and skins to produce leather for garments, serendipitously took advantage of enzyme activities." The enzyme industry now generates 1 billion dollars per year. The scope of this fast-expanding field is covered exceedingly well by this multi-authored text.

In this book, 34 multi-authored contributed chapters discuss the most important types of industrial enzymes, their structure, catalytic properties and applications. This task is accomplished by 80 scientists mainly from Europe.

The book has five major sections (as shown below) with the number of contributions in each section shown in parentheses:

- Carbohydrate active enzymes (9);
- Peptidases (6);
- Lipases (5);
- Nucleic acid enzymes (4);
- Oxidoreductases and other enzymes of diverse function (10).

The editors' goal was "...to provide in a single volume an updated revision of the most important types of industrial enzymes based on consideration of their physicochemical and catalytic properties, three-dimensional structure and range of current and foreseeable applications." In my opinion, they have done that.

Besides being an excellent treatise on the theory, structure and function of enzymes, the various contributors describe practical applications/uses for enzymes such as the production of starch hydrolysates (glucose or maltose serum).

One particularly interesting and very timely chapter written by employees of U.S. National Renewable Energy Center in Golden, Colorado discusses the use of cellulases for the above task. The authors state:

> It is now clear that cutting-edge and efficient biochemical technologies must be used to reduce the cost of cellulase activities delivered to the SSCF bioethanol process. The current estimate for NREL Proven Technologies and Best of Industry Technologies yields cellulase costs to the bioethanol process of $0.32 and $0.18 per gallon of ethanol produced respectively. These costs must be reduced to less than $0.05 per gallon ethanol by 2020 and this requires further increases in specific activity or production efficiency or some combination thereof.

In the next contribution, Miettinen-Oinonen of Finland discusses the use of cellulases in the textile industry for the manufacture and finishing of cellulose-containing material. This use began in the 1980s as denim finishing to create a fashionable stonewashed appearance; the process was known as biostoning.

The book contains numerous other applications. Given space limitations, I will restrict this review to two of them:

- *Application of pectinases*. Industrial applications of pectinases have included fruit juice clarification, wood preservation, wastewater treatment, and coffee and tea fermentation among others.
- *Application of alpha-*L*-rhamnosidases in the chemical industry*. These enzymes are used in the design of low-cost processes for the production of valuable aromatic compounds and flavors.

This review has only touched on a very few of the innumerable uses of enzymes discussed in this book which I feel will prove to be a very valuable reference tool in the field and a beacon for future development.

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23 January 2008

Available online 31 January 2008

doi:10.1016/j.jhazmat.2008.01.068

Risk Assessment for Chemicals in Drinking Water, R.A. Howd, A.M. Fan (Eds.). Wiley Interscience, John Wiley and Sons, Hoboken, NJ (2008). 387 pp., Price: US$ 99.95, ISBN: 978-0-471-72344-8

This book contains important information on methods to produce our most vital resource—water. It was edited by (and contains several contributions from) members of the California EPA with other contributions coming from the U.S. EPA, Canada, and France. In this volume, the authors examine current risk assessment methods for chemicals in drinking water.

The book has the following 14 chapters:

1. Introduction to drinking water risk assessment.
2. Summary of the development of Federal drinking water regulations and health-based guidelines for chemical contaminants.
3. Interpretation of toxicologic data for drinking water risk assessment.
4. Exposure source and multiroute exposure considerations for risk assessment of drinking water contaminants.
5. Toxicokinetics for drinking water risk assessment.
6. Health risk assessment of chemical mixtures in drinking water.
7. Protection of infants, children, and other sensitive subpopulations.
8. Risk assessment for essential nutrients.
9. Risk assessment for arsenic in drinking water.
10. Risk assessment for chloroform, reconsidered.
11. Risk assessment of a thyroid hormone disruptor: perchlorate.
12. Emerging contaminants in drinking water: a California perspective.
13. U.S. EPA drinking water field office perspectives and needs for risk assessment.

14. Risk assessment: emerging issues, recent advances, and future challenges.

In the first chapter, written by Howd, it is noted that the need for a clean and safe drinking water supply has been recognized for more than 2000 years (initially by the Romans). However, it was not until the efforts of John Snow who, when investigating a cholera outbreak in 1854, showed that specific diseases could result from drinking water that appeared to be clean.

Drinking water regulations did not appear in the United States until 1914 and then they only applied to interstate commerce. In 1925, standards for lead, copper and zinc were promulgated. By 1962, 28 constituents were on the EPA's regulatory list. As of 2006, Federal primary standards (MCLs, action levels, or maximum residual disinfectant levels) had been established for 80 chemicals in drinking water. Microbiological contaminants also are regulated. The two editors are also the authors of the second chapter in which they note that "Most of the chemicals of concern in drinking water are widely used or widely distributed in the environment." Although most have been studied extensively, the quality of toxicological data is highly variable.

Writing on risk assessment (Chapter 4), Krishnan and Carrier write: "Health risks associated with human exposure to drinking water contaminants are determined by their intrinsic toxicity and extent of exposure." This evaluation should include intensity of exposure, duration and frequency of contact for each exposure route and source. This evaluation includes air and dermal intake as well as ingestion.

An accurate health risk assessment resulting from multiple-route exposure to multiple chemicals in drinking water is discussed in Chapter 6. And the number of potential chemicals numbers in the hundreds varying with geographical location, source water, disinfection technique, and surrounding land use, i.e., nature or industrial. "Mixtures in drinking water can consist of many chemical classes (e.g., pesticides, pharmaceuticals, metals, organic solvents, and disinfection by-products). Such contaminants may be present in liquid, vapor, or aerosol forms and can enter the body via ingestion, respiration, or dermal penetration."

The current contaminant of current interest (major concern) in the United States (as well as in India where some very high concentrations have been found) is arsenic. Fortunately, most ingested arsenic is absorbed quickly through the gastrointestinal tract and is eventually converted by the liver to a less toxic form and is excreted in urine; it does not tend to accumulate in the body at low exposure levels. However, lower exposure levels can cause a variety of health problems. Higher concentrations, which are more dangerous, have been reported in Bangladesh. At higher levels, arsenic can induce lung cancer. The discussion in this section concludes thusly: "Inorganic arsenic in drinking water represents, possibly, the highest potential risk of any waterborne chemical with the possible exception of radon."

In a forward looking chapter, there is a discussion of contaminants of "emerging concern", i.e., unregulated chemicals such as MTBE, perchlorates, chromium-six, 1,2,3-trichloropropane, and *N*-nitrosoldimethylamine.

With water shortages on the horizon in the United States, cities will be turning more to recycled wastewater to supplement their water source. Currently accepted for use as landscaping, it becomes clear that recycled water will be injected into the drinking water chain. That use makes the material in this book more important.

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23 January 2008

Available online 31 January 2008

doi:10.1016/j.jhazmat.2008.01.069