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Test Report on: Salt Spray Testing of 12 steel tubes with various coatings.
MEi Test Report J0687.1, Issue 1

Introduction:

Materials Engineering, Inc. was requested to test the salt spray performance of 12 steel tubes with various coatings. Two samples of each adhesive condition were submitted for testing. Overall views of the samples received for analysis are presented in Figures 1 through 6.

Procedure:

Salt spray testing was conducted in accordance with ASTM B117-19 for 1000 hours starting on 11/12/24. The samples were secured in the chamber using non-reactive materials.

Results:

Images of the samples every 100 hours of testing are presented in Figures 7 through 66. The samples C and CC with mesh and adhesives applied performed the best with severe corrosion isolated only to the exposed surfaces of the pipe samples. The coated regions Samples C and CC exhibited no evidence of coating failure/deadhesion to the pipe substrate.

Table 1: Samples A, B, C Results

| **Sample ID** | **100 Hours (Figure 7)** | **200 Hours (Figure 13)** | **300 Hours (Figure 19)** | **400 Hours (Figure 25)** | **500 Hours (Figure 31)** |
|---|---|---|---|---|---|
| Samples A | Corrosion observed, majority of coated regions | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage |
| | **600 Hours (Figure 37)** | **700 Hours (Figure 43)** | **800 Hours (Figure 49)** | **900 Hours (Figures 55)** | **1000 Hours (Figures 61)** |
| | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage |
| **Sample ID** | **100 Hours (Figure 8)** | **200 Hours (Figure 14)** | **300 Hours (Figure 20)** | **400 Hours (Figure 26)** | **500 Hours (Figure 32)** |
| Samples B | Corrosion observed, sparse coverage in coated regions | Corrosion observed, majority of coated regions | Corrosion observed, majority of coated regions | Corrosion observed, 100% coverage of coated regions/not severe | Severe corrosion 100% coverage |
| | **600 Hours (Figure 38)** | **700 Hours (Figure 44)** | **800 Hours (Figures 50)** | **900 Hours (Figures 56)** | **1000 Hours (Figures 62)** |
| | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage |
| **Sample ID** | **100 Hours (Figure 9)** | **200 Hours (Figure 15)** | **300 Hours (Figure 21)** | **400 Hours (Figure 27)** | **500 Hours (Figure 33)** |
| Samples C | Corrosion observed, little to no coverage in coated regions | Corrosion observed, some discoloration at edges of coated regions | Corrosion observed, some discoloration at edges of coated regions | Corrosion observed, some discoloration at edges of coated regions | Corrosion observed, some discoloration at edges of coated regions |
| | **600 Hours (Figure 39)** | **700 Hours (Figure 45)** | **800 Hours (Figure 51)** | **900 Hours (Figure 57)** | **1000 Hours (Figure 63)** |
| | Corrosion observed, some attack at edges of coated regions | Corrosion observed, some attack at edges of coated regions | Corrosion observed, more severe attack at edges of coated regions | Corrosion observed, more severe attack at edges of coated regions | Corrosion observed, some attack in main coating region |

