



SYMPOSIUM ON ENVIRONMENTALLY ASSISTED CRACKING: PREDICTIVE METHODS FOR RISK ASSESSMENT AND EVALUATION OF MATERIALS, EQUIPMENT, AND STRUCTURES

November 13-15, 2000
Rosen Centre Hotel
Orlando, Florida

INTRODUCTION

This international symposium on environmentally assisted cracking (EAC)—stress corrosion cracking, hydrogen embrittlement, and liquid metal embrittlement—is sponsored by ASTM Committee G-1 on Corrosion of Metals and its Subcommittee G01.06 on Environmentally Assisted Cracking, in association with NACE International, the Materials Properties Council, the Materials Technology Institute of the Chemical Process Industries, the Electric Power Research Institute, and the European Structural Integrity Society.

The goal of this symposium is to address two important areas of EAC investigation: (1) recent developments in service simulations, corrosion modeling, and the generation of relevant materials properties data based on laboratory tests, and (2) methodologies for evaluation and serviceability assessment of environmentally assisted cracking in equipment and structures exposed to corrosive environments.

The symposium will focus on the increased interest in prevention of environmental assisted cracking, based on assessment of materials compatibility and operational risk relative to stress corrosion cracking, hydrogen embrittlement, liquid metal embrittlement, and corrosion fatigue. This interest has resulted in an effort to achieve improved mechanistic understanding and the development of better predictive models for crack initiation and growth, as well as analytical methods for assessment of the impact of corrosion-induced damage on structural integrity. It has also promoted the development of new methods for electrochemical monitoring and enhanced nondestructive inspection capabilities. The symposium will also address a

Introduction, continued

broad range of industrial asset management applications, including marine, aerospace, chemical, petroleum, electric power, biomedical, communications, consumer products and transportation applications.

The symposium will provide a global forum through which a sharing of state-of-the-art ideas and concepts can be transformed into cost-effective solutions.

Original papers will be presented on the following subjects:

- Uses of electrochemical, surface analysis, and dynamic and cyclic straining/loading methods and fracture mechanics techniques
- Applications of theoretical and applied corrosion modeling in life prediction
- Correlation between laboratory and in-service cracking resistance
- State-of-the-art developments in fitness-for-service and risk assessment methodologies
- Monitoring/Inspection of equipment and structures for environmentally assisted cracking

The symposium begins with a keynote address by Prof. Robert Wei titled “Materials Aging and Reliability of Engineered Systems.” A Plenary Session follows on the theme “Models for Environmentally Assisted Cracking—Theory to Practice.”

The general sessions, some of which were organized by the symposium sponsors, include the following:

- EPRI Session — Prediction of IASCC Performance in Reactor Cooling Water Systems
- NACE Session — Understanding and Predicting EAC Performance in Industrial Applications
- ESIS Session — EAC Testing and In-Service Experiences
- Research Session — Mechanistic Studies for Understanding and Control of EAC
- Industrial Applications Session — Applications for New Experimental and Analytical Methods

This symposium will be of great interest to those involved in materials engineering, inspection, and corrosion science and research, as well as to many operations personnel involved in maintaining and monitoring the ongoing reliability of plant equipment, structures, and end-user products. Attendees will be provided with a copy of the resulting Special Technical Publication (STP), which will include peer-reviewed papers presented at the symposium.

Introduction, continued

The STP will be an excellent reference volume for those involved in materials selection, inspection/monitoring, and process/plant troubleshooting.

This symposium will precede and be held in conjunction with the November 15-17, 2000 standards development meetings of ASTM Committee G-1 on Corrosion of Metals, the symposium sponsor.

Symposium attendees are encouraged to stay for these meetings on the two days following the symposium and to participate in various committee activities. A full listing of these committee activities can be found on the ASTM Website at: www.astm.org.

REGISTRATION INFORMATION

The fee to attend this symposium is \$180.00 for ASTM members, if paid in advance, or \$210.00 if paid on site. For those who are not members of ASTM, the fee is \$280.00, if paid in advance, or \$310.00 if paid on site. The fee is waived for symposium speakers. This fee covers the Monday evening reception (cash bar), the cost of the resulting Special Technical Publication (STP), and symposium-related expenses.

To register, complete the enclosed symposium preregistration form and mail or fax it—to arrive by **October 13, 2000**—to ASTM Accounting at the address indicated on the form. **All registrants, including those whose fees are waived, must send the preregistration form and check in at the ASTM registration desk on site to obtain a badge. Only one speaker per presentation is admitted to the symposium with a waived fee.** If you have questions concerning registration, please telephone Hannah Sparks at 610/832-9677.

