

Corrosion Monitoring and Contamination Mitigation in Salt Producing Plant by Optical Fiber Acoustic Emission Monitoring System

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Summary

Study aims to develop an optical fiber acoustic emission (AE) monitoring system and detect corrosion-induced damages in salt producing plant and thence to mitigate the product contamination by corrosion damages. The system is a homodyne Mach-Zhender interferometer and consists of two single-mode optical fiber, diode laser, photodiode detector and feed back system. Diode laser was transmitted into two optical fibers; one as reference fiber and another a sensor fiber, and coupled at the fiber end by a photodiode. AE was detected as a laser intensity due to the interference of two lasers through reference and sensor fibers. This system was significantly improved in its stability and S/N ratio by utilizing a specially designed feed back circuit, and demonstrated to detect the Lamb wave AE. Characteristic feature of this system is the detection of in-plane motion of elastic wave while the conventional PZT type AE sensor measures the out-of-plane motion. Thus the system is specially excellent in cylinder wave AE monitoring when the sensor fiber was round on the tube surface. It can measure the weak longitudinal mode of cylinder wave AE while the conventional system measures the strong flexural mode wave.

A noticeable achievement by this research is a development of in-water AE sensor with high directivity . The system monitor the water-bron longitudinal AE from corrosion damages of various type container and storage tanks. The sensor is explosion-proof sensor and can be utilized even in flammable fuel tank.

We also demonstrated that the system can detect AEs from SCC of austenitic stainless steel pipe and stainless clad plate taken from salt producing plant. AE were frequent generated by friction of SCC and fracture of solid rust in SCC when a very light thermal and external stresses are applied to the members.

As the AEs were generated by the fracture of oxide or rust produced by SCC, crevice corrosion and pitting corrosion, the system can make the monitoring of the initiation and progression of these corrosion damages possible.