CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: The 199th Meeting of The Electrochemical Society
Charge No. 20.01402.571
AI 01402.571.008

DATE/PLACE: March 25–29, 2001
Washington, DC

AUTHOR: Lietai Yang

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PERSONS PRESENT: This was the 2001 spring meeting of the Electrochemical Society. It was attended by approximately 1,600 people from many countries all over the world.

BACKGROUND AND PURPOSE OF TRIP:

The purpose of this trip was to attend the sessions on corrosion sensing and monitoring and to give two presentations: "A Multi-cell Senor for Localized Corrosion Monitoring" co-authored with N. Sridhar and O. Pensado in the afternoon session on March 28, 2001 and "In-Situ Monitoring of Chemistry and Corrosion Processes under Heat Transfer and Episodic Wetting Conditions" by S. Brossia, D. Dunn and O. Moghissi in the morning session on March 29, 2001.

SUMMARY OF PERTINENT POINTS:

This trip report summarizes some of the presentations attended by the author that are pertinent to corrosion sensing and monitoring.

J. Moffatt (U.S. Army Aviation Applied Technology Directorate) presented a talk on "The Corrosive Environment Monitoring System: An Innovative Technique for Monitoring and Preventing the Formation of Corrosion on Aircraft Structure." The Corrosive Environment Monitoring system is essentially a computerized integrated corrosion rate and environmental chemistry monitoring device. The sensor units contains sensors for pH, conductivity, and a metal specimen for corrosion rate as well as for corrosion potentials. During service, the sensor unit is installed at or near the locations that are susceptible to corrosion in an aircraft. The monitored data are stored in a memory on a continued basis. A corrosive index number is calculated from the measured data using an algorithm that is derived from the kinetic and thermodynamic data in the literature. The corrosion damage to the structure of an aircraft is predicted by tracking the cumulative corrosion index number. This corrosive environment monitoring system is currently under development by Honeywell Inc. under a contract funded by the Aviation Applied Technology Directorate.

D. Wall (Sandia National Laboratories) gave a presentation on "Quantifying Atmospheric Corrosion Using Stacked Foil Electrodes." The work was directed to measure the corrosion of metals at low relative humidities

down to 50 percent. As the solution resistance is extremely high in a low relatively humid environment, a galvanic sensor consisting of multiple thin layers of anode and multiple thin layers of cathode was employed. The thickness of the anode and the cathode layers were 25 micrometer and the layers were alternatively stacked together with a inter-electrode-distance of 4 to 5 micrometer. They demonstrated that the corrosion activity is sensitive to relative humidity. With aluminum as anode, the authors found that the corrosion activity ceases at relative humidities between 50 and 60 percent at room temperature.

The scheduled presentation by Y. Tan (Nanyang Technical University, Singapore) on corrosion measurements using a wire beam electrode method should have been an interesting talk. The wire beam electrode is similar to the multi-cell localized sensor (see below) being developed at Center for Nuclear Waste Regulatory Analyses (CNWRA). However, the talk was canceled due to the unavailability of the speaker.

L. Yang [CNWRA, Southwest Research Institute (SwRI)] presented the work co-authored with N. Sridhar and O. Pensado (CNWRA, SwRI) on the development of a multi-cell localized corrosion sensor. This work is funded by the focused internal research program of SwRI. The multi-cell sensor consists of a collection of small metal electrodes, with the electrical terminal of each electrode being connected to a resistor and then jointed together to simulate a one-piece electrode. In a localized corrosion environment, some of the electrodes corrode more and act as anodes and some of the other electrodes corrode less and act as cathodes. As a result, corrosion currents flow from the cathodes to the anodes through the external resistors and are measured by the voltage drop between the corresponding resistors. The study was carried out with Type 304 stainless steel electrodes in several environments known to promote localized corrosion. It was demonstrated in the presentation that the multi-cell senor is highly sensitive to localized corrosion and its signal is reproducible. As this sensor is resistant to episodic dryness and it can also be made resistant to high-temperature and radiation, it may be useful for localized corrosion measurements in the repository system.

L. Yang (CNWRA, SwRI) also presented the work by S. Brossia, D. Dunn and O. Moghissi (CNWRA, SwRI) on "*In-Situ* Monitoring of Chemistry and Corrosion Process under Heat Transport and Episodic Wetting Conditions." The results obtained from both the bench top test and the heater test were presented. In the tests, W/WO_3 and Ag/ACl electrodes were used to measure the local pH and chloride concentration; galvanic sensors were used to measure the corrosion. It was found that the measured local pH and chloride sensors responded well to the drying or wetting process. The galvanic sensor responded well to humidity changes. It was noted however, the location of the sensor placement is very important in the heater test because some locations were wet frequently, while others were dry all the time. Multiple placement locations must be employed in order to have more accurate and representative measurements.

SUMMARY OF ACTIVITIES:

None.

CONCLUSIONS:

Attendance at the Electrochemical Society meeting and opportunity to present our work provides a valuable forum for exchange of ideas. It also provides an opportunity to follow recent developments in the corrosion sensing and monitoring field that may be applicable for the Yucca Mountain performance confirmation studies.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

Participation at the corrosion sensing and monitoring symposium at the Electrochemical Society meeting provides visibility and recognition among peers.

SIGNATURES:

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Lietai Yang
Senior Research Engineer

04/12/01
Date

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4/12/01
Date

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