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ChE book review

ACCIDENT AND EMERGENCY MANAGEMENT

by Louis Theodore, Joseph P. Reynolds, and Francis B. Taylor

John Wiley & Sons, New York, NY 10158-0012; 478+ pages, $65.95 (1989)

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Although the authors state that this book is "intended primarily for regulatory officials, company administrators, (practicing) engineers, . . . industry maintenance personnel, and both undergraduates and first-year graduate students," I believe that it is much better suited as a reference than as a text for chemical engineering students. The primary objective of the book is to provide a diverse audience with a broad overview of the scope and interrelations of the parts and functions of accident and emergency management programs. The authors have been successful in meeting this objective.

The book is divided into thirteen chapters, each with references, a summary, and problems for discussion or homework (or term papers!). The chapters are divided into four parts: an overview of accident an emergency managements (Part I, 76 pages), process and plant accidents (Part II, 181 pages), dispersion (Part III, 142 pages), and hazard and risk assessment (Part IV, 79 pages). The index is reasonably detailed and is easy to use.

Chapter 1, "Past History," presents brief descriptions of early and recent major accidents (Flixborough, Three Mile Island, Chernobyl, Bhopal, etc.) to illustrate the scope and breadth of emergencies for which the reader may need to plan.

Chapter 2, "Legislation," discusses significant Federal laws regarding air and water pollution and hazardous and toxic wastes.

Chapter 3, "Emergency Planning and Response," is a continuation of Chapter 2. It presents brief descriptions and lists some of the items to be considered in the various stages of the development and implementation of emergency response plans. I have used this material as part of a graduate course on chemical process safety for practicing chemical and environmental engineers and safety professionals.

Chapter 4, "Process Fundamentals and Plant Equipment," contains elementary and descriptive material (remember the intended audience) from stoichiometry, thermodynamics, unit operations, and design. This chapter is designed to familiarize the non-chemical engineer with terminology, equipment, processes, and concepts used in examples in Part III.

Chapter 5, "Fires, Explosions, and Other Accidents," presents an overview of fire fundamentals, types, and sources with some physical property data. Appropriate calculation procedures are presented. (Caution: the f_i in Eqs. 5.2.1 and 5.2.2 are not correctly defined; they must be on an air/oxygen-free basis, *i.e.*, a combustibles-only basis.) The sections on fire hazards, and especially on fire prevention and protection, are altogether too brief. The section on explosion fundamentals is overly short and will require consider-

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able supplementation when it is incorporated into chemical engineering course work. The entire realm of toxicology and industrial hygiene has been compressed into three pages which do not refer to the OSHA or EPA standards.

Chapter 6, "Accident Prevention in Process Facilities," focuses on methods of preventing and reducing the frequency and severity of accidents, with primary emphasis on the chemical process industry. It begins with an excellent discussion of the general causes of accidents and proceeds to common specific causes associated with process equipment. This chapter should be required reading for unit operations, process control, and process/plant design courses. The material on relief selection and sizing must be expanded before use. It should be noted that the relief-sizing equations on page 202 are not general; they are only valid for conventional spring-operated reliefs in gas or vapor service.

After reading the material in Chapter 6 on the use of fault trees and HAZOPs, the major difficulty in using this book as a text became obvious. There are no worked examples until you reach Chapter 10.

Chapter 7, "Process Applications," contains very good discussions of five highly toxic and reactive chemicals, each of which can serve as a case study in the techniques of evaluating candidate/alternative procesing routes in plant design courses. Each section (*e.g.,* ammonia) contains physical property data, the exposure limits and human health effects, manufacturing methods, uses of the chemical, and near-catastrophic incidents involving the compound.

Chapter 8, "Dispersion," begins with the development of the dispersion equations involved with momentum, energy, and mass transfer. Classic analytic solutions are given for the PDEs as they would be in any course in transport phenomena.

Chapter 9, "Dispersion Calculations," applies the theoretical equations developed in Chapter 8 to dispersions in water and soil, with primary emphasis on the airborne dispersion of continuous (*e.g,* stack) and instantaneous/puff (*e.g.,* leaks, spills) sources. Factors affecting dispersion in air (meteorologic, effective stack height) are very clearly presented with standard empirical equations. The Pasquill-Gifford approach is clearly presented in adequate detail. The reader will find Figure 9.7.4 especially useful when estimating the location of maximum ground-level concentrations from continuous sources. This chapter also contains very useful information on the effects of aerodynamic downwash and the presence of multiple stacks not usually found outside graduate-level air-pollution texts.

In Chapter 10, "Dispersion Applications," the information in Chapter 9 is expanded in terms of various computer models developed by government (EPA), industry (CMA), and individual companies. These presentations are quite good and describe the limitations, characteristics, input parameters, assumptions, and typical applications of the models. Specific examples are provided for spills on water and soils and for plume rise, continuous and instantaneous point source calculations to match the developments in Chapter 9. The inclusion of particulate deposition calculations is a real "plus," as are those for line and area sources. The examples in this chapter all illustrate the types of calculations needed for emergencies.

Chapter 11, "Hazard and Risk Assessment Fundamentals," is mis-named. It is really a crash course in elementary statistics: probabilities, empirical distribution functions, expected values, and descriptive statistics (means and variances of samples).

Chapter 12, "Hazard and Risk Assessment Calculations," introduces the concepts of reliability and failure rates. The use of a few theoretical (standard normal, log-normal, binomial, Poisson) distributions are included, as are some fault tree and event tree examples.

Chapter 13, "Hazard and Risk Assessment Applications," is illustrated with six examples, including a runaway reaction and dispersion of a toxic chemical from a single point-source release. All these examples, as are the ones in Chapters 9 and 10, are presented in a realistic style. ❐