CAL POLY
California Polytechnic State University
San Luis Obispo, CA 93407

Mechanical Engineering
805.756.1334 FAX: 805.756-1137
me.calpoly.edu

Evaluation of Maxon under Freeze-Thaw tests and Water submergence tests

Authors: Jorge Pluma Reyes, Tanner Jolly, Eltahry Elghandour, Mohammad Noori

Specimen preparation:

Clean steel and rusted steel coupons were cleansed for application of the Maxon coating. The clean steel coupons were thoroughly cleaned with cycles of sanding, degreaser, acetone, and water washing. The rusted coupons were only rinsed in water to preserve the rust and allow it to interact with the Maxon coating. Multiple specimen were cut to carry out a freeze-thaw and salt water submergence test for seven days following application.

Below are the pieces prepared for testing.

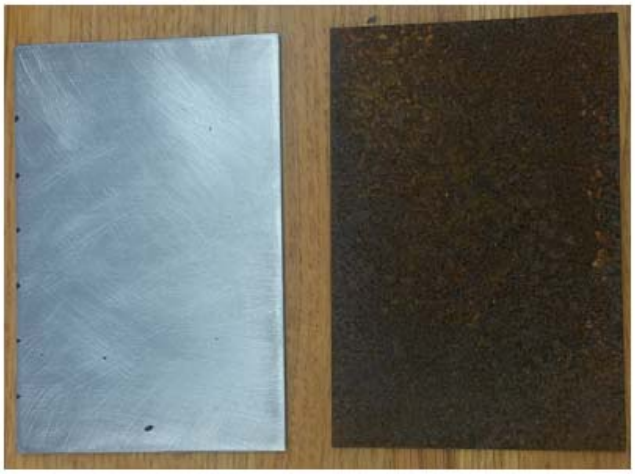

Figure 1. Clean steel coupon and rusted coupon ready for cutting and coating

Figure 2. Seven clean and seven rusted cut pieces coated with Maxon

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Freeze-thaw tests:

The experimental setup for the freeze-thaw tests consisted of exposing the specimen under room temperature for 5 minutes and then inserting it in a cool environment of -10 degrees Celsius. The specimen was maintained in that environment for 10 minutes, and then submerged to warm tap water for a period of 30 seconds. Thereafter the specimen was visually inspected for any signs of cracking or delamination damage. This was repeated 3 times to observe if multiple cycles would enhance any visible damage.

The results for days 1-7 were identical with no visible damage from cracking or delamination. Although curing times were different for each of these days, the behavior was the same when undergoing the freeze-thaw test. The only visible event that occured was the outer coating layer washing off during the 30 second period under the tap water. A conclusion can be made that for the first seven days after application of the Maxon coating can endure temperature changes from a -10 degrees Celsius environment to temperatures of warm tap water (approximately 45 degrees Celsius) and experience no damage from cracking or delamination.

Below are pictures of the specimen in experimentation during different days after application.

Figure 3. Day 1: Clean (left) and rusted (right) specimen before test

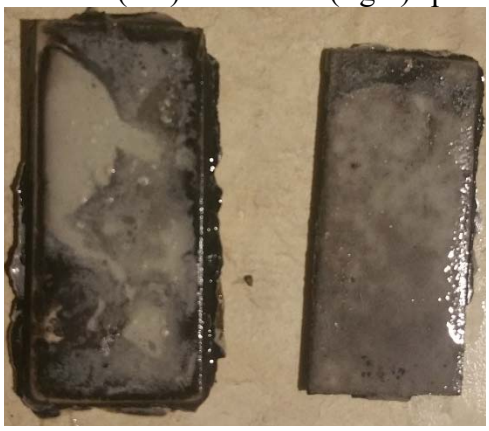

Figure 4. Day 1: After last cycle's 30 sec. submergence under warm tap water.

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Figure 5. Day 5: Clean (left) and rusted (right) specimen before test

Figure 6. Day 5: After last cycle's 30 sec. submergence under warm tap water.

Figure 7. Day 7: Clean (left) and rusted (right) specimen before test

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Figure 8. Day 7: After last cycle's 30 sec. submergence under warm tap water.

Salt water submergence tests:

The experimental setup for the salt water submergence tests consisted of submerging the specimen under an environment of salt water with a salinity of 3%. Lab grade sodium chloride salt was added to a clean tub of tap water and measured to 3% based on mass ratios. The specimen were submerged in water for 10 minutes and then taken out of the salt water for visual inspection. This was repeated 3 times to observe if multiple cycles would enhance any visible damage.

Like the freeze-thaw tests, the salt water submergence tests yielded identical visual results with no damage seen from salt water exposure. The only event that occurred through visual inspection was the washing off of the outer coating layer from the water submergence. It can be concluded that no visual damage happens to the specimen from salt water exposure during the first seven days after application. The next steps are to analyze the specimen under an SEM machine to observe changes in the chemical composition.

Below are pictures of the specimen in experimentation during different days after application.

Figure 9: Day 3: Clean (left) and rusted (right) specimen at moment of submergence

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Figure 10. Day 3: After all cycles

Figure 11. Day 5: Clean (left) and rusted (right) specimen before submergence

Figure 12. Day 5: After all cycles

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Figure 13. Day 7: Clean (left) and rusted (right) specimen after first cycle

Figure 14. Day 7: After all cycles