Radioactive Waste Forms for the Future

Edited by Werner Lutze and Rodney C. Ewing
(Elsevier Science Publishers, Amsterdam, New York, 1988), 712 pages
ISBN: 0-444-87104-7

Disposal of high-level nuclear waste is an important scientific and technological issue, impacting the whole future of nuclear power. It is not surprising, then, that much research has been conducted on performance and stability of the various waste forms that have been proposed.

It *is* surprising, however, that the amount of research in this area has decreased markedly in recent years. As the editors of this compendium point out, the reason for the decrease of effort is that system analyses of waste repository performance have shown that huge differences in the host material's behavior have little effect on the calculated radiation dose to man.

Why then this book? Because it is important to furnish the nuclear waste and general materials communities with a "repository" for the extensive work that has been done in this field.

And the book does just that. Coverage is comprehensive, including sections on crystalline, noncrystalline, and novel waste forms, spent fuel, and a summary and evaluation by the editors. The 12 chapters that comprise the volume are by their nature reviews, but are nevertheless thorough and up-to-date, as one would expect from authors who are authorities in the field. The chapters have a welcome consistency that derives from the editors' efforts to see to it that all authors address certain basic topics such as composition and microstructure, chemical durability, physical properties, radiation effects, and production technologies.

The chapters offer a good balance between background, overviews on waste performance, and detailed descriptions of critical technical points. The extent of detail may, in some cases, be more than the general reader needs; however, the summary chapter supplies a handy overview.

This book can be appreciated not only for its thorough description of the status of research on nuclear waste forms, but also for its recognition of the important contributions to materials science that have resulted from this work. Studies of nuclear waste performance require a multidisciplinary approach, and researchers whose work is described here have done a good job of answering critical scientific and technological questions in an intrinsically complex area.

The choice of appropriate geologic sites and use of a multibarrier approach appear to promise the necessary isolation for high-level nuclear waste. However, the added assurance that comes from selecting an optimal waste form (which is, after all, the first barrier) certainly cannot hurt, and will help to persuade the public that everything has been done to achieve maximum safety. The work described in this book demonstrates that materials researchers have done their part, within programmatic limitations, to develop the data base needed to make a wise selection.

Reviewer: Frank W. Clinard Jr., a laboratory associate at Los Alamos National Laboratory, has managed and conducted research on radiation effects in materials, including damage effects in nuclear waste forms, since 1972.

Wood-Water Relations

Christen Skaar
(Springer-Verlag, New York, 1988), 283 pages
ISBN: 3-540-19258-1

This book is an updating and reworking of Christen Skaar's earlier book, *Water in Wood* (1972). Like its predecessor, it is intended for graduate students and researchers in wood science and technology. Designed to be rather limited in scope, it presumes considerable working knowledge in such diverse background subjects as thermodynamics and wood anatomy. Six chapters discuss wood moisture and the environment, moisture sorption thermodynamics, theories of water sorption by wood, hygroexpansion in wood, moisture movement in the wood cell wall, and, electrical properties of wood. The last two chapters cover topics not discussed at length in the earlier book. The chapter on electrical properties is the major addition. In fact, without the 59 pages of this chapter, the book equals the number of pages in *Water in Wood*.

The book's theme is that the interaction between wood and water must be understood in order to comprehend the fundamental properties of wood. This interaction is so pervasive that one errs seriously if he or she expects to base an understanding of wood's properties and behavior upon only its physical structure and anatomy. Skaar's message is that differences in behavior of wood resulting from changes in its moisture content must be considered of equal importance to the structure of wood.

A wood scientist, like all specialists, tends to emphasize those aspects of the material that are felt to be unique. But wood isn't the only water sensitive gel, it isn't the only microporous adsorbent, and it isn't the only polymeric composite whose mechanical properties are moisture dependent. From the materials scientist's point of view, much can be learned from the extensive studies of wood discussed in this volume. Skaar's approach is that of a wood scientist, but he does develop unifying generalizations. He refers often to similar phenomena in textiles. His treatment of hygroexpansion in terms of a limited swelling gel has wide applicability in such diverse fields as biopolymers, foods and textiles. Similarly, theories of water sorption by wood can provide valuable lessons to materials scientists concerned with such unrelated materials as clays, glass and cement. And, certainly, because thermodynamics has universal applicability regardless of models, his chapter on moisture sorption thermodynamics is relevant to all hygroscopic materials.

One important topic of longstanding interest and current befuddlement that Skaar should have analyzed more fully is mechano-sorptive phenomena. Little mention is made of the unusual phenomena of accelerated creep, reduced load carrying capacity, and premature wood failure that occurs under cyclic humidity environments. But Skaar's book clearly contains the background information and fundamental theories necessary to achieve insights into the solution of these problems.

Many large sections of the text are verbatim transcriptions of *Water in Wood*. For those unfamiliar with Skaar's earlier book, or for those wanting an update (and a 50% enlargement) of the reference section, *Wood-Water Relations* will be a welcome addition to their libraries.

Reviewer: Daniel F. Caulfield, a physical chemist with the Forest Products Laboratory, U.S. Department of Agriculture, Forest Service, has been engaged in research on structure/properties relationships of cellulose and paper for 23 years.

□

1990 MRS Spring Meeting Proceedings...see p. 76