

# Overview

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Durability testing of nonmetallic materials has been a common practice in many industries, such as paint and coatings, plastics, textiles, and building materials. However, the role of this testing is expanding from that of a basic research tool to that of a quality control technique and predictor of service life. The needs of durability testing, even as a research tool, have been changing. These changes have necessitated the development of new procedures for exposing and evaluating materials and analyzing data.

Today, we are witnessing a revolution in material sciences. More and more new materials are being developed and the applications for existing materials are expanding. The time required for these new developments and applications is becoming shorter and shorter. As a result, the need for faster and more precise testing and analytical methods is growing. More sensitive analytical tools are required. We no longer have the time to place a sample in the Florida or Arizona sun and wait a few years to determine its durability to sunlight and other environmental factors.

Not only are we seeing more and more new materials, we are also seeing that many materials are being designed to be more durable. It is common today for a material to last years longer than it did just a decade ago. This increases the need for faster and more precise durability tests. Further, as we become more concerned about durability, we need to be able to predict the service life of materials in a realistic manner.

Historically, much of the durability testing of nonmetallic materials has been conducted to compare one material or material formulation against another. We have been answering the question, "Is it better than another material?" While we are still interested in that question, we are also interested in the absolute questions such as "How long will it last?"; "Can I guarantee it for 10 years?" and "How will its durability in Florida compare to its durability in Minnesota?" In order to answer questions such as these, we will need to expand durability testing from a tool of assessing rank correlation to a tool for predicting service life and absolute correlation with real world experience. We will continue to see durability testing becoming more widely used as a quality control tool for making decisions on the lot-to-lot acceptability of production goods. This will require that durability tests become more controllable and, as a result, more reproducible and repeatable.

In January of 1996, ASTM Committee G-3 on Durability of Nonmetallic Materials sponsored a symposium on durability testing. This publication presents the papers that were presented at that symposium. The papers have been divided into three subject ranges: characterizing natural and accelerated exposure environments and samples; correlating natural and accelerated durability testing; and predicting service life. The following paragraphs provide a brief overview of the presented papers.

## **Characterizing Natural and Accelerated Exposure Environments and Samples**

Key steps in the development of new durability tests and evaluation tools relate to obtaining a better understanding of the current methodology. The first set of papers addresses these subjects. Fischer and Ketola provide an overview of the studies conducted under the auspices of the ASTM Committee G-3 to examine the repeatability and reproducibility of

durability tests. They summarize the new methods on sample conditioning and handling, control of variability, and statistical analysis that are being drafted within ASTM G-3.

Kockott examines the impact that tolerance variations in spectral distribution and irradiance have on the reproducibility and repeatability of durability tests. Putnam, Pekara and McGreer examine how different temperature and moisture methodologies impact exposures in accelerated outdoor weathering devices using fresnel reflector systems. Ketola, Skogland, and Fischer detail the results of how lamp aging and filter solarization affect the performance of xenon arc accelerated weathering devices. Jacques examines the limitations of the existing evaluation techniques and presents information on new evaluation techniques utilizing digital imaging technology.

### **Correlating Natural and Accelerated Durability Testing**

The objective of almost all accelerated and laboratory durability tests is to simulate the weathering effects that occur naturally. This is particularly challenging since natural weathering is an uncontrolled phenomenon subject to the natural variations of local meteorological conditions. The second set of papers from this symposium addresses this important topic.

Fedor and Brennan detail a series of experiments comparing the natural weathering of polymers in Florida, Arizona, and Ohio over a two-year period with accelerated weathering tests in fluorescent UV condensation-type exposure devices. Schulz and Trubiroha describe experiments with a different fluorescent device and focus on how this device can be used to simulate etch damage to coatings resulting from exposure to acid precipitation in the presence of light. Jorgensen, Kim, and Wendelin describe experiments and analytical tools that enabled them to develop a model for predicting the degradation of solar reflector materials to environmental stresses.

Putman and McGreer compared the performance of various materials used within an automobile interior using several different behind glass outdoor exposure testing techniques. The differences between the testing techniques as well as the geographical location of the tests were studied. Boocock, in his paper, examines corrosion tests and describes the round-robin testing being conducted to compare natural exposures with newly adopted ASTM test methods, which are believed to be better simulations of the natural corrosion.

### **Predicting Service Life**

The ASTM Committee G-3 has recognized the need to develop test methods and procedures for analyzing durability data in order to predict the service life of nonmetallic materials. The papers presented in this portion of the symposium provide examples of how service life can be predicted from the results of durability tests.

Kim, Jorgensen, Czanderna, and King describe a method for predicting service life of reflector materials used in renewable energy devices. They present an analytical tool that explains the bridge functions from stresses to performance and from performance to service life prediction. Fujii, Ramakrishna, and Hamada detail experimental techniques using acoustic emission measurements to predict the durability of certain laminates under stress corrosive environments.

Czanderna and Pern examine the performance degradation of materials used in photovoltaic modules. They outline a test protocol that simulates reality and permits the development of service life projections. In the final paper, Asher addresses some of the practical issues of using data obtained in weathering experiments. He reviews the issues of ranked and rated data in the analysis process.

Finally, let me express my thanks to the authors, reviewers, and participants in this symposium, as well as the past and current members of the Executive Committee of ASTM Committee G-3. Without their effort and support, this symposium would not have succeeded.

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