TEST REPORT

Project Name:
Wire Rope Corrosion

Testing:

1) ASTM B117 - 11 Standard Practice for Operating Salt Spray (Fog) Apparatus

Items Tested:
1) Wire rope, treated with Thermal Cycling, and untreated conditions

Goal of Testing:
1) Measure the change in the corrosion rate of the wire rope as a result of applying Thermal Cycling.

For questions regarding this test report, please contact:

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1. Executive Summary

The aim of the study is to perform the following:

1. Perform salt spray testing on wire rope in accordance with ASTM B117 - 11 Standard Practice for Operating Salt Spray (Fog) Apparatus
2. Measure the change in the corrosion rate of the wire rope as a result of applying Thermal Cycling.

In summary, the sample treated with Thermal Cycling corroded to a lesser extent than the untreated sample. As well, the corrosion present was not as thick on the treated wire rope as compared to the untreated wire rope. The crevice corrosion was also observed to be appreciably more severe for the untreated wire rope compared to the treated wire rope.

The conclusion of this testing is that treatment of the wire rope with Thermal Cycling improved its corrosion resistance.

It is recommended that Thermal Cycling be applied to the wire rope to improve the corrosion resistance of the material.
It is recommended that further salt spray testing be conducted to more accurately duplicate the environmental exposure that is the typical application for the wire rope. Also, it is recommended that this testing be conducted for a longer duration for more accurately determine the end use life cycle of the wire rope in the real word application.

2. Introduction

Thermal Cycling is an innovative and cost effective process of enhancing the mechanical properties of many materials commonly used in commercial and industrial technologies. Thermal Cycling has been determined to significantly increase the corrosion properties of many ferrous alloys.

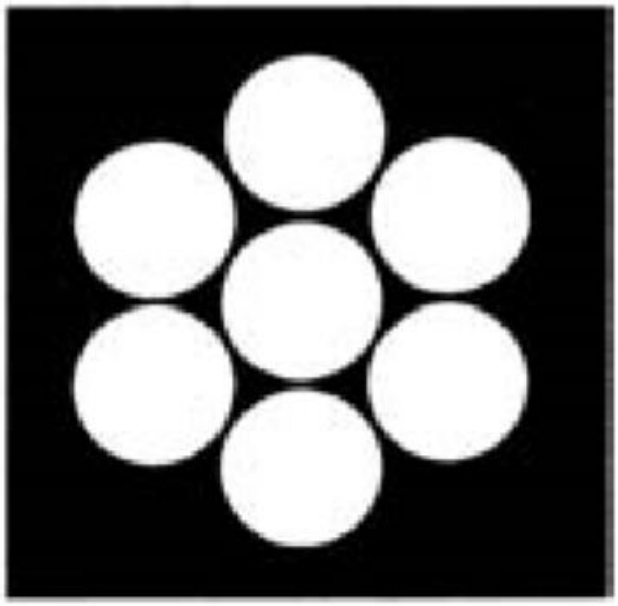
The salt spray test is a standardized test method used to check corrosion resistance. Salt spray testing is an accelerated corrosion test that produces a corrosive attack to the tested samples. The appearance of corrosion products (oxides) is evaluated after a period of time. Test duration depends on the corrosion resistance of the tested material.

Salt spray testing is popular because it is well standardized and reasonably repeatable. The correlation between the duration in salt spray test and the expected life of a material is not necessary simple to interpret as corrosion is a very complicated process and can be influenced by many external factors. Nevertheless, salt spray test is widely used in the industrial sector for the evaluation of corrosion resistance of finished surfaces.

Wire rope, or cable, is a type of rope which consists of several strands of metal wire laid (or 'twisted') into a helix. Initially wrought iron wires were used, but today steel is the main material used for wire ropes.

Historically wire rope evolved from steel chains which had a record of mechanical failure. While flaws in chain links or solid steel bars can lead to catastrophic failure, flaws in the wires making up a steel cable are less critical as the other wires easily take up the load. Friction between the individual wires and strands, as a consequence of their twist, further compensates for any flaws.