Table 2: Samples AA, BB, CC Results

| **Sample ID** | **100 Hours (Figure 10)** | **200 Hours (Figure 16)** | **300 Hours (Figure 22)** | **400 Hours (Figure 28)** | **500 Hours (Figure 34)** |
|---|---|---|---|---|---|
| Samples AA | Corrosion observed, majority of coated regions | Corrosion observed, majority of coated regions | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage |
| | **600 Hours (Figure 40)** | **700 Hours (Figure 46)** | **800 Hours (Figure 52)** | **900 Hours (Figure 58)** | **1000 Hours (Figure 64)** |
| | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage | Severe corrosion 100% coverage |
| **Sample ID** | **100 Hours (Figure 11)** | **200 Hours (Figure 17)** | **300 Hours (Figure 23)** | **400 Hours (Figure 29)** | **500 Hours (Figure 35)** |
| Samples BB | Corrosion observed, moderate coverage in coated regions | Corrosion observed, majority of coated regions | Corrosion observed, majority of coated regions | Corrosion observed, majority of coated regions | Corrosion observed, majority of coated regions |
| | **600 Hours (Figures 41)** | **700 Hours (Figures 47)** | **800 Hours (Figures 53)** | **900 Hours (Figures 59)** | **1000 Hours (Figures 65)** |
| | Corrosion observed, majority of coated regions | Corrosion observed, majority of coated regions | Severe Corrosion | Severe Corrosion 100% coverage | Severe Corrosion 100% coverage |
| **Sample ID** | **100 Hours (Figure 12)** | **200 Hours (Figure 18)** | **300 Hours (Figure 24)** | **400 Hours (Figure 30)** | **500 Hours (Figure 36)** |
| Samples CC | Corrosion observed, no coverage in coated regions | Corrosion observed, no coverage in coated regions (some discoloration from runoff) | Corrosion observed, no coverage in coated regions (some discoloration from runoff) | Corrosion observed, no coverage in coated regions (some discoloration from runoff) | Corrosion observed, no coverage in coated regions (some discoloration from runoff) |
| | **600 Hours (Figure 42)** | **700 Hours (Figure 48)** | **800 Hours (Figure 54)** | **900 Hours (Figure 60)** | **1000 Hours (Figure 66)** |
| | Corrosion observed, edges of coated regions blackened | Corrosion observed, edges of coated regions blackened | Corrosion observed, edges of coated regions blackened | Corrosion observed, edges of coated regions blackened | Corrosion observed, edges of coated regions blackened |

Please call if you have any questions or require additional analysis.

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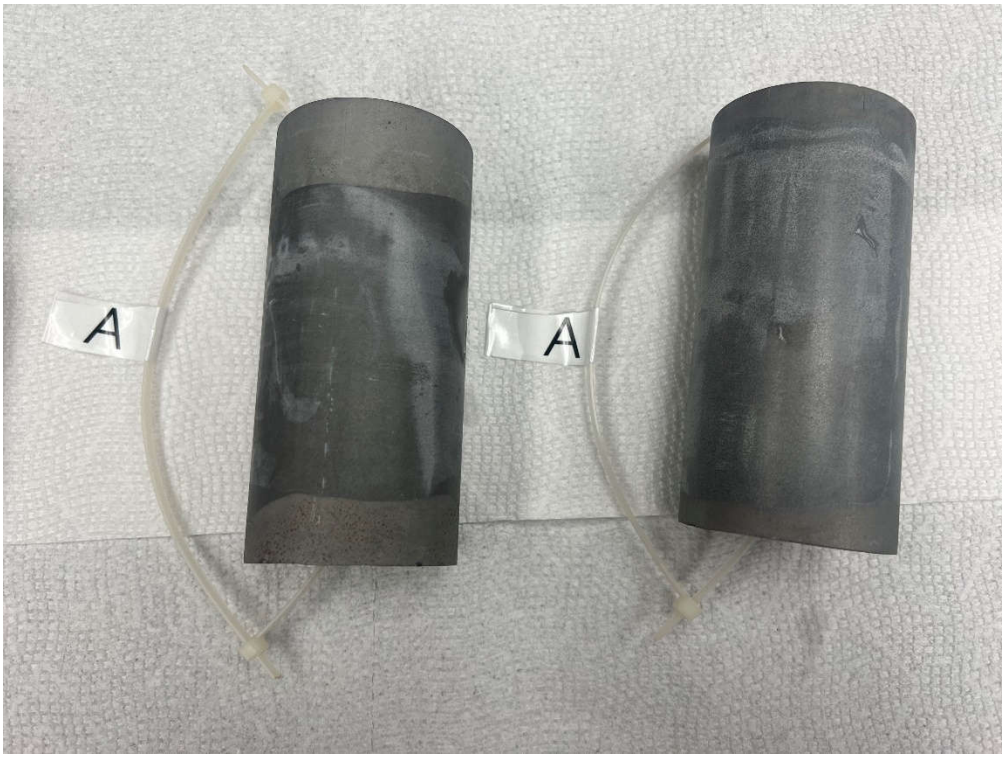


Figure 1: Photographs showing samples A as-received for testing.

