BOOK REVIEWS

Quality in America: How to Implement a Competitive Quality Program

Reviewed by A. T. Riga, senior research chemist and quality literacy instructor, The Lubrizol Corporation, Wickliffe, OH 44092.

REFERENCE: Hunt, V. D., *Quality in America: How to Implement a Competitive Quality Program*, Business One Irwin, Homewood, IL, 1992, ISBN: 1-55623-536-4, $24.95.

This is a timely, well thought-out book. It is organized into eleven chapters and three appendices. Highlights of the book's contents include: Quality in America Today, An Executive's Guide to Quality, The American Quality Award and Leaders, Quality First-Self Assessment, How to Significantly Improve Your Quality, Implementation, Tools and Techniques. Summarized in the appendices are 27 references for executive reading, definitions, and a wealth of resource information from national associations, regional and university-based centers, organizational resources, and quality consultants.

The motivation of this monograph is based on the premise that producing quality goods and services is crucial not only to the continued economic growth of the United States, but also to our national security and the well being and standard of living of each American family. The author points out the varying quality priorities of the United States, Japan, and Europe. The theme of this book is to show how to improve the quality of goods and services, which results from improving productivity and lowering costs.

The scope and objectives were clearly outlined in the preface and early chapters. The content along with the tables and figures show the significance of implementing quality into all phases of management and the research laboratories. I use this book as an important reference in teaching quality literacy for a number of national organizations.

Fracture Mechanics: Fundamentals and Applications

Reviewed by Ibrahim H. Shehata, Department of Industrial Technology, University of Northern Iowa, Cedar Falls, IA 50614-0178.

REFERENCE: Anderson, T. L., *Fracture Mechanics: Fundamentals and Applications*, CRC Press, Inc., Boca Raton, FL, 1991, ISBN: 0-8493-4277-5.

Since World War II, the field of fracture mechanics has become one of the most promising fields related to structural design due to the increase of the complexity of the advanced technology, especially in modern aerospace industry. Catastrophic failure of sophisticated structures and the dangerous damages causing billions of dollars loss can be reduced if the current appropriate technology and fracture mechanics approach have been properly applied. Many books in the field of fracture mechanics are now available. Some of these books are written in highly mathematical format while others are technically oriented for certain applications. Very few updated references which combine fundamental concepts, material microstructure, and applications for diversity of readers are available. This book is one of the better ones in this field.

This book is mainly for graduate students (in the fields of material science and solid mechanics) as a textbook and for engineers and researchers as a reference. However, undergraduate students can also benefit from some portions of this book, especially the first three chapters. The book provides theoretical background as well as practical applications to the field of fracture mechanics in detail. The chapters of the book are constructed qualitatively to serve the ordinary reader who can grasp with a minimum of higher level mathematics. Appendices are also attached to certain chapters providing a detailed mathematical background for the more advanced reader. One of the strongest points in this book is that both the continuum theory and the material's microstructure are combined to predict the stresses and strains near a crack tip theoretically and also to determine the critical conditions for fracture practically in metals as well as nonmetals. However, the author fails to avoid the continuum theory in the chapters discussing fracture mechanisms of metals and nonmetals. This may be attributed to his intention to involve both material scientists and solid mechanists in these chapters.

The book is divided into five parts totalling about 800 pages. The author uses short and clear sentences supported, whenever needed, by expressive visual aids. The organization of the book is well done, and the symbol drawn on the hardcover, which is related to the subject covered, is meaningful. The author cites references at the end of each chapter for readers interested in more details. Part I, which contains only one chapter, is mainly an introduction to the history of, and an overview for, the subject of fracture mechanics. The author gives real examples of disasters caused by the lack of knowledge in the field of fracture mechanics to show how this field can play a vital role in saving lives and property. However, this chapter includes a review of the dimensional analysis which seems inappropriately located.

The following three parts represent the core of the book. Part II describes in three chapters the fundamental concepts of linear elastic fracture mechanics (LEFM), elastic-plastic fracture mechanics (EPFM), and dynamic and time-dependent fracture, respectively. Chapter 2 provides a comprehensive overview of some basic concepts related to LEFM such as the energy release rate and stress-intensity approaches. The relationship between these parameters and under what conditions they can be used as single material parameters are also presented. Chapter 3 introduces two additional single parameters to describe crack tip conditions in EPFM and the validity requirements for using them: the crack

BOOK REVIEWS

tip opening displacement (CTOD) and the J contour integral. Chapter 4 provides an introduction to dynamic fracture and crack arrest (including a brief discussion of rapid loading of a stationary crack, crack propagation and arrest, and dynamic contour integral). The concepts of other parameters in creep crack growth and viscoelastic fracture mechanics (linear and nonlinear behavior) are also introduced.

Part III concentrates on material behavior in two chapters and outlines the micromechanisms of fracture in metals and alloys as well as in nonmetals (polymers, ceramics, and composites), respectively. Chapters 5 and 6 emphasize the importance of microstructure and material properties on the fracture behavior especially when the single parameter fails to be valid. Chapter 5 presents three types of common fracture mechanisms in metals and alloys: ductile, cleavage, and intergranular fractures. Chapter 6 gives a brief overview of the current state of understanding of fracture and failure mechanisms in selected nonmetallic structural materials (polymer matrix composites and ceramic matrix composites).

