Durability 2000

Accelerated and Outdoor Weathering Testing

Warren D. Ketola and
John D. Evans, editors

ASTM STP 1385

STP 1385

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ASTM Stock Number: STP1385

ASTM
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959

Printed in the U.S.A.

Library of Congress Cataloging-in-Publication Data

Durability 2000: accelerated and outdoor weathering testing
Warren D. Ketola and John D. Evans, editors.
p. cm.—(STP ; 1385)
ASTM Stock Number: STP1385
Includes bibliographical references.
ISBN 0-8031-2856-8
1. Testing. 2. Accelerated life testing. 3. Weathering. I. Ketola, Warren D., 1948–
II. Evans, John D., 1967– III. ASTM Committee G3 on Weathering and Durability.
IV. ASTM special technical publication; 1385.

TA410.D78 2000
620.1′12—dc21

00-056917

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Printed in Baltimore, MD
August 2000

Foreword

This publication, *Durability 2000: Accelerated and Outdoor Weathering Testing*, contains papers presented at the symposium of the same name held in New Orleans, Louisiana, on 25–26 January 2000. The symposium was sponsored by ASTM Committee G3 on Weathering and Durability. The symposium co-chairmen were Warren D. Ketola, 3M Traffic Control, Materials Division, and John D. Evans, DuPont Automotive.

Contents

Overview

Weathering and durability issues play an important role in the performance of many products that are used both outdoors and indoors. Products used in both environments are exposed to degradation caused by light, heat, moisture and the effects of pollutants. Customer expectations for durability are increasing and today's market often requires faster introduction of new products. These factors require a better understanding of the exposure stresses in both indoor and outdoor environments, more reliable laboratory accelerated tests, and analysis techniques that provide for more precise characterization of the changes caused by exposure.

STP 1385 represents the work of a number of researchers presented at Durability 2000: Accelerated and Outdoor Weathering Testing, January 25 and 26, 2000, in New Orleans, Louisiana. This was the third in a series of symposia sponsored by the ASTM G3 Committee on Weathering and Durability in its continuing effort to promote research leading to advances and innovations in durability testing. The papers presented in STP 1385 are divided into three categories: (1) characterization of materials that have been subjected to exposure tests; (2) advances in understanding or new developments in either outdoor, indoor, or laboratory accelerated tests; and (3) service life prediction.

Material Characterization

Many products or materials are evaluated using visual inspection for changes in important appearance or other attributes caused by exposure. These visual inspections can be imprecise because of differences in assessment criteria of those conducting the evaluation. The papers by Warburton and Gibbon and Lee et al. describe the use of images analysis techniques that can significantly improve the repeatability and reproducibility of appearance characterization of a variety of materials, appearance attributes, and exposure tests. Very long laboratory accelerated or outdoor exposures are often needed to produce measurable changes in physical properties of a material. Analytical techniques that can detect changes that correspond to loss of physical properties can significantly shorten exposure times needed to evaluate different materials or material formulations. Adkins reports on the use of ion scattering spectroscopy to measure H/C and O/C ratios as a function of depth in materials exposed for 500 hours in a laboratory accelerated test. The H/C and O/C ratios correlated with physical property changes produced in long term outdoor exposures of the same materials. In many cases it is important to know which spectral regions of the light source used for exposure are primarily responsible for degradation. Searle describes monochromatic and polychromatic techniques for determining this "activation spectrum" of a material and shows it can be used for the development of more light stable materials and in the design of laboratory accelerated tests.

Developments in Outdoor, Indoor, and Laboratory Accelerated Exposure Tests

The type and rate of degradation may vary significantly with the type of climate where a product is used. Veleva and Valadez-Gonzalez report on black box under glass exposures of mineral filled polyethylene that were conducted in two different climates. This research showed that for black box under glass exposures of this material, the degradation mechanism did not change, but the rate of degradation was related to differences in specific climate parameters. Ketola et al. and Fischer describe the development and evaluation of a laboratory accelerated test to simulate a specific indoor light environment. Results from the new test are compared to those from conventional laboratory accelerated test in order to determine which can best be used to estimate long term color stability of a series on ink-jet inks. Patel et al. describe improvements in techniques used to control irradiance, temperature, and humidity in laboratory accelerated exposure tests and show how more modern equipment can provide more consistent exposure conditions. Bortz and Wonneberger report on the development of a laboratory accelerated exposure test that has been successfully used to estimate the long-term durability of building stone. This test is based on a cyclic freeze/thaw immersion of the stone material in acidic solution that simulates the effects of exposure in polluted environments. Brennan and Everett report on results from outdoor and laboratory accelerated exposure tests that are being done as part of an effort to develop a new ASTM standard for assessing lightfastness of artists' colored pencils. In general, performance ranking produced better agreement between the tests than a rating system.

Service Life Prediction

Predicting service life of materials is the ultimate goal of any exposure program. Meaningful predictions of service life are contingent upon reliable measurements of the exposure stresses that can affect durability. Kockott and Manier describe a computer model that can be used to determine the spectral power distribution of daylight in many different locations. This program can be used to more realistically estimate the radiant exposures in critical spectral regions in a variety of climates, Cash reports on a method for estimating the durability of a variety of roofing materials based on thermal load and various construction and design parameters. Adams and Tré show how characterization of the properties of a glass and its response to accelerated environmental stresses can be used to determine that a sculpture made of the glass will remain relatively unchanged for at least 20 years.

Significant advances have been made in exposure tests and the methods used to characterize materials that have been subjected to exposure tests. Some of these advances may ultimately be incorporated into ASTM standards describing durability tests or methods for material characterization. The ASTM G3 Committee is committed to promoting this research. We hope that you find the advances reported in STP 1385 helpful in your research and encourage you to participate in the work of the ASTM G3 Committee.

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ISBN 0-8031-2856-8