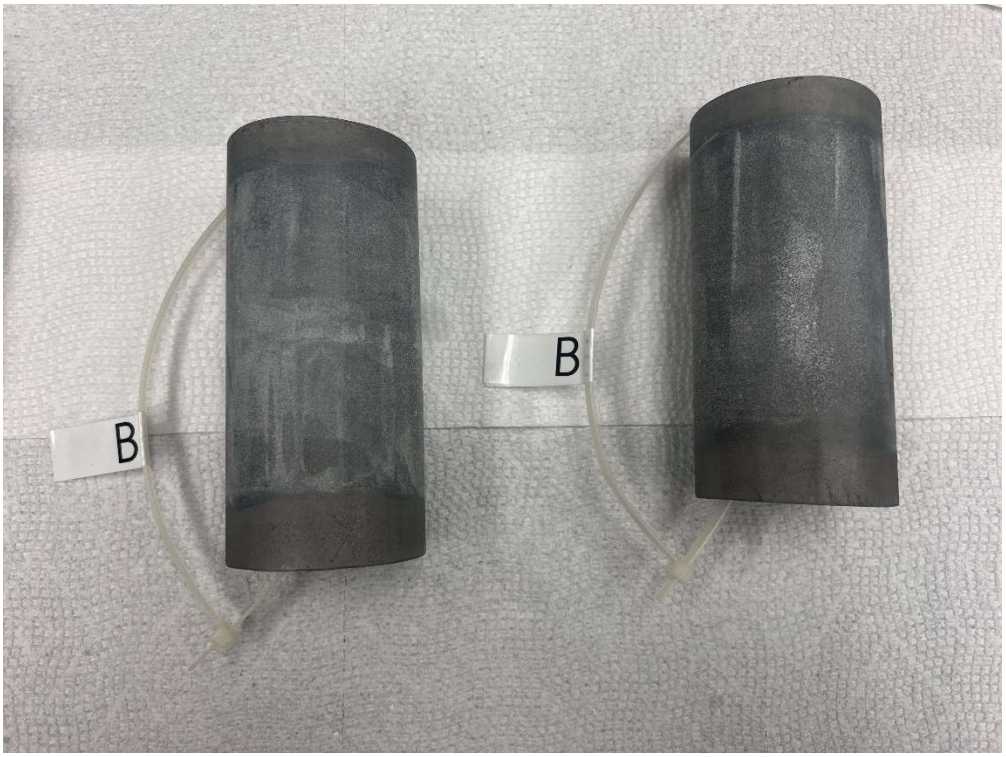


Figure 2: Photographs showing samples B as-received for testing.


Figure 3: Photographs showing samples C as-received for testing.

