

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: CORROSION/2005 Annual Conference and Exposition
Project No. 20.06002.01.322; AI Number 06002.01.322.505

DATE/PLACE: April 3-7, 2005
Houston, Texas

AUTHORS: K.T. Chiang, G.A. Cragolino, D.S. Dunn, X. He, and L. Yang

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PERSONS PRESENT: K.T. Chiang, G.A. Cragnolino, D.S. Dunn, X. He, L. Yang {Center for Nuclear Waste Regulatory Analyses (CNWRA)}, and about 5,500 representatives from various countries and organizations

BACKGROUND AND PURPOSE OF TRIP:

The CORROSION/2005 Annual Conference and Exposition features technical symposia, technical committee meetings, and an exhibitor show. The main goals of attending the conference were to:

- Present papers authored by the CNWRA staff that were included in several symposia
- Attend presentations by the DOE contractor staff on the high-level waste program
- Gain information on materials and test methods from exhibitors

In addition to presentations in the technical symposia, CNWRA staff participated in symposia organization and technical committee meetings.

MEETING SUMMARY

The following papers co-authored by the CNWRA staff were presented at the Corrosion/2005 conference:

- (i) Localized Corrosion Propagation of Alloy 22 authored by X. He and D.S. Dunn
- (ii) Performance Assessment of Alloy 22 as a Waste Package Outer Barrier authored by D.S. Dunn, G.A. Cragnolino, and O. Pensado
- (iii) Effect of Simulated Groundwater Chemistry on Stress Corrosion Cracking of Alloy 22 authored by K.T. Chiang, G.A. Cragnolino, and D.S. Dunn

All papers were well received, prompted questions, and generated subsequent discussion.

Environmentally Assisted Cracking

The Environmentally Assisted Cracking Symposium, co-chaired by D. Dunn, featured fourteen papers. Environmentally assisted cracking studies and case histories for nickel-based alloys, stainless steels, copper alloys and magnesium alloys were included. R. Rebak (Lawrence Livermore National Laboratory) presented a review of stress corrosion cracking of nickel-chromium-molybdenum alloys. The presentation included a description of the effects of alloying element additions on the stress corrosion cracking susceptibility of the C- family of nickel-based alloys (i.e., C-276, C-4, and C-22) and related alloys used in the chemical process industry. Limited information on the stress corrosion cracking of Alloy 22 as a possible waste package container material was also presented. In addition to the CNWRA paper on stress corrosion cracking of Alloy 22, the symposium also included two papers focused on stress corrosion cracking of stainless steels in nuclear reactor applications by P.L. Andresen (General Electric Corporate Research and Development) and several papers focused on cracking of alloys used in the oil and gas industry.

Corrosion in Nuclear Systems

The Corrosion in Nuclear Systems Symposium contained five papers focused on corrosion in nuclear reactors, five papers on corrosion monitoring and assessment in radioactive waste storage systems, and ten papers, including one from the CNWRA staff, on engineered barrier materials for the potential repository at Yucca Mountain.

Papers on reactor systems focused on stress corrosion cracking in pressurized water reactors and boiling water reactors. Materials covered in the presentations included stainless steels such as Types 304 and 316 and nickel-based alloys such as Alloy 600. P.L. Andresen presented papers on (i) the effects of silicon on the stress corrosion cracking of stainless steels and nickel-based alloys, and (ii) the effects of pressurized water reactor water chemistry on stress corrosion cracking. N. Totsuka (Institute of Nuclear Safety Systems, Inc.) presented a paper on the influence of minor elements on primary water stress corrosion cracking of Alloy 600.

Papers on radioactive waste storage systems included presentations by authors from Los Alamos National Laboratory, Westinghouse Savannah River Company, and UK Nirex Ltd. P. Wood (UK Nirex Ltd.) presented the results of condition monitoring of a low-level waste stainless steels storage box. Monitoring and surface analyses have shown significant chloride deposits attributed to transportation of ocean salts.

Papers focused on the potential repository at Yucca Mountain included a presentation by F. Hua (Betchel SAIC Company, LLC) on the DOE approach to evaluate the possibility of hydrogen embrittlement of titanium alloys proposed as drip shield materials, including Titanium Grades 7 and 24. The information presented was consistent with that previously included in response to Container Life and Source Term Key Technical Issue Agreements.

R. Rebak (Lawrence Livermore National Laboratory) presented a series of papers on uniform corrosion rates and localized corrosion of Alloy 22. Other papers from Lawrence Livermore National Laboratory included a presentation from T. Lian on the resistance of titanium oxide to corrosion in solutions containing fluoride and chloride and a presentation by G.O. Ilevbare on the effects of sulfate ions on the crevice corrosion susceptibility of Alloy 22.