A refund of the symposium fee will be honored only if requested at least seven working days prior to the symposium.

SPECIAL TECHNICAL PUBLICATION

If you are unable to attend the symposium but wish to receive information on the resulting Special Technical Publication (STP), simply check the appropriate box on the preregistration form, and information will automatically be sent to you just prior to publication by ASTM.

CONTINUING EDUCATION UNITS

Symposium attendees interested in receiving 1.75 Continuing Education Units (CEUs) should complete a CEU application form at the adjournment of the symposium.

HOTEL RESERVATIONS

All members of Committee G-1 and symposium authors/co-authors will automatically be sent hotel registration information.

ASTM has reserved a block of rooms at the Rosen Centre Hotel. The group rate is \$99.00, single or double, and will be available until October 13, 2000 or when the ASTM room block is full. You may be charged a higher rate if reservations are received after this time.

Symposium attendees are responsible for making their own hotel room reservations. Contact the Rosen Centre Hotel directly (9840 International Drive, Orlando, FL 32819, Tel: 407/996-9840). You or your travel agent must identify yourself as attending the ASTM symposium to receive the ASTM special rate.

SPECIAL EVENT

On Monday, November 13, a (cash bar) reception will be held immediately following the adjournment of the symposium.

SPECIAL NEEDS

Please advise the hotel and ASTM of any disability which will require special attention. The Rosen Centre Hotel complies with ADA Standards.

AIRLINE DISCOUNTS THROUGH UNIGLOBE WINGS TRAVEL

Uniglobe Wings Travel is providing ASTM with discount fares to Orlando and is able to give you the best price available.

Explore your airfare options—airline discounts, zone fares, or a special discount if you are age 62 or older.

Uniglobe Wings Travel charges a \$15.00 service fee per ticket.

Airline Discounts, continued

You may contact Uniglobe Wings Travel, Monday through Friday between 8:30 a.m. and 5:00 p.m. Eastern Time (Tel: 215/628-3322 or 1-800/243-4370, Fax: 215/628-0310, E-mail: uniwings@aol.com). Identify yourself as attending the ASTM symposium.

ADDITIONAL INFORMATION

For more information, contact the symposium chairman: Dr. Russell D. Kane, InterCorr International, Inc., 14503 Bammel North Houston Road, Suite 300, Houston, TX 77014, USA, E-mail: rdk@intercorr.com, Tel: 281/444-2282, Fax: 281/444-0246.

STANDARDS DEVELOPMENT MEETINGS

If you are a member of Committee G-1 you will auto-matically be sent, in advance of the symposium, a schedule of the committee's standards development meetings, to be held in conjunction with this symposium. For more information regarding these meetings, contact the ASTM staff manager, Bruce Noe, at ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610/832-9719, Fax: 610/832-9666, E-mail: bnoe@astm.org.

FUTURE MEETING DATES

Committee G-1 invites you to attend their future standards development meetings. There is no fee to attend these meetings, and membership in ASTM is not required. For more information, contact Bruce Noe at the ASTM address given above.

May 9-11, 2001
Phoenix, Arizona, USA

November 7-9, 2001
Dallas, Texas, USA

May 8-10, 2002
Pittsburgh, Pennsylvania, USA

November 20-22, 2002
Hollywood, Florida, USA



SYMPOSIUM ON ENVIRONMENTALLY ASSISTED CRACKING: PREDICTIVE METHODS FOR RISK ASSESSMENT AND EVALUATION OF MATERIALS, EQUIPMENT, AND STRUCTURES

Sponsored by:

ASTM Committee G-1 on Corrosion of Metals, and its Subcommittee G01.06 on Environmentally Assisted Cracking, in association with NACE International, the Materials Properties Council, the Materials Technology Institute of the Chemical Process Industries, the Electric Power Research Institute, and the European Structural Integrity Society

Symposium Chairman: Dr. Russell D. Kane
InterCorr International, Inc.
Houston, Texas, USA

MONDAY, NOVEMBER 13, 2000

8:00A

Welcome and Opening Remarks—R.D. Kane, Symposium Chairman

8:15A

KEYNOTE PRESENTATION: Material Aging and Reliability of Engineered Systems—R.P. Wei, Lehigh University, Bethlehem, Pennsylvania, USA