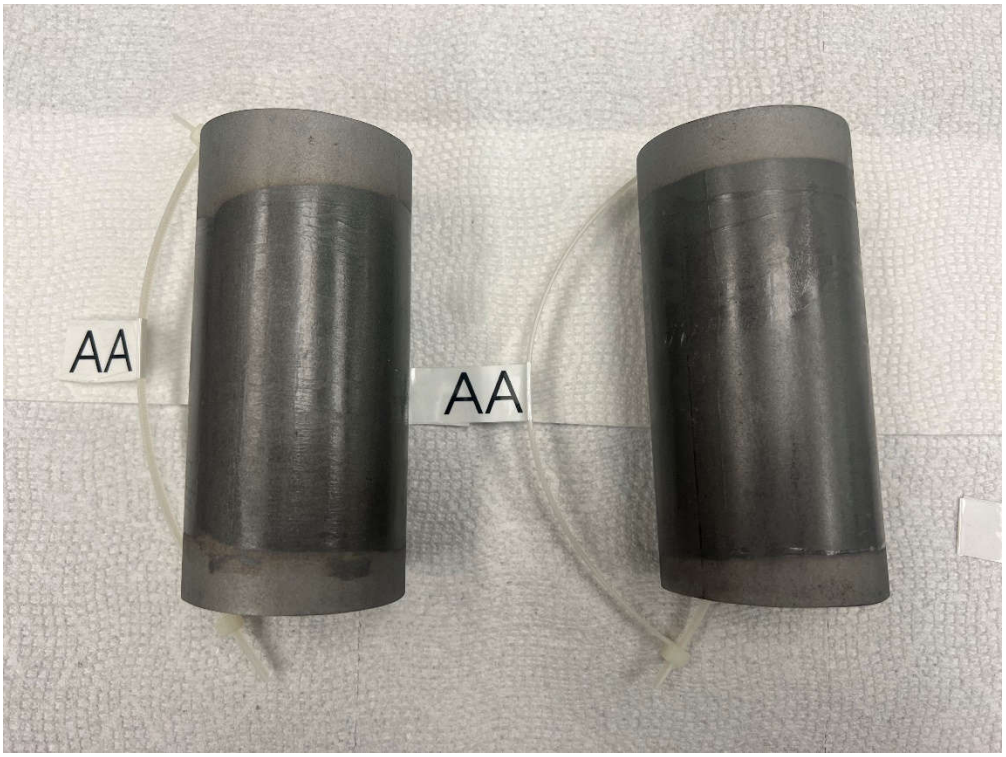


Figure 4: Photographs showing samples AA as-received for testing.


Figure 5: Photographs showing samples BB as-received for testing.


Figure 6: Photographs showing samples CC as-received for testing.


Figure 7: Photographs showing samples A after 100 hours of exposure.


Figure 8: Photographs showing samples B after 100 hours of exposure.

Figure 9: Photographs showing samples C after 100 hours of exposure.


Figure 10: Photographs showing samples AA after 100 hours of exposure.


Figure 11: Photographs showing samples BB after 100 hours of exposure.


Figure 12: Photographs showing samples CC after 100 hours of exposure.

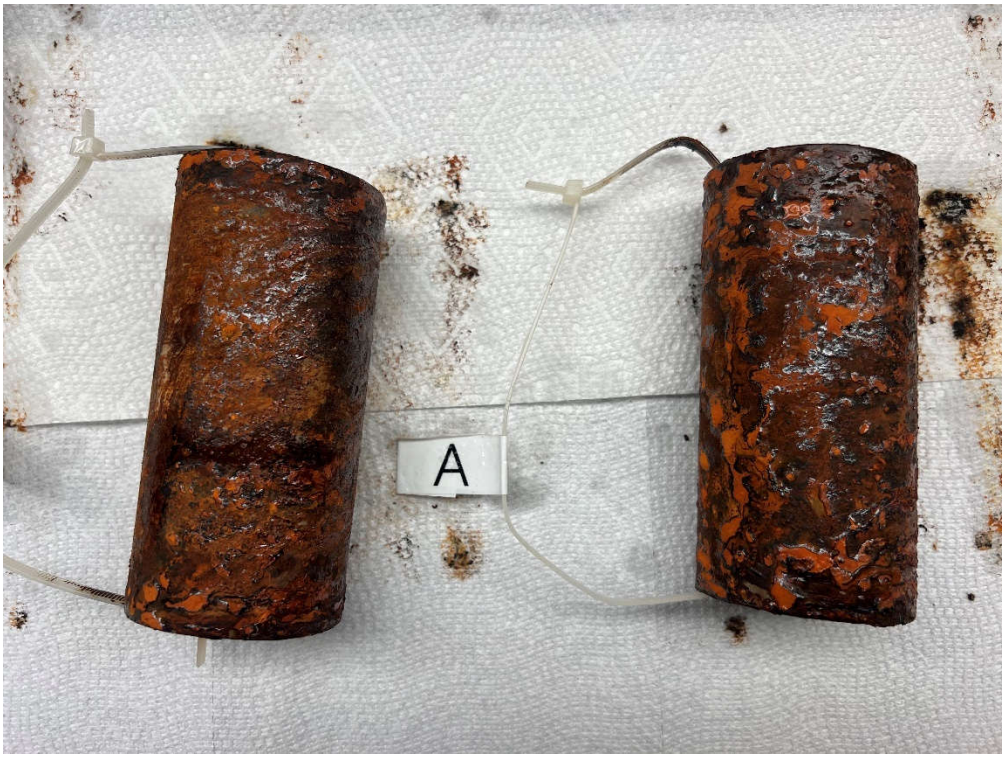


Figure 13: Photographs showing samples A after 200 hours of exposure.


Figure 14: Photographs showing samples B after 200 hours of exposure.


Figure 15: Photographs showing samples C after 200 hours of exposure.


Figure 16: Photographs showing samples AA after 200 hours of exposure.


