Development of Atmospheric Corrosion Test Devices

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Although necessity may be the mother of invention, seven years after the start of research on atmospheric corrosion in the STX-21 (Ultra-Steels) Project, the true nature of atmospheric corrosion is at last gradually being revealed. This report describes three recently-developed devices for research on atmospheric corrosion.

The first is a portable surface reaction measuring device (shown in photo). In Japan, some steel structures such as bridges are constructed using weathering steel, which is used without painting. The steel surface forms a stable protective rust film, preventing further corrosion, but the protective property cannot be judged by visual inspection. Based on the principle that electric potential shifts from noble to base (becomes lower) when corrosion occurs, this device enables in situ judgment of the protective property of the rust film from the potential behavior when water is dripped on the structure surface. In spite of its low cost, a built-in CPU gives the device high expandability. For example, when used in combination with an X-Y stage, basic research work such as measurement of potential distribution is possible.

The second device is a new atmospheric corrosion tester. In actual environments, corrosion progresses most rapidly when sea salt particles with diameters of approximately 10 μm accumulate on a metallic surface which is subject to a cyclical process of condensation and drying (evaporation). However, atmospheric corrosion testers currently available in the market have various disadvantages. For example, the equipment is expensive, with prices of ¥10 million or higher, but because the saltwater spray method is used, it cannot reproduce actual environments. With the new tester, any desired condensation/drying process can be simulated while controlling the generated quantity of sea salt particles. Accuracy is high, and the cost of a test-manufactured unit was extremely reasonable, at less than ¥500,000.

The third item is a portable measuring device for airborne sea salt particles. Because the corrosion rate of steel materials depends on the number of airborne sea salt particles, when constructing steel structures, it would be extremely useful in deciding the need for higher grade steel and/or painting if the concentration of airborne salt could be known in advance. However, no existing device was capable of measuring the airborne salt concentration in a short period of time. Using a silver-coated quartz resonator (piezoelectric resonator), this device measures the salt concentration, distinguishing salt particles from other airborne matter, based on frequency changes in the quartz resonator when the humidity in a simple closed container is changed. High accuracy measurements can be obtained by exposing the quartz resonator for as little as 2-3 days.

Fig. Portable surface reaction measuring device.