

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Professional Development
Short Course on "Corrosion: Fundamentals and Experimental Methods"
Charge No. 20.06002.01.011; AI No. 06002.01.011.023

DATE/PLACE: July 24–29, 2005, State College, Pennsylvania

AUTHORS: Pavan K. Shukla

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PERSONS PRESENT:

Twenty-four registered participants from various background including academia, industry, and government research laboratories participated in the course. While most of the participants were from the United States, two were from G E India Pvt. Ltd., India, and one was from Calgary, Canada.

BACKGROUND AND PURPOSE OF TRIP:

I attended a five-day short course titled "Corrosion: Fundamentals and Experimental Methods" at Pennsylvania State University, State College, Pennsylvania. The Center for Nuclear Waste Regulatory Analyses (CNWRA) Professional Development Program funded my participation. The course covered fundamentals of corrosion and various electrochemical techniques. The course was taught by four experienced and acclaimed instructors in the area of corrosion. They were:

- Rudolph Buchheit, Associate Professor, Ohio State University.
- Gerald Frankel, Professor, Ohio State University.
- Howard Pickering, Professor, Penn State University.
- Barbara Shaw, Professor, Penn State University.

SUMMARY OF PERTINENT POINTS:

The course format included lectures and related laboratory experiments. A day-by-day summary is given below.

Day 1: The course started with lectures on fundamentals of corrosion and electrode kinetics in the morning session. In the afternoon, laboratory exercises were carried out to measure corrosion potential and corrosion rate of iron in 0.5 M sulphuric acid. A late evening session discussed laboratory results.

Day 2: Lectures on thermodynamics of corrosion, passivity, and localized corrosion were presented in the morning session. The corresponding laboratory exercise was

dedicated to measure localized corrosion parameters of iron in 0.5 M sulphuric acid. A late evening discussion highlighted the role of crevices in corrosion measurements.

Day 3: The third day lecture was on experimental difficulties associated with corrosion parameter measurements. In the laboratory exercise, we measured galvanic corrosion of iron and platinum in 0.5 M sulphuric acid.

Day 4: Two lectures were presented on electrochemical impedance spectroscopy (EIS), and the laboratory exercise was on measuring the corrosion rate of iron in 0.5 M sulphuric acid using EIS. In the evening session, the corrosion rate data collected for iron by different methods were analyzed and compared.

Day 5: Four half-hour lectures on scanning probe microscopy, electrochemical noise analysis, statistical analysis of corrosion data, and corrosion inhibitors were presented. The course ended after the morning session.

SUMMARY OF ACTIVITIES:

I arrived in State College on Sunday evening, July 24th, 2005. The course registration, introductory lecture, and welcome dinner were held that evening. The schedule of classes was as follows:

- Monday, Tuesday, and Thursday: Lectures from 8:30 am to noon, laboratory exercise from 1–5 pm, and closing discussion from 7:30–9:00 pm
- Wednesday: Lecture from 8:30–10:00 am and laboratory work from 10:30 am–1:00 pm
- Friday: Lectures from 9:00–11:30 am

Morning sessions included lectures, and afternoon sessions were dedicated to experimental exercises. Each day was closed by an evening discussion on experimental exercises. Participants were encouraged to ask questions in formal and informal settings. Hard copies of the course lectures, laboratory exercises, and closing discussion were provided to the participants.

CONCLUSIONS:

The short course was valuable in understanding corrosion processes and experimental techniques for measuring corrosion parameters. The short course highlighted two key points.

- In general, there is a large statistical spread in corrosion parameters. Therefore, orders of magnitude for the corrosion parameters, such as corrosion current and corrosion rate, are more meaningful than exact values.

- Crevices in the specimen contribute to error in the corrosion rate measurements, therefore, unless crevice corrosion is the process of interest, crevices must be eliminated before making measurements.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

I recommend this short course to CNWRA employees who are currently working in the area of corrosion but do not have extensive prior experience. The course material can be understood and assimilated with a basic engineering or science background.

SIGNATURES:

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Corrosion Science & Process Engineering

8/10/2005
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