Figure 17: Photographs showing samples BB after 200 hours of exposure.

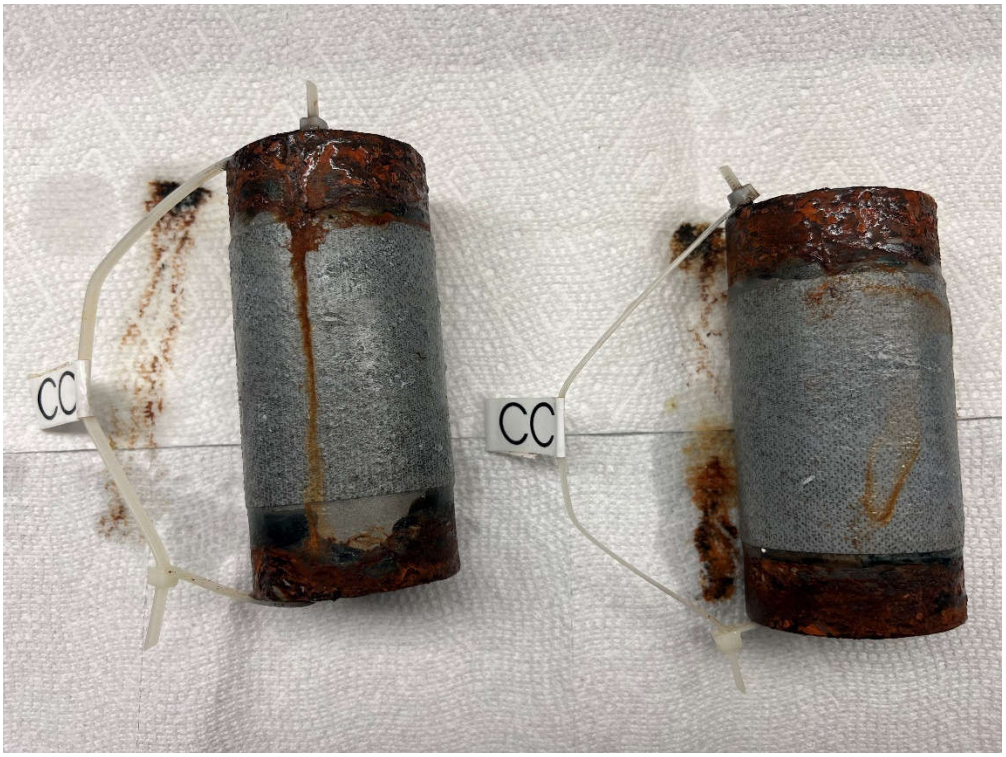


Figure 18: Photographs showing samples CC after 200 hours of exposure.

Figure 19: Photographs showing samples A after 300 hours of exposure.


Figure 20: Photographs showing samples B after 300 hours of exposure.

Figure 21: Photographs showing samples C after 300 hours of exposure.


Figure 22: Photographs showing samples AA after 300 hours of exposure.

Figure 23: Photographs showing samples BB after 300 hours of exposure.


Figure 24: Photographs showing samples CC after 300 hours of exposure.

Figure 25: Photographs showing samples A after 400 hours of exposure.


Figure 26: Photographs showing samples B after 400 hours of exposure.