SESSION I: PLENARY PROGRAM

9:00A

Issues in Modeling of Environment Assisted Cracking—A. Turnbull, National Physical Laboratory, Teddington, Middlesex, UK

9:40A

BREAK

10:00A

Environment Assisted Intergranular Cracking: Factors That Promote Crack Path Connectivity—

J.R. Scully, University of Virginia, Charlottesville, Virginia, USA

10:40A

Micromechanics of Hydrogen Transport and Embrittlement—P. Sofronis and A. Taha, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA

11:20A

Strain Rate Dependent Environment Assisted Cracking of α/β -Ti Alloys in Chloride

Solution—

R. Gangloff, University of Virginia, Charlottesville, Virginia, USA

12:00N LUNCH (On Your Own)

SESSION I CONTINUES

1:30P

Framework for Predicting Stress Corrosion Cracking—R.W. Staehle, Consultant, North Oaks, Minnesota, USA

2:10P

Deterministic Prediction of Localized Corrosion Damage in Power Plant Coolant Circuits—

D.D. Macdonald, G. Engelhardt, and I. Balachov, SRI International, Menlo Park, California, USA

2:50P

BREAK

**SESSION II—EPRI-SPONSORED SESSION:
PREDICTION OF IASCC PERFORMANCE IN REACTOR COOLING WATER
SYSTEMS**

3:10P

Status of JAERI Material Performance Database (JMPD) and Analyses of Aqueous Environmentally Assisted Cracking Data Using It—Y. Kaji, T. Tsukada, H. Tsuji, and H. Nakajima, Japan Atomic Energy Research Institute (JAERI), Ibaraki, Japan

3:40P

An Analysis of Baffle/Former Bolt Cracking in French PWRs—P.M. Scott and M.-C. Meunier, Frammatome, Paris, France; and D. Deydier and S. Silvestre, Electricite de France, Villeurbanne, France

4:10P

Improvement of IASCC Resistance for Austenitic Stainless Steels in PWR Environments—T. Yonezawa and K. Fujimoto, Mitsubishi Heavy Industries, Ltd., Takasago City, Japan; T. Iwamura, Nuclear Development Cooperation, Ibaraki, Japan; H. Ajiki, Kobe Shipyard and Machinery Works, Kobe, Japan; and S. Urata, Kansai Electric Power Company, Inc., Osaka, Japan

4:40P SYMPOSIUM ADJOURNS FOR THE DAY

TUESDAY, NOVEMBER 14, 2000

SESSION III—NACE-SPONSORED SESSION:

UNDERSTANDING AND PREDICTING EAC PERFORMANCE IN INDUSTRIAL APPLICATIONS

8:00A

Prediction of Conditions Leading to Stress Corrosion Cracking of Gas Transmission Lines—N. Sridhar, Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute, San Antonio, Texas, USA

8:30A

Considerations in Using Laboratory Test Data as an Indicator of Field Performance: Stress Corrosion Cracking—R.H. Jones, Pacific Northwest National Laboratory, Richland, Washington, USA

9:00A

Effects of Environmental Factors and Potential on Stress Corrosion Cracking of Fe-Ni-Cr-Mo Alloys in Chloride Solutions—Y.-M. Pan, D.S. Dunn, G.A. Cragnolino, and N. Sridhar, Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute, San Antonio, Texas, USA

9:30A

Environmentally Assisted Cracking in the Chemical Process Industry: Stress Corrosion Cracking of Iron, Nickel, and Cobalt Based Alloys in Chloride and Wet HF Services—R.B. Rebak, Haynes International Inc., Kokomo, Indiana, USA

10:00A

BREAK

SESSION IV—ESIS-SPONSORED SESSION: EAC TESTING AND IN-SERVICE EXPERIENCES

10:30A

Hydrogen Embrittlement: Loading Rate Effects in Fracture Mechanics Testing—R.W.J. Koers, Shell International Oil Products, Amsterdam, The Netherlands; A.H.M. Krom, TNO Institute of Industrial Technology, Amsterdam, The Netherlands; and A. Bakker, Delft University of Technology, Delft, The Netherlands

11:00A

EAC Problems in the Industry: Some Experiences Inside the ENI Group—R. Rauso, G. Gabetta, R. Braga, D. Condanni, E. Demarsilliis, A. Ghisetti, P. Rampin, S. Ragazzoni, P. Sartori, and V. Pistoue, ENI, Rome, Italy

