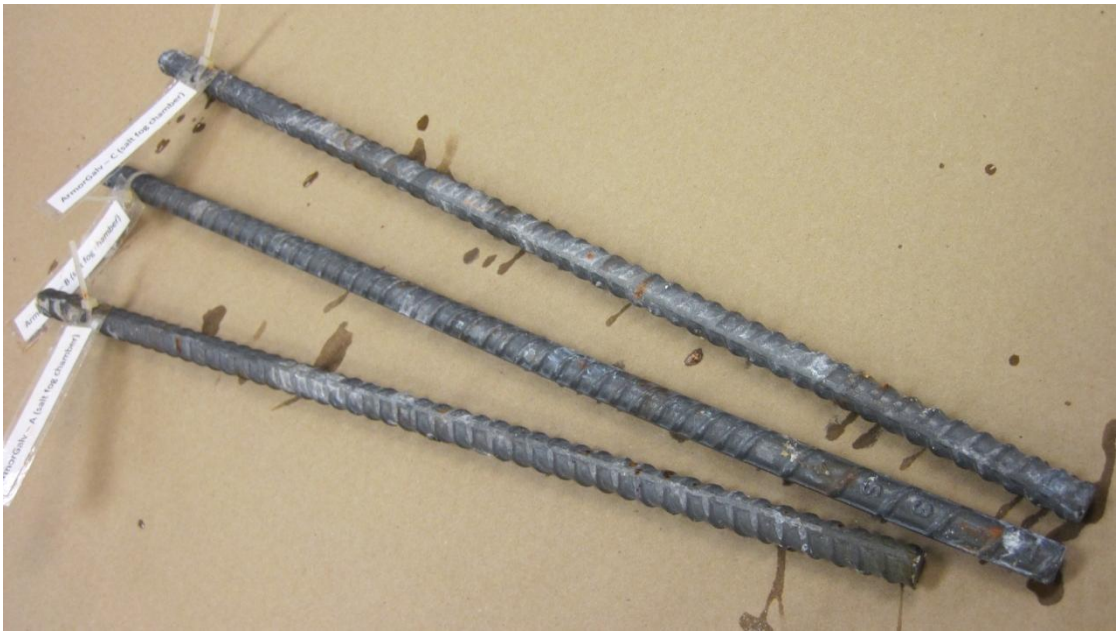

Figure 4 Armorgalv® process after 3000 hours in salt fog exposure

was cross sectioned and mounted in epoxy and polished to a 1 micron finish for metallographic examination. This exposed specimen of the ArmorGalv® process was compared to an unexposed specimen prepared in like manner. From this comparison, consumption of the coating was not identifiable, primarily due to variations in the measured coating thickness. (Figures 5 and 6.) Although measurements indicated a slight difference in coating thickness of the two specimens, the thicknesses were similar and in fact a thinner coating layer was measured on the unexposed specimen. Since the coating thicknesses measured were similar, there was no measureable coating loss.

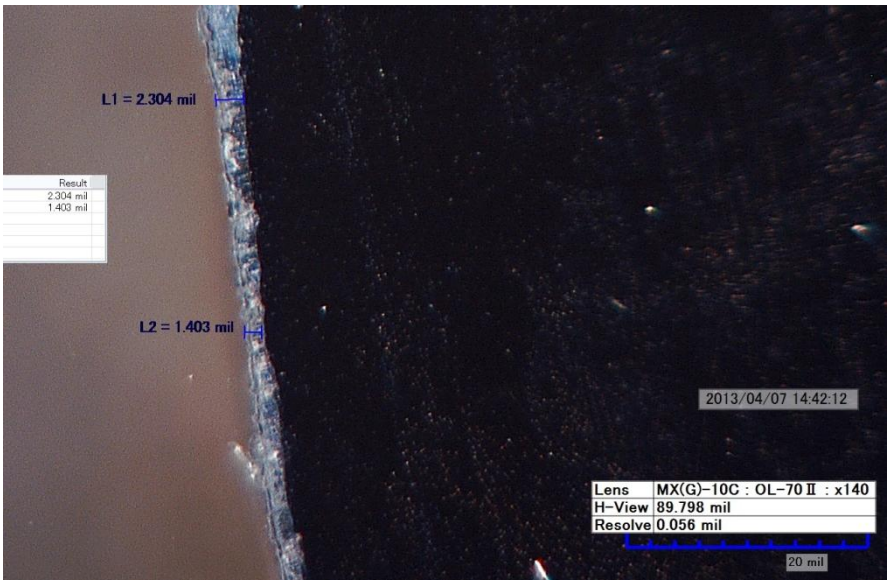

Figure 5 Unexposed specimen of ArmorGalv®

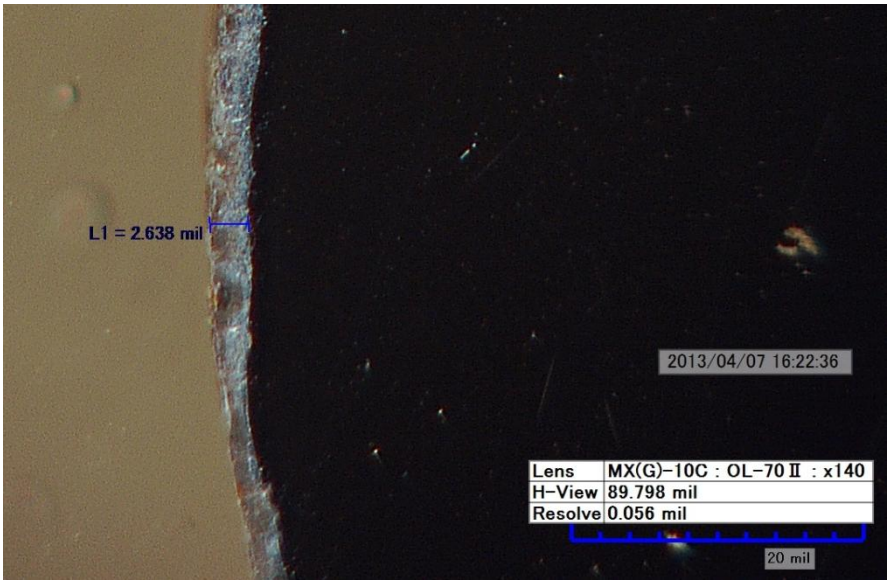

Figure 6 ArmorGalv® after 3000 hours in salt fog environment

Conclusions

The ArmorGalv® coating inhibited corrosion when exposed to salt fog and partial immersion environments very well. It outperformed control samples that were coated utilizing the traditional hot dip galvanizing process. However, while initial results are promising, more rigorous evaluation should be performed before considering widespread usage of this product.

Applications

It is recommended that this coating product be used for small critical hardware like nuts and bolts to replace hot dip galvanizing where the extra cost can be justified by longer service life.