Degradation of Metals in the Atmosphere







DEGRADATION OF METALS IN THE ATMOSPHERE

A symposium sponsored by ASTM Committee G-1 on Corrosion of Metals Philadelphia, PA, 12-13 May 1986

ASTM SPECIAL TECHNICAL PUBLICATION 965 Sheldon W. Dean, Air Products and Chemicals. Inc., and T. S. Lee, National Association of Corrosion Engineers, editors

ASTM Publication Code Number (PCN) 04-965000-27



Library of Congress Cataloging-in-Publication Data

Degradation of metals in the atmosphere: a symposium sponsored by ASTM Committee G-1 on Corrosion of Metals, Philadelphia, PA, 12-13 May 1986 / Sheldon W. Dean and T. S. Lee, editors.

(ASTM special technical publication; 965)

Proceedings of the Symposium on Degradation of Metals in the Atmosphere.

"ASTM publication code number (PCN) 04-965000-27." Includes bibliographies and index. ISBN 0-8031-0966-0

1. Corrosion and anti-corrosives—Congresses. 2. Metals-Congresses. I. Dean, S. W. II. Lee, T. S. (Thaddeus Shuptrine), 1948- . III. Symposium on Degradation of Metals in the Atmosphere (1986: Philadelphia, PA) IV. American Society for Testing and Materials. Committee G-1 on Corrosion of Metals. V. Series.

TA462.D37 1987 87-33261 620.1'623—dc19 CIP

Copyright © by American Society for Testing and Materials 1987 Library of Congress Catalog Card Number: 87-33261

NOTE

The Society is not responsible, as a body, for the statements and opinions advanced in this publication.

FOREWORD

The Symposium on Degradation of Metals in the Atmosphere was presented at Philadelphia, PA, on 12-13 May 1986. The symposium was sponsored by ASTM Committee G-1 on Corrosion of Metals. Sheldon W. Dean, Air Products and Chemicals, Inc., and T. S. Lee, National Association of Corrosion Engineers, served as chairmen of the symposium and are editors of the resulting publication.

Related ASTM Publications

Atmospheric Corrosion of Metals, STP 767 (1982), 04-767000-27

Atmospheric Factors Affecting the Corrosion of Engineering Metals, STP 646 (1978), 04-646000-27

Corrosion in Natural Environments, STP 558 (1974), 04-558000-27

A Note of Appreciation to Reviewers

The quality of the papers that appear in this publication reflects not only the obvious efforts of the authors but also the unheralded, though essential, work of the reviewers. On behalf of ASTM we acknowledge with appreciation their dedication to high professional standards and their sacrifice of time and effort.

ASTM Committee on Publications

ASTM Editorial Staff

Susan L. Gebremedhin Janet R. Schroeder Kathleen A. Greene William T. Benzing

Contents

Introduction	1
Materials Performance	
Sixteen-Year Atmospheric Corrosion Performance of Weathering Steels in Marine, Rural, and Industrial Environments—	
C. R. SHASTRY, J. J. FRIEL, AND H. E. TOWNSEND Discussion	5 15
Discussion	13
Atmospheric Corrosion Problems with Weathering Steels in Louisiana	
Bridges—aravamudhan raman	16
Discussion	29
Effects of Weathering of Chromate Passivation Films on Aluminum-Zinc Alloy Coated Sheet Steel—	
HAROLD J. CLEARY	30
Discussion	34
The Corrosion of Stainless Steels in the Atmosphere—J. R. KEARNS, M. J. JOHNSON, AND P. J. PAVIK Discussion	35 50
Long-Term Atmospheric Corrosion Behavior of Various Grades of	50
Stainless Steel—EARL A. BAKER AND THAD S. LEE	52
Discussion	67
Atmospheric Corrosion and Development of a Stainless Steel Alloy	
Against Marine Environments—SATOSHI ITO, H. OMATA,	
TOMOMI MURATA, AND M. YABUMOTO	68
Discussion	77
Atmospheric Corrosion of the Suspension Cables on the Williamsburg	
Bridge—LAWRENCE E. EISELSTEIN AND ROBERT D. CALIGIURI	78
Discussion	93

Observations on Atmospheric Corrosion Made of Architectural	
Copper Work at Yale University—H. B. FISHMAN,	
B. P. DARLING, AND J. R. WOOTEN	96
Discussion	113
Environmental Degradation of Telecommunication Hardware—	
T. S. F. LEE, NEVINE HEALEY, AND WILLIAM P. TRUMBLE	115
Long-Term Corrosion Behavior of Materials in the Marine	
Atmosphere—EARL A. BAKER	125
Atmospheric Corrosion Behavior of Clad Metals—GARDNER HAYNES	
AND ROBERT BABOIAN	145
Atmospheric Corrosion of Wrought Aluminum Alloys During a	
Ten-Year Period—sheldon w. dean and	
WILLIAM H. ANTHONY	191
Barrier Coatings for the Protection of Steel and Aluminum Alloys in	
the Marine Atmosphere—BARBARA A. SHAW AND	
DENISE M. AYLOR	206
Computer Techniques in Corrosion Protection—JAROSLAV PRÜŠEK	220
Environment Characterizations	
Environmental Effects in the Atmospheric Corrosion of Zinc-	
STEPHEN CRAMER, J. P. CARTER, P. J. LINSTROM, AND	
D. R. FLINN	229
Discussion	246
Using the Classification of Corrosivity of Atmospheres to Extend the	
Service Life of Materials, Structures, and Products—	
LEOPOLD VROBEL AND DAGMAR KNOTKOVA	248
Corrosion of Steel and Zinc in Scandinavia with Respect to the	
Classification of the Corrosivity of Atmospheres—	
VLADIMIR KUCERA, SVEIN HAAGENRUD, LYDER ATTERAAS,	
AND JAN GULLMAN	264
Discussion	281
Environmental Factors Affecting the Corrosion of Galvanized Steel—	
FRED H. HAYNIE	282

Atmospheric Corrosion in Maritime Industrial Atmospheres:	
Laboratory Research—DAGMAR KNOTKOVÁ, KAREL BARTOŇ,	
AND BUI VAN TU	290
Degradation of Copper and Copper Alloys by Atmospheric Sulfur—	_
JOHN FRANEY	306
Discussion	315
Marine Salts Contribution to Atmospheric Corrosion—	
JOHN R. DUNCAN AND JULIE A. BALLANCE	316
Discussion	326
The Chemistry of Precipitation: Perspectives on Potential Impacts	on
the Corrosion of Metals—T. E. GRAEDEL	327
Test Methods	
A Study of the Effects of Dry and Wet Deposition on Galvanized Steel and Weathering Steel: A Three-Year Field Exposure— JOHN W. SPENCE, FRED H. HAYNIE, DAVID C. STILES, AND	-
E. O. EDNEY	339
Discussion	353
Corrosion Monitoring of Shipboard Environments—	
VINOD S. AGARWALA	354
A New Method to Monitor In-Situ Protective Properties of Rust on Weathering Steel—SATOSHI ITO, HIROSHI KIHIRA, AND	
TOMOMI MURATA	366
Discussion	372
A Second Generation Accelerated Atmospheric Corrosion Chambe	e r —
ACDOM: GOMODENI	0,1
Appendixes	
ISO CORRAG Collaborative Atmospheric Exposure Program: A	385
Preliminary Report—sheldon w. dean	303
Summary	432
Index	435