The wire rope specimens provided for testing were of the basic strand construction, as shown below



Crevice corrosion refers to corrosion occurring in confined spaces to which the access of the working fluid from the environment is limited. These spaces are generally called crevices. Crevice corrosion is a common problem encountered in wire rope, with the region between the strands susceptible to crevice corrosion.

Crevices can develop a local chemistry which is very different from that of the bulk fluid. Non-volatile impurities may concentrate in crevices. "Concentration factors" of many millions are not uncommon for common water impurities like sodium, sulfate or chloride.

For a given crevice type, two factors are important in the initiation of crevice corrosion: the chemical composition of the electrolyte in the crevice and the potential drop into the crevice. Researchers had previously claimed that either one or the other of the two factors was responsible for initiating crevice corrosion, but recently it has been shown that it is a combination of the two that causes active crevice corrosion.

3. Methods

The apparatus used for performing salt spray testing in accordance with ASTM-B-117 consists of a closed testing chamber, where a salted solution (5% sodium chloride) is atomized by means of a nozzle. This produces a corrosive environment of dense saline fog in the chamber so that parts exposed in it are subjected to severely corrosive conditions. A salt spray chamber is shown below.

Test duration is a function of the material being tested. Testing periods range from a few hours to more than a month. For the wire rope samples provided, testing occurred for a 100 hour period. The samples provided are shown below.

Wire Rope samples. The sample treated with Thermal Cycling is at the top.

4. Results

Following 100 hours of treatment and exposure within the salt spray chamber the wire rope samples were removed and examined.

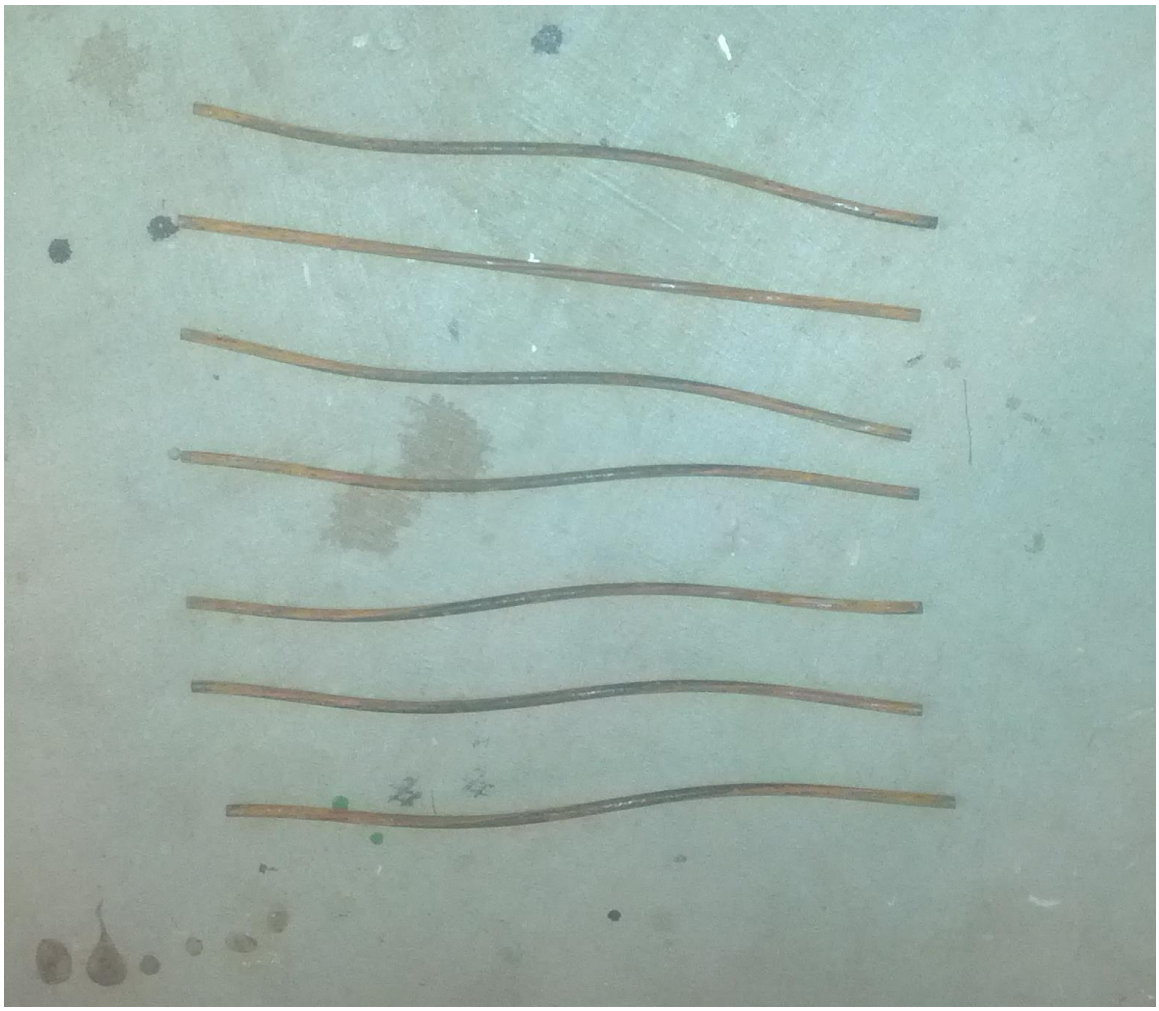
The untreated wire rope showed appreciably more surface corrosion than the treated wire rope. The corrosion was also thicker where it was present. Both are shown below for comparison.

