Corrosion Performance of Carbon Steel under Marine Environment

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The offshore structures are exposed to the various environments, and it is well known that the corrosion rate and the corrosion mechanism under each environment, marine atmosphere, splash zone, tidal zone, underwater zone and bottom zone, are different. However, most of the past reports were researched by the exposure test under the real marine environment, and in this case, the continuous information for the corrosion behavior of metals cannot be obtained. In this study, AC impedance method has been applied to corrosion monitoring under the condition that simulated the marine environment. In addition, the corrosion behaviors of carbon steel under the simulated environments are examined.

The sensor for corrosion monitoring was shown in Fig.1. The two electrodes of the sensor made of carbon steels are placed concentrically in epoxy resin. Figure 2 shows the schematic of the apparatus to simulate the marine environments. This apparatus was installed in the chamber set at 298K and 60%RH, and it allows simulating three environments, marine atmosphere, tidal zone and underwater zone. The tidal zone was simulated by exposure to alternate conditions of 1-hour immersion in test solutions (0.56M NaCl solution and artificial seawater) and 7-hour drying in the chamber.

The corrosion rate in a simulated marine atmosphere showed much lower value than that in the other environment. The underwater zone gave approximately constant corrosion rate of carbon steel, indicating that the corrosion rate of carbon steel is determined by the reaction rate of oxygen reduction. On the other hand, the corrosion rate in a simulated tidal zone was accelerated with increasing the number of cycles. This acceleration is attributed to electrochemically active species such as γ-FeOOH formed in the drying process, which act as a strong oxidant in the wet process. Furthermore, the corrosion losses in each environment were calculated by integrating the corrosion rate with the exposure time. As the result, the corrosion loss in tidal zone was much larger than that in underwater zone, which agrees with the result of the past reports.

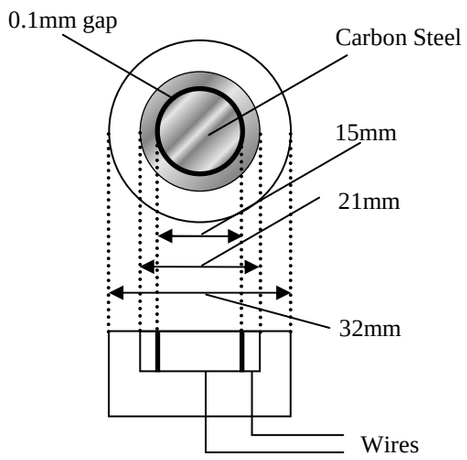

Fig.1 The Sensor for corrosion monitoring.

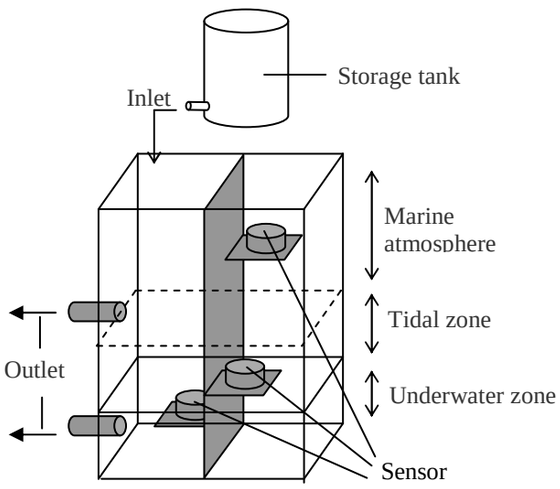

Fig.2 Schematic of the apparatus to simulate the marine environments.