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A New Optical Fiber Acoustic Emission System for Crevice Corrosion Monitoring in Salt Producing Plants

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Summary

Crevice corrosion is one of serious corrosion damages in a salt producing plant. The crevice corrosion tends to cause not only the leakage of process fluid but the contamination of salt by corrosion products or the rust. This study aims to monitor the crevice corrosion utilizing a new acoustic emission (AE) method. Here the AEs are produced by the fracture of the rusts produced in the crevice. We first studied progression behavior of the crevice corrosion of spot-weld type 304 stainless steel disks in 3.5 and 20 mass % NaCl solution by monitoring both the AE and anode current under controlled corrosion potentials. Two piezo-type AE sensors were mounted on the large base plate of Type-304 plates outside of the corrosion cell in which a 25 mm diameter disk was spot weld. AEs from the crevice corrosion increased with potential shift to noble region. AE counts increased proportional with anodic current. Conventional AE system with PZT sensor was successfully utilized to monitor the crevice corrosion progression of a connection of Type-304 steel flange and polysulfate gasket.

Next we utilized a new optical fiber AE monitoring system to detect AEs from crevice corrosion. This system is the Michelson-type laser interferometer, but feed back controlled to improve both the stability and sensitivity. Owing to flexibility and hardness of the quartz fiber, the fiber was easily inserted into the narrow crevice of flange joints of Type-304 plates (70 mm square with 5 mm thickness) and PMMA plate. The PMMA plate was fastened to the stainless plate by nut and bolts at torque of 2 Nm or 4 Nm. We utilized a swirled copper-coated optical fiber as both the AE sensor and counter electrode. The swirled fiber sensor of 20 mm inner and 52 mm outer diameters detected AEs after an increase of anodic currents at noble potentials in 3 mass % NaCl solution. The delayed emission of AE suggests that the rust fracture occurs after the crevice is filled with the rust produced by oxidation of dissolved metallic ions. The delayed time decreased with an increase of fastening torque. AE counts rate increased proportional to the electric amount of anodic currents. We observed a number of cracks in grown rust in the crevice. Signal to noise ratio or S/N ratio of the AEs detected by the developed optical fiber system was found to be higher than that by the conventional PZT sensor.