

ABSTRACT:

Development of Thin Film Electrical Resistance Sensors for Corrosivity Monitoring in Jamaica

Over the years Jamaican society has not acknowledged that it may have an environmental problem as a result of factory emissions. Jamaicans living in communities on the outskirts of the Bauxite companies have complained for years that emissions from factories resulted in the deterioration of their properties due to intensive corrosion. Much of this blame has been placed on the bauxite industry [4]. Numerous Jamaican environments have not been classified yet. Therefore, industries are not able to decipher the role, which they have played in environmental pollution and, in particular in emission of corrosive species. The development, implementation and performance evaluation of low cost thin film (TFER) sensors for corrosivity monitoring in Jamaica is the focus of this study.

TFER sensors are based on traditional electrical resistance probes used in the oil and gas industry. Exposure of the sensors (600nm thick) in test chambers conditioned with pH values from 5.0, 3.0, 2.0, 1.5 and 1.0 yielded corrosion rates of 0.33mpy (mils-per-year), 0.64mpy, 0.72mpy, 1.24mpy and 2.05mpy respectively. In the evaluation of the sensors performance by standard coupons it was found that the efficiency of TFER sensors in the above environments were

93%, 89%, 71% and 59% respectively. Laboratory work showed that the efficiency of TFER devices decreases with increasing air pollution levels.

Results gathered in different areas of Kingston and St. Andrew showed a similar pattern to the results gathered in the laboratory. However, the device does give a relatively good estimation of the degree of corrosivity of the monitored environments. The data gathered showed that the parishes of Kingston and St. Andrew have varying degrees of corrosivity that ranged from corrosivity categories C1 (very Low) to C5 (Very Strong) [34]. Three of these categories appeared most frequently, St. Andrew central was categorized mainly by C3, and the most likely cause of this is air pollution from vehicle emissions. Kingston East and Port Royal were characterized mostly by C4 as a result of the salt sea air. Industrial areas are characterized largely by both C4 and C5 due to factory emissions and also, a combination of salt sea air and factory emissions, as many industries are located very near to the coast.

The results obtained using the developed sensors were compared with data acquired from standard test coupons. It was concluded that TFER corrosion sensors provide an efficient means of corrosion evaluation and hence classification of Jamaican environments. The study also showed that combining information from the sensors and that gathered from standard coupons would improve the precision of environmental analysis. Also, environmental classification using TFER corrosion sensors proved to be far less time consuming and work intensive than classification by coupons or by collecting time of wetness data and atmospheric pollution level data.

Key words: Thin Films; Electrical Resistance; Corrosivity; Atmospheric Pollution; Classification.