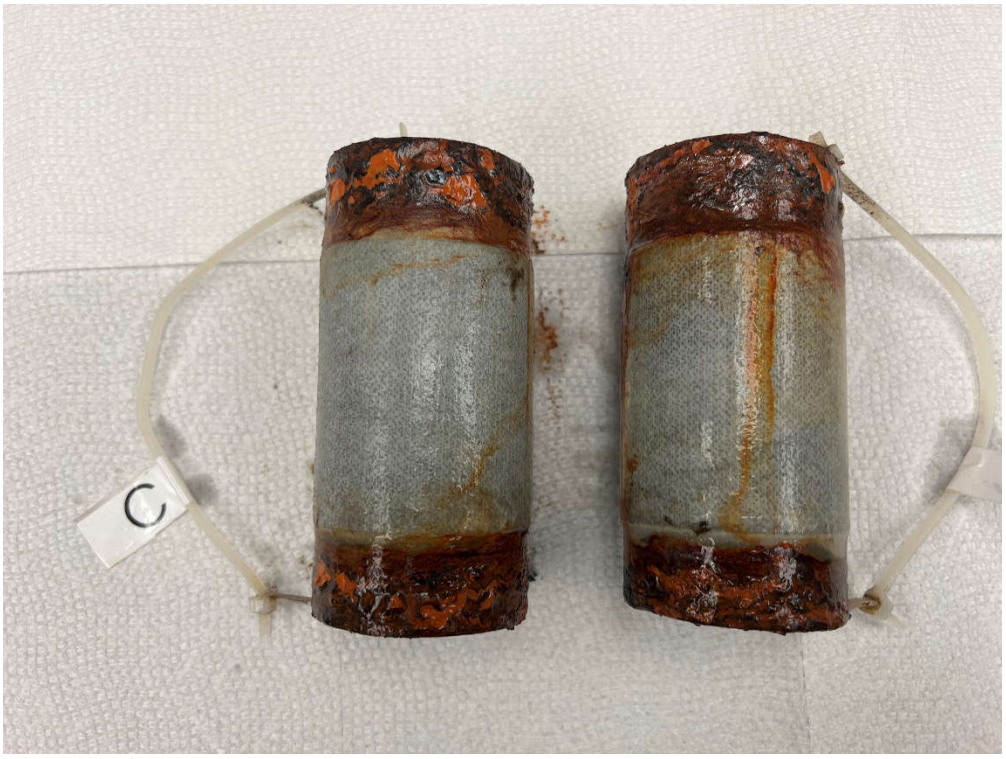


Figure 27: Photographs showing samples C after 400 hours of exposure.


Figure 28: Photographs showing samples AA after 400 hours of exposure.


Figure 29: Photographs showing samples BB after 400 hours of exposure.


Figure 30: Photographs showing samples CC after 400 hours of exposure.


Figure 31: Photographs showing samples A after 500 hours of exposure.


Figure 32: Photographs showing samples B after 500 hours of exposure.


Figure 33: Photographs showing samples C after 500 hours of exposure.


Figure 34: Photographs showing samples AA after 500 hours of exposure.


Figure 35: Photographs showing samples BB after 500 hours of exposure.


Figure 36: Photographs showing samples CC after 500 hours of exposure.


Figure 37: Photographs showing samples A after 600 hours of exposure.


Figure 38: Photographs showing samples B after 600 hours of exposure.


Figure 39: Photographs showing samples C after 600 hours of exposure.


Figure 40: Photographs showing samples AA after 600 hours of exposure.


Figure 41: Photographs showing samples BB after 600 hours of exposure.


Figure 42: Photographs showing samples CC after 600 hours of exposure.


Figure 43: Photographs showing samples A after 700 hours of exposure.


Figure 44: Photographs showing samples B after 700 hours of exposure.


Figure 45: Photographs showing samples C after 700 hours of exposure.


Figure 46: Photographs showing samples AA after 700 hours of exposure.


Figure 47: Photographs showing samples BB after 700 hours of exposure.