11:30A

Standardization of Rising Load/Rising Displacement SCC Testing—W. Dietzel, Institut fuer Werkstofforschung, Geesthacht, Germany

12:00N

LUNCH (On Your Own)

SESSION V—RESEARCH:

**MECHANISTIC STUDIES FOR UNDERSTANDING
AND CONTROL OF EAC**

1:15P

Role of Cyclic Pre-Loading in Hydrogen Assisted Cracking—J. Toribio and V. Kharin, University of La Coruna, La Coruna, Spain

1:45P

The Use of Atomic Force Microscopy to Detect Nucleation of Stress Corrosion Cracking in Stainless Steel—G.H. Koch, M.P.H. Brongers, and A.K. Agrawal, CC Technologies Laboratories, Inc., Dublin, Ohio, USA

2:15P

Stress Corrosion Cracking of Stainless Steel in Acidic Chloride at Room Temperature—R. Etien and T.M. Devine, University of California, Berkeley, California, USA

2:45P

BREAK

3:15P

A Rational Mechanistic Taxonomy for Corrosion-Assisted Cracking—P.F. Ellis, Jr., R.M. Munson, and J.N. Cameron, Mechanical and Materials Engineering, Austin, Texas, USA

3:45P

Environmentally Influenced Near-Threshold Fatigue Crack Growth in 7075-T651 Aluminum Alloy—E.U. Lee, H.C. Sanders, K. George, and V.V. Agarwala, Naval Air Warfare Center, Patuxent River, Maryland, USA

4:15P

Improvement of Stress-Corrosion Cracking (SCC) Resistance by Cyclic Pre-Straining in FCC Materials—I. de Curiere, B. Bayle, and T. Magnin, Ecole Nationale Supérieure des Mines de Saint-Etienne, Saint-Etienne, France

4:45P

An Electrochemical Film-Rupture Model for SCC of Mild Steel in a Phosphate Environment—R. Raicheff, Centro de Investigacion y de Estudios Avanzados del IPN, Merida, Yucatan, Mexico

5:15P SYMPOSIUM ADJOURNS FOR THE DAY

WEDNESDAY, NOVEMBER 15, 2000

**SESSION VI—INDUSTRIAL APPLICATIONS:
ENGINEERING APPLICATIONS FOR NEW EXPERIMENTAL AND ANALYTICAL
METHODS**

8:30A

Long-Term Crack Growth and Leakage in Two Large Process Tanks—S.H. Barber and N.W. Sachs, Sachs, Salvaterra & Associates, Inc., Syracuse, New York, USA; and W.J. Salot, AlliedSignal, Inc., USA

9:00A

Cyclic Strain Cracking of Stainless Steels in Hot Steam/Hydrocarbon Reformer Condensates: Test Method Development—S.W. Dean, Air Products and Chemicals, Inc., Allentown, Pennsylvania, USA; and J.G. Maldonado and R.D. Kane, InterCorr International, Inc., Houston, Texas, USA

9:30A

Environmentally Assisted Cracking of Cold-Drawn Eutectoid Steel for Civil Engineering Structures—
J. Toribio and E. Ovejero, University of La Coruna, La Coruna, Spain

10:00A

BREAK

10:30A

Premature Failures of Copper Alloy Valves and Fittings in the New York City Water Supply System—G.A. Andersen, New York City Department of Environmental Protection, New York City, New York, USA

11:00A

Stress Corrosion Cracking of Linepipe Steels in a Near-Neutral pH Environment: The Role of Operational Stress—W.-Y. Zheng, et al., CANMET, Natural Resources Canada, Ottawa, Ontario, Canada

11:30A

Closing Remarks—R.D. Kane, Symposium Chairman

11:45A

SYMPOSIUM ADJOURNS

OFFICERS OF ASTM COMMITTEE G-1

Chairman: J.S. Snodgrass
Reynolds Metals Company
Chester, Virginia, USA

Vice Chairmen: N.S. Berke
W. R. Grace and Company
Cambridge, Massachusetts, USA

S.M. Corey

Haynes International Inc.
Kokomo, Indiana, USA

Secretary: D.B. Reiser
Air Products and Chemicals Inc.
Allentown, Pennsylvania, USA

Membership Secretary: D. Aylor
Naval Surface Warfare Center
West Bethesda, Maryland, USA

Meetings Secretary: E.L. Hibner
Special Metals Corporation
Huntington, West Virginia, USA

ASTM Staff Manager: B. Noe
610/832-9719
bnoe@astm.org