Applications of the fracture mechanics based approaches are discussed in Part IV, which contains five chapters. Chapter 7 describes standard fracture testing methods of metals (especially ASTM standards since they are the most common used methods worldwide in this field). Recent research results are also presented in addition to a section on weldment testing, which has to be standardized in the United States. Chapter 8 discusses the validity of using some of the standard fracture testing methods, which are being used to characterize the metals behavior, for nonmetals (engineering plastics, fiber-reinforced composites, and ceramics) and how these methods can be improved. Chapter 9 focuses on fracture initiation and instability in structures made from linear elastic and elastic plastic materials. It also outlines the available methods for applying time-independent fracture mechanics (including probabilistic fracture mechanics) to structures and discusses the shortcomings of the existing analyses. Chapter 10 describes life predictions for all types of time-dependent crack growth in the presence of cyclic stresses of metals. It also discusses some of the critical issues in this area, including crack closure, the micromechanism of fatigue, the behavior of short cracks, and procedures for experimental measurements of fatigue crack growth. Chapter 11 introduces some of the traditional and most recent innovative approaches in numerical analysis of fracture problems. The chapter includes procedures for determining the stress-intensity factor and energy release rate in structure with an emphasis on the energy domain integral approach. Part V includes two chapters containing the reference material that is usually found in fracture mechanics handbooks (stress intensity, compliance, limit load, plastic energy release rate and plastic displacement solutions for three configurations) and a series of practice problems related to the first eleven chapters for educational purposes.

I personally believe that researchers who seek new openings in the fracture mechanics field will find this book of great help, especially in the areas of fracture mechanisms and testing of polymer and ceramics matrix composites. However, although the author has done his best to present many of the recent works related to fatigue crack propagation in Chapter 10, it seems that he has omitted, unintentionally, the crack layer theory established by Chudnovsky (1986) which has been successfully used to characterize the material resistance to fatigue crack propagation (FCP) for metals as well as nonmetals. I believe by considering this theory in addition to reconsidering undergraduate students as potential readers in the next edition, which I think should be available within a few years, this book will be widely read. In general, the book in its present shape is an excellent reference, and I urge those interested in the field of fracture mechanics to read it.

Modern Ceramic Engineering: Properties, Processing, and Use in Design, Second Edition

Reviewed by R. A. Eppler, Eppler Associates, Cheshire, CT 06410.

REFERENCE: Richerson, D. W., *Modern Ceramic Engineering: Properties, Processing, and Use in Design, Second Edition*, Marcel Dekker, Inc., New York, 1992, ISBN: 0-8247-8634-3, 876 pp.

The objective of this book is to provide an increased understanding of ceramic technology and its practical application. It is designed to be intermediate in level, going beyond introductory materials science texts, but without the mathematical jargon of a scientific treatise. The intended audience is practicing engineers and graduate students in ceramics and materials science and engineering.

The book does a very good job of presenting material in an easily understood, yet technically correct manner. There are illustrative problems throughout. The technically trained reader will have no difficulty with a topic that is new to him or her. The references provide an entree to the primary literature for those wishing to go further with a particular topic.

It is not clear from the title that the author has focused almost exclusively on the properties and processing of nonplastic crystalline ceramic bodies. Plastic (i.e., clay-containing) ceramic bodies, glasses, and coatings are not covered.

The book is divided into three parts: Part I, Structures and Properties; Part II, Processing; and Part III, Design with Ceramics. These three parts are very different in the scope of the material presented.

Part I, Structures and Properties attempts to present the nature and properties of ceramic materials. This is the least successful part of the book. While the exposition is clear, it is only a little more comprehensive than the coverage of a good introductory text in materials science. Hence, while it will serve as background for the other two parts, it is inadequate for an understanding of the nature and properties of ceramic materials.

Part II, Processing covers selected topics in the processing of nonplastic ceramic bodies. The items that are covered—powder processing (especially milling); selected shape forming processes (pressing, casting, plastic forming); densification (firing); machining; and quality assurance are very thorough and well-presented. However, other important topics, such as drying and post-firing treatments other than machining, are not covered.

BOOK REVIEWS

The very important topic of processing additives is covered incidentally to the processes themselves. As long as the reader's interest is limited to the processes discussed, and to nonplastic ceramic bodies, this part is an excellent place to learn about them. For a more comprehensive treatment, consult "Introduction to the Principles of Ceramic Processing," by J. S. Reed.

Part III, Design with Ceramics covers an approach to the problem of designing with ceramic materials. It includes an excellent discussion of failure analysis of ceramic products, and a summary of some of the newer applications of ceramics. This part is a unique contribution to the literature. Nobody with an interest in design of ceramic ware or in the failure of ceramic products should be without this text.

Overall, this book is an excellent starting point for anyone interested in design and processing of nonplastic crystalline ceramics. Information is presented clearly and in sufficient depth to serve as the basis for study of the primary literature, but without the complication of undue mathematical jargon. However, there is more to the technology of ceramics than is suggested here.