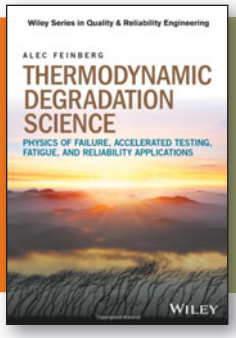



## Thermodynamic Degradation Science: Physics of Failure, Accelerated Testing, Fatigue, and Reliability Applications

Alec Feinberg

Wiley, 2016
264 pages, $115.00
ISBN 978-1-119-27622-7

This book uses thermodynamic concepts coupled with physical analogies to address the complex issues associated with material degradation. As part of the Wiley Series in Quality and Reliability Engineering, this text presents a review of thermodynamic principles from the perspective of reliability engineering. The laws of thermodynamics are restated in terms of damage and repair rather than simply as the result of state variables.

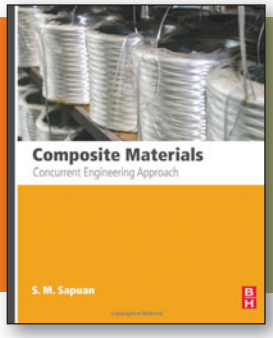
The book begins by introducing equilibrium thermodynamics as a foundation for discussing the behavior of nonequilibrium systems. The second chapter clearly states the nomenclature required to bridge the two, including numerous explicit examples spanning many physical paradigms. Later chapters describe the utility of key concepts and analytical tools in addressing thermodynamic degradation, including work, accelerated testing, corrosion, thermal activation, viscoelastic and fatigue effects, and diffusion. Activation (Arrhenius) and other aging laws are discussed in the context of specific applications as well as predicting failure.

The last chapter and the appended "Special Topics" suggest interesting directions in which the developed methods can be taken, but seem rushed relative to the richness of the early chapters. This may be a limitation of the organization in conjunction with the paucity of work done in this area to date. This is a minor limitation of the enlightening approach used throughout the remainder of the text. The "Special Topics" include reliability statistics, accelerated testing, and the conceptualization of humans as thermodynamic engines, which can wear in predictable ways.

Practical examples from classical physics and biomechanics are abundant. Each chapter concludes with a summary of key concepts and equations. Thermodynamic laws are restated in terms of nonequilibrium processes, and then used to derive common semiempirical and theoretical results from Miner's rule to the diffusion equation. The early chapters include tables that explicitly list variables and equations of interest, which allow the developed methods to be applied to any classical physical system by analogy. Later chapters extend these analogies to nonequilibrium examples, including accelerated aging. The presentation is very accessible and avoids overly complex mathematics in favor of intuitive, descriptive derivations. As one might expect with a book presenting a new perspective, the nomenclature can be somewhat challenging. The author therefore takes pains to clarify the terminology. In some cases, primarily arising in the "Special Topics," attempts to use existing terminology rather than developing an alternative is confusing.

This book is a useful reference for anyone engaging in research or graduate-level instruction in thermodynamics, aging, degradation, and damage. Chapters do not include exercises and examples do not yield numerical results, instead focusing on the conceptual products of this line of reasoning. The tables, figures, and chapter summaries also allow the text to serve as a useful reference for those working in classical thermodynamics.

***Reviewer: Matthew A. Reilly*** *is an assistant professor in the Department of Biomedical Engineering, The Ohio State University, USA.*




## Composite Materials: Concurrent Engineering Approach

S.M. Sapuan

Butterworth-Heinemann, 2017
338 pages, $119.00 (e-book $119.00)
ISBN 9780128025079

This book is innovative in that it applies the concepts of concurrent engineering to composite materials. According to Report 338 of the US Institute for Defense Analyses (1988), concurrent engineering is the "systematic approach to the integrated design of products and their related processes including manufacture and support." Composite materials are a current and ever-growing area.

In this book, Sapuan emphasizes the importance of considering the manufacturing aspects in the early stages of product design and development. The book presents details of concurrent engineering for composite development, including the conceptual design of composite materials, materials selection, and design for sustainability. The first chapters describe the background for concurrent engineering, design for sustainability, conceptual design for composites (including several models for design), and materials selection using composites. In sequence, composite materials are defined, and their applications are listed for some industries along with their manufacturing methods. Polymer matrix composites (PMCs) are emphasized, especially natural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