Book Review

Management of Plutonium Contaminated Waste. Edited by J. R. Grover, Harwood Academic Publishers (1982). $30.00.

In a nutshell, this book is a collection of monographs and facts dealing with the treatment of wastes contaminated with plutonium. It is an interesting volume to browse through and should be a valuable reference work in the area of nuclear waste management.

The reader has to be a bit careful with the title of this book. The wastes described therein, if not on day one, will in time contain significant quantities of ^{241}Am and ^{237}Np as well as plutonium. The origin and nature of the primary plutonium waste are defined in terms of the effluents expected from a mixed-oxide fuel fabrication plant such as the reference plant described in a report issued by the Commission of the European Communities. (The design appears to be the Belgonucleaire reference plant.) The plant receives, as its feed, plutonium dioxide (PuO_2), uranium (natural or depleted) dioxide (UO_2), and all structural materials required for assembling fuel elements for light water and liquid-metal fast breeder reactors. The various operations carried out in the plant generate waste streams that are radiological hazards and, for this reason, must be treated appropriately. The strategy involves recycling the clean scrap to the primary process and recovering and purifying the UO_2-PuO_2 from the dirty scrap for reuse in the main plant. Wastes from the secondary processes are treated to produce waste forms acceptable for interim storage or for shipment to ultimate disposal. The primary process used to prepare the mixed oxide is the rather standard procedure of mechanically mixing the dry UO_2 and PuO_2. After precompaction-granulation, the mixed oxide is converted to sintered $(U,Pu)O_2$ pellets. The pellets are then loaded into fuel rods, and the rods are subsequently assembled into fuel bundles.

Operation of the plant generates various solid, liquid, and airborne wastes—all contaminated with plutonium. The book provides a careful description of the nature of the broad spectrum of these materials. The solid wastes are subdivided by the level of plutonium contamination as follows: low-level or suspect waste, plutonium-contaminated materials, and residues or scrap. The liquid wastes, which generally have low plutonium contents, may be decontaminated by floc precipitation, solvent extraction, ion exchange, etc. Organic wastes can be treated by incineration. The gaseous wastes usually arise from the ventilation system and are collected on high-efficiency particulate air (HEPA) filters, further treated if required, and finally discharged through a stack to obtain adequate dispersion.

The book goes into detail about isotopic composition of the plutonium from various sources and about the growth of ^{241}Am and ^{237}Np into the fuel material. The special problems arising from the use of plutonium are also discussed. The environmental impact of the use of this alpha emitter is summarized by observing that there has been no proven injury from plutonium uptake after more than 30 years of plutonium handling by thousands of individuals. The growth of ^{241}Am is discussed, and the complications of the alpha and gamma-ray emissions from this isotope on plutonium waste handling are analyzed.

The book next turns to a description of current management practices for solid and liquid wastes, including treatment, conditioning, storage, and disposal. This discussion is based on present practices in the United Kingdom, Belgium, France, and the Federal Republic of Germany. An interesting appendix, which provides specific examples of plutonium recovery by Belgonucleaire, is included. The examples are recovery from HEPA filters, ceramic samples, centerless grinding machine filters, and contaminated liquids.

The chapter on immobilized waste forms, in which eight standard forms are described and compared, is excellent. The major disadvantage of the high-alumina cement plus firing and glazing and the pelletization products is that it requires additional packaging. Bitumen has the problem that it is subject to excessive temperature and fire. On balance, cement or concrete appears to be the favored approach with the statement, "In general, all low and medium active, liquid and solid alpha contaminated wastes could be conditioned (for disposal) by cementation."

A discussion of R&D needs and future trends includes monitoring and treatment of liquid and solid wastes. Waste minimization and volume reduction processes are emphasized.

Finally, the book concludes with a recommendation for more R&D and identifies the universal need for development and acceptance of nuclear waste disposal criteria.

In summary, this book is easy reading for one interested or experienced in the field of nuclear waste management. The rather complete coverage of the treatment of wastes contaminated with plutonium is almost certain to make this volume an important reference work that will have applications to both governmental and industrial operations and research.

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About the Reviewer: Don Ferguson is Technical Advisor, Nuclear and Engineering Technologies, Oak Ridge National Laboratory (ORNL). His primary interests are nuclear fuel recycle, nuclear waste management at ORNL, and conversion of a uranium solution to a stable solid form for long-term storage. He is also chairman of the Waste Disposal Steering Committee for the four Union Carbide Nuclear Plants in Oak Ridge and Paducah and served for many years as the director of the ORNL Chemical Technology Division. Mr. Ferguson's graduate studies were at the University of Tennessee at Knoxville.