Untreated Wire Rope following 100 hours exposure in salt spray chamber

Treated Wire Rope following 100 hours exposure in salt spray chamber

The wire strands were then separated for each sample to expose the interior of the strands to evaluate the presence and extent of crevice corrosion. Again, the corrosion was more predominate for the untreated material, and the corrosion that did occur was thicker. Both samples following strand separation are shown below for comparison.

Untreated Wire Rope with Strands Seperated



Treated Wire Rope with Strands Seperated

5. Discussion / Interpretation

Both samples were found to corrode as a result of the salt spray test. The sample treated with Thermal Cycling corroded to a lesser extent. As well, the corrosion present was not as thick on the treated wire rope as compared to the untreated wire rope.

The crevice corrosion was also observed to be appreciably more severe for the untreated wire rope compared to the treated wire rope. This is critical, as the level crevice corrosion present cannot typically be assessed by simple visual examination of the wire rope while in use. Destructive testing is required to see within the twisted strands. Reducing crevice corrosion is critical to ensuring the wire rope does not fail during into application.

The salt spray test confirmed that treating the wire rope material with Thermal Cycling improved the corrosion resistance of the material. The salt spray test does not accurately determine the relative level of improvement provided, the test only demonstrates how one sample compares to another. The test also does not reflect any specific operational time in an outdoor environment.

The test does reveal whether a material treated by a process is equal to, less than, or greater than the untreated material, in respect to corrosion resistance. The conclusion of this testing is that treatment of the wire rope with Thermal Cycling improved its corrosion resistance.

6. Conclusion

Thermal Cycling is proven to enhance the corrosion resistance of many ferrous alloys. The conclusion of this testing is that treatment of the wire rope with Thermal Cycling improved its corrosion resistance.

7. Recommendations

It is recommended that Thermal Cycling be applied to the wire rope to improve the corrosion resistance of the material.

It is recommended that further salt spray testing be conducted to more accurately duplicate the environmental exposure that is the typical application for the wire rope. Also, it is recommended that this testing be conducted for a longer duration for more accurately determine the end use life cycle of the wire rope in the real word application.