Slow Strain Rate Testing for the Evaluation of Environmentally Induced Cracking

Research and Engineering Applications



RUSSELL D. KANE EDITOR

STP 1210

STP 1210

Slow Strain Rate Testing for the Evaluation of Environmentally Induced Cracking: Research and Engineering Applications

Russell D. Kane, editor

ASTM Publication Code Number (PCN) 04-012100-27



Library of Congress Cataloging-in-Publication Data

Slow strain rate testing for the evaluation of environmentally induced cracking : research and engineering applications / Russell D. Kane, editor.
(STP; 1210)
Includes bibliographical references and index.
ISBN 0-8031-1870-8
1. Stress corrosion—Testing. 2. Alloys—Fatigue—Testing.
I. Kane, R. D. II. Series: ASTM special technical publication ; 1210.
TA462.S565 1993
620.1'63—dc20

93-19461 CIP

Copyright ©1993 AMERICAN SOCIETY FOR TESTING AND MATERIALS, Philadelphia, PA. All rights reserved. This material may not be reproduced or copied, in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of the publisher.

Photocopy Rights

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by the AMERICAN SOCIETY FOR TESTING AND MATERIALS for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$2.50 per copy, plus \$0.50 per page is paid directly to CCC, 27 Congress St., Salem, MA 01970; (508) 744-3350. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Service is 0-8031-1870-8/93 \$2.50 + .50.

Peer Review Policy

Each paper published in this volume was evaluated by three peer reviewers. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM Committee on Publications.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution to time and effort on behalf of ASTM.

Printed in Baltimore, MD July 1993

Foreword

This publication, Slow Strain Rate Testing for the Evaluation of Environmentally Induced Cracking: Research and Engineering Applications, contains papers presented at the symposium of the same name, held in Pittsburgh, PA on 18–19 May 1992. The symposium was sponsored by ASTM Committee G-1 on Corrosion of Metals. Russell D. Kane, Cortest Laboratories, Inc., presided as symposium chairman and is editor of the resulting publication.

Contents

Overview

1

Development and Application of Slow Strain Rate Testing Techniques	
Slow Strain Rate Testing-25 Years Experience-R. N. PARKINS	7
Limitations of the Slow Strain Rate Test Technique—J. A. BEAVERS AND G. H. KOCH	22
Status of Standardization Activities on Slow Strain Rate Testing Techniques— R. D. KANE AND S. M. WILHELM Discussion	40 47
Uses of Slow Strain Rate SCC Testing to Control or Monitor Industria Processes: Applications in Nuclear Power	L
SSRT for Hydrogen Water Chemistry Verification in BWRs-M. E. INDIG	51
Applications of Slow Strain Rate Testing in the Nuclear Power Industry- M. T. MIGLIN AND B. P. MIGLIN	65
Measurement of the Deformability of Austenitic Stainless Steels and Nickel-Base Alloys in Light Water Reactor Cores—P. Dewes, D. Alter, F. GARZAROLLI, R. HAHN, AND J. L. NELSON	83
Research Applications and Developments in Slow Strain Rate Testing Techniques	
The Use of Precracked and Notched Slow Strain Rate Specimens—J. TORIBIO	105
Environmental Slow Strain Rate J-Integral Testing of Ni-Cu Alloy K-500 M. G. VASSILAROS, R. L. JUERS, M. E. NATISHAN, AND A. K. VASUDEVAN	123

Application of the Rising Displacement Test to SCC Investigations—w. DIETZEL AND KH. SCHWALBE	134
Slow Strain Rate Fracture of High-Strength Steel at Controlled Electrochemical Potentials in Ammonium Chloride, Potassium Chloride, and Ammonium Nitrate Solutions—D. T. NGUYEN, D. E. NICHOLS, AND R. D. DANIELS	149
Slow Strain Rate Testing of Precracked Titanium Alloys in Salt Water and Inert Environments—D. A. MEYN AND P. S. PAO	158
Industrial Applications of Slow Strain Rate Testing To Evaluate Environmentally Induced Cracking	
Case Histories Using the Slow Strain Rate Test —K. L. BAUMERT AND W. R. WATKINS, JR.	173
Use of Slow Strain Rate Tests to Evaluate the Embrittlement of Aluminum and Stainless Alloys in Process Environments Containing Mercury—R. D. KANE, D. WU, AND S. M. WILHELM	181
Effect of Heat Treatment on Liquid Metal-Induced Cracking of Austenitic Alloys — J. J. KRUPOWICZ	193
Hydrogen Cracking Initiation of a High-Strength Steel Weldment—P. A. KLEIN, R. A. HAYS, P. J. MORAN, AND J. R. SCULLY	202
Use of Slow Strain Rate Testing for Qualification of SCC Resistance of Corrosion Resistant Alloys: Case Histories in Petroleum Producti	0F ON
Problems Associated with Slow Strain Rate Quality Assurance Testing of Nickel- Base Corrosion Resistant Alloy Tubulars in Hydrogen Sulfide Environments—H. S. AHLUWALIA	225
The Role of Slow Strain Rate Testing on Evaluation of Corrosion Resistant Alloys for Hostile Hot Sour Gas Production—A. IKEDA, M. UEDA, AND H. OKAMOTO	240
Relationship of Localized Corrosion and SCC in Oil and Gas Production Environments— S. M. WILHELM AND D. M. CURRIE	263
Improved SSR Test for Lot Acceptance Criterion—E. L. HIBNER	290
Author Index	295
Subject Index	297

ISBN 0-8031-1870-8