

Review on
POLYMERS: An Encyclopedic Sourcebook
of Engineering Properties

REVIEWED BY RANGA KOMANDURI¹

Polymers—an encyclopedic sourcebook of engineering properties is a welcome addition to the reference literature on this subject. It is concise and contains relevant topics. This volume is one of an Encyclopedia Reprint Series offered by John Wiley & Sons, Inc. It contains selected reprints in their entirety from the original 19 volume series of Encyclopedia of Polymer Science and Engineering with the intention of tailoring the needs of a community interested in the knowledge-base of engineering polymers—materials, properties, and performance. The Executive Editor of this volume is Jacqueline Kroschwitz and the members of the Editorial Board are Herman F. Mark, Norbert M. Bikales, Charles G. Overberger, and Georg Menges. The topics selected are appropriate and the authors of these articles represent a good balance between university and industry/research laboratories.

The 665 page volume contains 18 topics; a section on conversion factors, abbreviations, and unit symbols; and a subject index. The following topics organized alphabetically in the encyclopedic style are covered in this volume.

- Abrasion and Wear
- Aging, Physical
- Chemically Resistant Polymers
- Composites
- Composites, Fabrication
- Composites, Testing
- Crazing
- Dynamic Mechanical Properties
- Engineering Plastics
- Fatigue
- Fibers, Engineering
- Fracture
- Hardness
- Heat-Resistant Polymers
- High Modulus Polymers
- Impact Resistance
- Liquid Crystalline Polymers
- Mechanical Properties

The subject matter can be broadly divided into three groups—polymeric materials (including composites), their engineering properties and response. Materials covered include chemically resistant polymers; engineering plastics; fibers; composites—mechanics, materials, fabrication, and testing; heat-resistant polymers; high modulus polymers; and liquid crystalline polymers. Properties covered include

mechanical properties, dynamic mechanical properties, impact resistance, hardness, fatigue. Topics covered under polymer response include abrasion and wear, aging (physical), crazing, and fracture.

Normally, some of the properties, such as hardness, and fatigue are considered under mechanical properties. However, we have here in this volume separate topics which could have been part of the broad area of mechanical properties. This is unavoidable, since this volume is composed of selected reprints in their entirety and not rewritten to avoid such an issue. However, the material contained in these topical areas is far from repetitive and addresses different intellectual issues.

This volume is not a handbook, where the emphasis is on the tabulation of data but an encyclopedia, where the emphasis is on the knowledge-base. Nevertheless, it does contain some physical and mechanical data, and standards and specifications for materials. The content of this volume, as pointed out in the Preface, would be of value to researchers interested in the design, manufacturing, and use of current lightweight, tough engineering polymers for such applications as in consumer goods, automotive, and aerospace. The book is recommended as a reference volume for researchers and teaching professionals, and to engineering libraries.

Review on
RELIABILITY ENGINEERING,
P.D.T. O'CONNOR
Reviewed by Ranga Komanduri¹

“Reliability Engineering,” by Patrick D. T. O'Connor is the edited version of the proceedings of a seminar on “Reliability” held in Syria during July of 1986. A team of speakers, all from the U.K., presented the seminar. Part of the book has been extracted (by permission) from “Practical Reliability Engineering” (2nd Edition), written by the editor (O'Connor) and published by John Wiley & Sons.

The 305 page book contains 20 chapters contributed by eight authors. Ten of those chapters were written by the editor of this volume. The book deals with the practical engineering and management approaches to reliability of new technology products and systems. The approach reflects a move away from the conventional academic approach to reliability with only a brief treatment of probability techniques and reliability analysis.

In the introduction (Chapter 1) the author defines reliability as the probability a product meets the performance requirements (without failure) for a given period of time, under stated conditions of use. This definition implies that measurements or forecasts of reliability are to be based on probability theories, and therefore on statistics. While they do provide a basis, the author points out the need to control the source of variation and cautions the need to establish cause

and effect relationships in order to improve reliability of products and systems. Industry to be a leader and to capture a major share of the market must produce highly reliable products. The industrial competitiveness of a company on a local environment or of a country on a global scale depends very much on the reliability of goods and services it offers. Therefore, the importance and appropriateness of the subject matter under the current business environment cannot be overemphasized.

Chapters 2 and 3 on Reliability Mathematics I and II respectively present briefly the mathematical principles behind reliability, namely, Statistics, and Probability theory.

Chapter 4 deals with the modeling of systems reliability. The author distinguishes between continuously operated (repairable systems) and "mission" oriented systems. Series/parallel systems, redundant systems and standby systems are also briefly covered. This is followed by a brief discussion of fault trees for assessing the reliability of the system, and event trees for simulating the topology of a system as well as its sequential operational logic.

Chapter 5 on Design for Reliability stresses the importance of developing product designs which are inherently reliable such that the products would perform satisfactorily in a given environment for intended life. The rationale for this approach is that with very short development cycles typical of many products introduced currently, the design has to be correct the first time. Otherwise, extra cost and loss of market share may result. Therefore, the traditional approach to design based on experience and refinements is no longer adequate in most cases. The influence of environment, the concept of "robust" design (Taguchi methods), and design review methods including fault tree analysis and sneak analysis are briefly reviewed.

Chapters 6, 7, 9 to 12 deal with reliability of mechanical

components and systems, electronic systems, microelectronic devices, process plant and power systems, power system planning, and software respectively. These chapters cover a broad range of modern products and systems particularly in relation to quality circle. The authors also present differences in hardware and software reliability, which are important especially in an information technology world.

Chapter 13 deals with the reliability analysis of a distributed system. It introduces two new measures for modeling the reliability of distributed systems. Chapter 14 deals with reliability testing and presents environmental and reliability development tests and specifications. Environments considered include dynamic mechanical (vibration and shock), temperature and humidity, electrical and electromagnetic, and combined environments.

Chapter 15 deals with reliability prediction, including inherent uncertainty in the physical phenomena, manual as well as computerized techniques for reliability prediction and production quality assurance. Chapter 16 gives a case history of the weapons system reliability program in U.K. dealing mainly with reliability test aspects. Chapter 17 deals with production quality control. Chapter 18 introduces such concepts as maintainability, maintenance, and availability of a system. Chapter 19 presents methods to solve reliability problems. They include Pareto analysis, cause-effect diagram (Ishikawa diagrams), analysis of variance, proportional hazard methods, and exploratory data and analysis. Chapter 20 deals with the management of reliability programs.

Over all, the book is well written and represents a useful body of knowledge in engineering dealing with reliability of products and systems. It is recommended as a text book for undergraduate engineering students as well as for short course for practicing engineers. It is also recommended as a reference book.