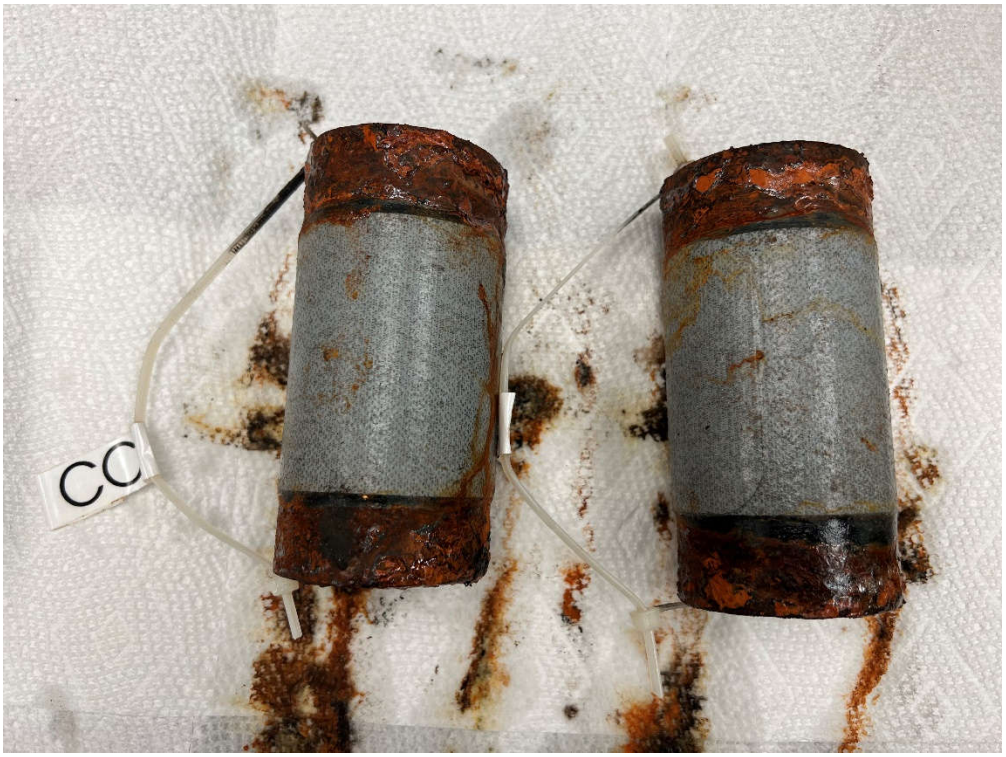


Figure 48: Photographs showing samples CC after 700 hours of exposure.


Figure 49: Photographs showing samples A after 800 hours of exposure.


Figure 50: Photographs showing samples B after 800 hours of exposure.


Figure 51: Photographs showing samples C after 800 hours of exposure.


Figure 52: Photographs showing samples AA after 800 hours of exposure.


Figure 53: Photographs showing samples BB after 800 hours of exposure.


Figure 54: Photographs showing samples CC after 800 hours of exposure.


Figure 55: Photographs showing samples A after 900 hours of exposure.


Figure 56: Photographs showing samples B after 900 hours of exposure.

Figure 57: Photographs showing samples C after 900 hours of exposure.


Figure 58: Photographs showing samples AA after 900 hours of exposure.


Figure 59: Photographs showing samples BB after 900 hours of exposure.


Figure 60: Photographs showing samples CC after 900 hours of exposure.


Figure 61: Photographs showing samples A after 1000 hours of exposure.

Figure 62: Photographs showing samples B after 1000 hours of exposure.

Figure 63: Photographs showing samples C after 1000 hours of exposure.

Figure 64: Photographs showing samples AA after 1000 hours of exposure.

Figure 65: Photographs showing samples BB after 1000 hours of exposure.


Figure 66: Photographs showing samples CC after 1000 hours of exposure.

Materials Engineering, Inc.

Laboratory Accreditation

Materials Engineering, Inc., meets the requirements of ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories" (equivalent to relevant requirements of the ISO 9000 series of standards) as audited and accredited by an independent laboratory accreditation agency.

The accreditation covers specific tests and types of tests as represented on the scope of accreditation, which will be provided to customers upon request, or on the MEi website, www.materials-engr.com.

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2. The test data reported pertains only to the item(s) tested as-received, and does not necessarily extend to the lot or batch from which the sample(s) were drawn. We accept no responsibility or liability for results due to non-representative test items, improper sampling, insufficient testing or misinformation.

3. Materials Engineering, Inc. based the findings, conclusions and opinions expressed in this report on the information provided by the customer and observations obtained at the time of inspection and preparation of this report. We reserve the right to add to, or modify this report should additional information become available.

4. Decision Rule – If Decision Rule 2 or 3 is not requested by the customer (where applicable), all statements of conformity shall be based on Decision Rule 1, simple acceptance criteria (i.e., for the values produced by the analysis only, no uncertainty value shall be applied).

5. It is our policy to retain components, samples and remnants for 30 days from the date of the report, after which they may be discarded. Please contact us immediately if you desire your components or samples to be returned to you, or to be retained for a longer period of time.

6. If you have any comments or concerns regarding the laboratory staff, the conduct of the testing and/or the report contents, we invite you to email the laboratory owners at customer.comment@materials-engr.com.

December 5, 2024