A quantitative evaluation method for salt fog corrosion test using image process

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1. Introduction

Environmental tests on defense systems require higher levels of reliability than those of commercial supplies, and MIL-STD-810 was established by the U.S. Department of Defense. In order to perform environmental tests, it is essential to have testing apparatus and related testing techniques that can create the requirements and profiles specified in the test standards. For the temperature and humidity tests, which are the main test items for environmental testing, related technologies, including equipment, have matured to the point where commercial products can be used. However, the use of commercial products was limited due to the lack of relevant technology for salt fog testing equipment, especially those for large test products. Through this study, a salt fog testing equipment was developed that satisfied the detailed requirements of the latest revision of the MIL-STD-810 test standards and maximized operability.

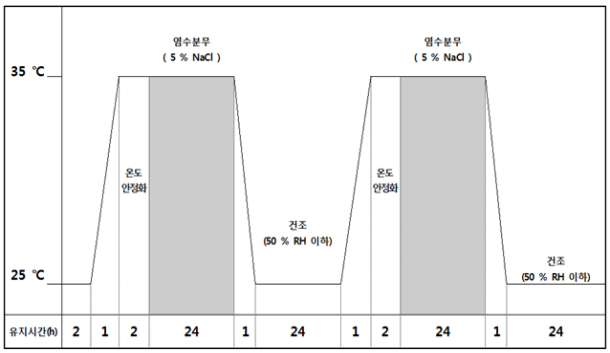

Fig.1 The profile of the salt fog test on harsh condition

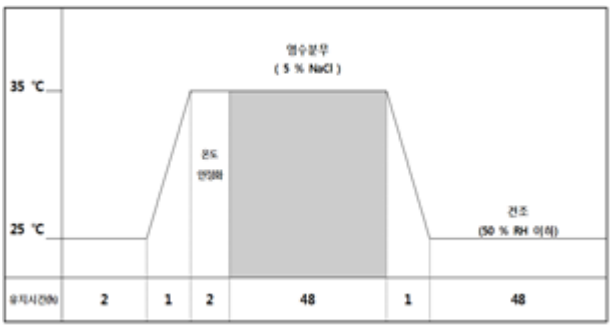

Fig.2 The profile of the salt fog test on mild condition

Apart from testing apparatus, the MIL-STD-810 test standards do not provide a method for assessing corrosion of test products after performing the salt water spray environmental test, causing confusion among testing request agencies, testing agencies, and evaluation institutions. To solve these problems, the present study proposed a method of applying the KS standard's rating evaluation method after processing the image of specimens.

2. The development of the salt fog test equipment

The salt fog test equipment developed through this study consists of a salt water automatic stirring system, a salt water supply line, an air supply line, a salt spray nozzle system, and an air circulation system inside the chamber.

In order to perform the salt fog test, salt solution conforming to the test conditions must be manufactured first. In this equipment, extra air from the main compressor was supplied to the stirring device, which was used as the power of the stirring. An air venting system was installed inside the stirring tank to directly spray air into the saltwater junction tank. Salt water junction is caused by air bubbles and currents. In addition to improving energy efficiency by utilizing the extra air that is inevitably generated during compressor operation, the optimal design of the bridge air venting system achieved a stirring efficiency (based on Junction completion time) of approximately 30% higher than the conventional stirring method. Salt water supply line is a system that controls the flow of salt water in a salt fog tester. The air supply line controls the pressure, temperature and humidity of the air and serves to supply air during the salt water Junction, spray and drying process. During the salt spray process, air is saturated at 35°C and sprayed with salt water. The use of saturated air facilitates temperature and humidity control during salt spray, which was first attempted in this development. Finally, air-heated, 25°C of dry air enters the nozzle in the test room and carries out the drying process This whole process was automated through LabVIEW, enabling real-time monitoring of environmental factors such as temperature/humidity/salinity/pH, enabling salt fog testing to conform to the latest standards in MIL-STD-810.

Fig. 3 The photo of the equipment

3. A quantitative evaluation method for salt fog corrosion test

A quantitative evaluation method is essential for assessing the surface of specimens or inorganic systems for corrosion and the degree of corrosion. However, the MIL-STD-810 standard does not provide a quantitative assessment of the degree of corrosion.

Therefore, we applied the corrosion evaluation method of applying the rating technique through image processing. In order to quantitatively assess the degree of corrosion of specimens (lightness, color temperature, etc.) specimens were taken before and after the salt fog test under the same conditions and compared and analyzed. First, determine the range of RGB data in the raw side that did not corrode and the range of RGB values in the part where the corrosion occurred. Later, the range of corrosion can be automatically found on the corrosion specimen through the image processing program. MIL-STD-810G Since the purpose of the salt fog test is to determine if corrosion is present, corrosion can be divided into black (corrosive) and white (non-corrosive) in the photograph. Quantitative corrosion was also allowed to be assessed when testing the saline spray on the inorganic system using the Rating method specified in KS standards.

In order to verify the possibility of the method, we produced 16 steel specimens and conducted the salt spray test under the harsh condition (24 hours spray/dry, twice), and under the mild condition (48 hours spray/dry, once). It is generally known that harsh conditions (24 hours spray/dry twice) cause more corrosion to be lost than the mild conditions (48 hours spray/dry once).

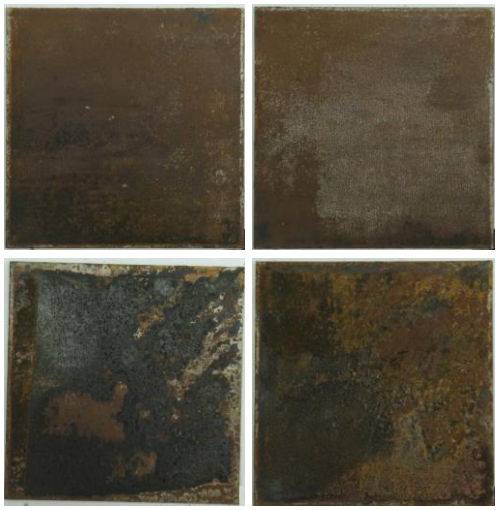

Fig.4 Specimens of the test

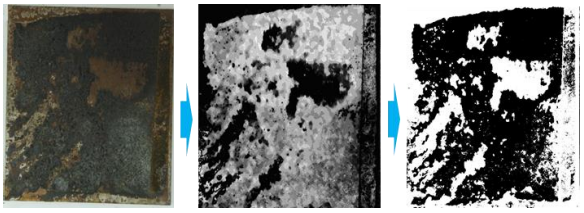

Fig.5 The procedure of the evaluation

Corrosion occurred at an average area of 40.4% under mild conditions and at an average area of 59.6% under harsh conditions. This method has quantitatively identified commonly known facts.

4. Further work

In this paper, image processing is done directly for individual specimens, and the results are checked by comparison. In future tasks, we are going to apply Machine Learning technology to image processing. The government plans to study the comparison photos before and after corrosion so that the degree of corrosion can be expressed quantitatively.

References

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