Research Topical Symposium on Corrosion Resistant Materials in Extreme Environments

This symposium, in which G. Cragnolino was Vice-Chair, had seven invited presentations and was well attended. The objective of this symposium is to strengthen communications between corrosion science and engineering communities. Topics included high temperature corrosion in fossil power systems and similar applications, and aqueous corrosion in oil and gas well environments, supercritical water systems, chemical processing industry and pulp and paper processing. There were two presentations of particular interest. D. Shoesmith (University of Western Ontario) presented a comprehensive review assessing the expected corrosion performance of high-level nuclear waste containers in various potential repository settings, including Yucca Mountain environments. G. Was (University of Michigan) provided a detailed assessment of the stress corrosion cracking susceptibility of materials used in the core of nuclear power reactors. He discussed in detail issues related to the effect of high energy neutron fluence and gamma radiation on metallurgical and environmental changes which are critical factors on stress corrosion cracking propensity of the stainless steels and nickel-based alloys used in this extreme aggressive environments.

Research In Progress Symposium on Corrosion in Nickel-Based Alloys

This symposium included seven presentations on corrosion of Alloy 22 (among them a presentation by CNWRA staff) and a presentation on passivity of a variety of nickel-based alloys, including Alloy 22. R. Newman (University of Toronto) gave one presentation on the effect of metal cations including Pb^{2+} on dissolution and passivation of nickel-based alloys. L. McMillion (University of Nevada Reno) presented his deterministic modeling work of Alloy 22 uniform corrosion, developed in cooperation with D. Macdonald (Pennsylvania State University), based on the point defect model for passive films and using electrochemical impedance spectroscopy data in support of the model. Graduate students from University of Nevada Reno gave five presentations on localized corrosion of Alloy 22 under accelerated nuclear waste repository conditions, influence of hydrogen on the stability of passive film of Alloy 22, hydrogen permeation, isothermal oxidation studies, and stress corrosion cracking/hydrogen embrittlement of Alloy 22. The information presented was preliminary and further work on these topics is underway.

Corrosion Sensors for Online Monitoring

The corrosion sensors for online monitoring symposium, chaired by L. Yang, included eleven presentations. Three of the presentations were related to the application and improvements of multielectrode array sensors. In these presentations, it was shown that the multielectrode array sensors have been successfully used as online sensors for monitoring localized corrosion in

liquid, soil, and gases. Four of the other presentations were related to the application of electrochemical noise methods in the fields and laboratories. G. Schmitt from Iserlohn University of Applied Sciences (Germany) gave a presentation on a bimetallic electrochemical noise sensor. The authors used a new approach of counting the total charge flowing between two coupled electrodes. It was demonstrated that the total charge correlated with the corrosion of the test coupons.

Technical Committee Activities

D. Dunn and G. Cragnolino participated in the Technical Committee Meeting on Environmentally Assisted Cracking. D. Dunn will chair the next Technical Symposium on the subject to be held at CORROSION/2006 in San Diego, CA. The Technical Committee Meeting on Corrosion in Nuclear Systems was attended by G. Cragnolino. G. Cragnolino also participated as a member in the Research Committee Meeting. L. Yang chaired the Technical Committee Meeting on Sensors, Multielectrode: Laboratory and Field Applications and the Technical Symposium on Corrosion Sensors for Online Monitoring. L. Yang also participated in the Technical Committee Meeting on Sensors: Corrosion and Corrosiveness Sensor Technology and was selected Vice Chair for the next Technical Symposium on Online Sensors.

CONCLUSIONS

The conference provided an opportunity to follow the activities related to the potential repository at Yucca Mountain supported by the DOE. In addition, many symposia had papers that are relevant to the performance of engineering alloys that are used in reactors as well as those that may be used in the potential repository.

PROBLEMS ENCOUNTERED

None.

PENDING ACTIONS

None.

RECOMMENDATIONS

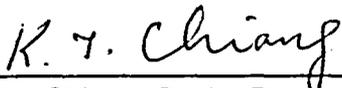
Attendance at future NACE International Annual Corrosion Conferences is highly recommended as well as participation in selected committee meetings.

SIGNATURE



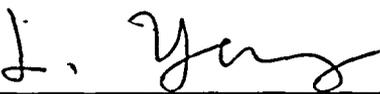
Darrell Dunn, Principal Engineer
Corrosion Science & Process Engineering

4/20/05
Date



Ken Chiang, Senior Research Scientist
Corrosion Science & Process Engineering

4/20/05
Date



Lietai Yang, Senior Research Scientist
Corrosion Science & Process Engineering

4/20/05
Date



Xihua He, Research Scientist
Corrosion Science & Process Engineering

4/20/05
Date



Gustavo Cragnolino
Technical Advisor

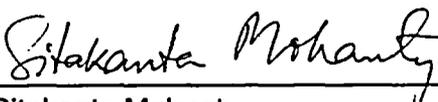
4/20/05
Date

CONCURRENCE:



Vijay Jain
Manager
Corrosion Science and Process Engineering

4/20/05
Date



Sitakanta Mohanty
Assistant Director
Engineering and Systems Assessment

4/20/2005
Date