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Guidelines for use of VAPOR CLOUD DISPERSION MODELS, S.R. Hanna and P.J. Drivas. Center for Chemical Process Safety, American Institute of Chemical Engineers, New York, 1987. 177 pp. $75.00 ($40.00 for members AIChE). Hardbound.

Adress: American Institute of Chemical Engineers
345 East 47th Street
New York, New York 10017

Modeling of episodic releases of hazardous or toxic gas clouds is a rapidly evolving field driven by the need for the chemical industry to prevent and mitigate incidents and the public to evaluate and regulate potential process, storage and transportation hazards. This book is the second project of the new AIChE Center for Chemical Process Safety (CCPS). The stated objective of the authors is to "help facilitate the development and use of dispersion modeling as an everyday tool within the industry, along with an understanding of the limitations of that tool."

The book provides in one publication an overview of vapor cloud dispersion which will act as a primer for the beginning researcher in the field, an introduction to plume physics and dispersion semantics for the manager, and an overview for the expert and a reminder of research needs. The body of the text is broken into five sections: An overview of release scenarios; Source, meteorological and site information required for model input; Source emission models; Transport and diffusion models; and Consequent model validation experience. The two chapters which focus on model structure begin with a general discussion of physical principles followed by a critique of specific models. The

book concludes with a summary of research needs for model improvement. The book is well indexed, contains an exhaustive list of symbols, a reading list of references for those who desire to pursue the topic further, and an Appendix which reports results from model questionnaires received from 33 model builders.

The authors provide a very valuable service for the non-chemical engineer by providing a set of examples of hypothetical hazardous chemical release. These releases are likely to be more realistic for day-to-day plant operation than the catastrophic releases often reported by the news media. Chapter 2 groups these releases into tank rupture, pipe break, and venting of runaway reactions. Appendix B provides details for realistic releases of specific chemicals such as Ammonia, Chlorine, Hydrogen Sulfide, or Acrolein. In Chapter 3 the authors identify critical input parameters such as source, meteorological, site and receptor information which determine the impact of vapor cloud dispersion. Since the models discussed are limited to clouds moving over flat homogeneous surfaces in the absence of obstructions, model predictions may not be realistic near many chemical facilities. The interested reader should also consult the recent reviews by Petersen and Ratcliff (1988) or Meroney et al. (1988) which consider the effects of surface roughness variability, fences, buildings, and water-spray curtains on vapor clouds.

The complexity of source configurations is described in Chapter 4. The source may produce gases from subsonic or supersonic jets, liquid jets or sprays, two-phase gas-aerosol mixtures, boiling pools, and evaporating pools,

which can be composed of single or multicomponent species. None of the models referenced include the additional complexities of post-release phase change, chemical reaction, and aerosol formation associated with releases of such substances as Hydrogen Fluoride. The reader should be warned that slight variations in source temperature and atmospheric temperature or humidity can for such substances result in factors of two variation in initial cloud density (Schotte, 1987).

The longest section, Chapter 5, deals with the physical characteristics of the many alternative transport and dispersion models available. The authors wisely point out that most models are extremely vague about the intended averaging periods for their calculations. Unfortunately most modelers also seem reluctant to report computer resources and time required to run the codes. Some of the model codes are proprietary and are not available for open evaluation. Although the authors list many of the available model programs, they make no effort to critique or differentiate between them, but report only the model builder's self assessment of the capabilities of their own models. The value of the book would be greatly enhanced by reporting results from blind comparisons of each model on a set of standard situations, ie. a model shoot-out in the manner of the famous Computation of Turbulent Boundary Layers Conference held at Stanford (Coles and Hirst, 1968). The review represents the state-of-the-art as of December, 1986, and, as the authors note, more models have appeared, more field experiments have been conducted, and many models have been improved (CCPS, 1987).

Chapter 6 provides a concise introduction to the very important topic of model validation and estimate uncertainties. This often misunderstood topic is at the heart of model improvement and realistic regulatory use of model computations. A short list of research needs is included in a final Chapter 7.

The book was well reviewed for clarity and grammatical mistakes. The writing style is concise and easy to read. The only technical error found was an incorrect vertical scale on Figure 5-6, where V/V_o should be V_o/V.

References

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Robert N. Meroney is a Professor of Civil Engineering and Director of the Fluid Dynamics and Diffusion Laboratory at Colorado State University, Fort Collins, CO.