The sizing of pressure relief systems and their associated effluent handling equipment is probably one of the most academically demanding tasks that will be carried out by practising engineers. It requires a detailed understanding of thermodynamics and fluid flow in all cases and, in some cases, it also requires an understanding of reaction kinetics. Some of the design procedures are an integral part of mandatory or quasi-mandatory standards. Other information has in the past been found only in conference proceedings or published papers. Few practising engineers will have access to all of the published literature and in many cases they will be confused by some of the apparent contradictions in the information that they do have available. A book that seeks to bring together the most appropriate design methods and form a 'one stop shop' for the designer, has been required for sometime. Earlier books such as that by Parry, moved in this direction but this book by the AIChE goes all the way.

The second chapter is particularly useful for discussing all the design methods for sizing pressure relief systems. Although published by an American organisation, the authors have recognised the existence of the rest of the world by citing a wide range of international standards and highlighting the differences. They have also succeeded in reducing, if not completely eliminating, the confusions arising from the different methods of calculating the heat input from a fire.

The third chapter is perhaps the most important since it covers the sizing of relief devices. Unfortunately I found it the most muddled. At times it was the intellectual equivalent of wading through treacle. Much of the problem arose because computer methods were presented alongside hand calculation methods. These methods may have been better presented in separate chapters. The confusion is sadly compounded by a number of typographic errors and confused symbology within the equations. On the positive side, most of the equations presented in this chapter are accompanied by examples and there are a number of explanatory diagrams. Most of the basic calculations that have been carried out using computer software use the programs that are provide in the CD-ROM that accompanies the book. The use of these programs is explained with appropriate examples. Crucially, the book covers two-phase relief along with many of the design methods arising from the $\mathscr{DIERS}$ programme.

The inclusion of computer software tied into the design procedures within the book is, in my opinion, a good idea. However, the exclusion of some hand calculation methods from the book, on the basis that the computer program is the preferred method, is not a good idea. Many people purchasing the book will not have a computer with a CD-ROM drive and/or Windows 95. The hand calculation would allow them to make the calculation even if the results were somewhat conservative. Turning to the computer software included, those familiar with the latest graphic user interfaces will find the programs on the CD-ROM somewhat of a disappointment. However, the authors seem to have chosen a software that is well proven and available at a sensible price.

The second section of the book covering effluent handling systems is well written and easy to follow. It covers sizing the system for the best estimate flow rate rather than the calculated relief flow for relief device sizing. Handling equipment includes gravity separators, cyclones, quench pools, absorbers, release to atmosphere and flare systems. The inclusion of quench pools is interesting because the authors admit that quench pools have not, to date, been used in significant amounts in the chemical industry although they have been used extensively in the nuclear industry. Their inclusion in such an authoritative book will almost certainly change this situation.

This book succeeds in being a 'one stop shop' with design methods covering all aspects, discussions on the acquisition of design data, methods of estimating the physical properties of mixtures, detailed references, a glossary of terms plus the inclusion of computer software. In my opinion, this book will become the 'Bible' for designers of relief systems and may become as ubiquitous as Perry.

In spite of the gripes, my verdict is, "Buy it".

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Atmospheric Dispersion. European Process Safety Centre, Institution of Chemical Engineers, UK, 1999, 320 pp., hardback, £99.00, ISBN 0-85295-404-2.

Process safety and loss prevention are matters of interest to all, and the European Process Safety Centre, therefore, aims to link industrial R and D forces in these areas. As part of this work the EPSC has translated one of several safety guidelines written by the Union de Industries Chimiques. The resulting book gives a broad introduction to dispersion of toxic and flammable gas clouds including the phenomenon of heavy-gas dispersion where horizontal spreading is driven by gravity and vertical mixing is reduced by density stratification (www.risoe.dk/vea-atu/densegas). The book is written for the risk engineer, who needs to understand the concepts and limitations of dispersion models, related source models and mitigation methods. It also discusses application of wind statistics and how to assess spatial distribution of the risk.

The use of meteorological data is illustrated by a 30-year wind climatology supplied by a national meteorological office. The chosen data set is clearly influenced by local topography, and it would have been natural to discuss how to correct for flow distortion and how to predict the wind speed distribution at a location with different local topography. Such methods are currently used for wind turbine siting (www.wasp.dk).

Pure gas phase emission is described by compressible fluid mechanics, and semi-empirical models describe jets, including heavy-gas jets with 'ballistic' trajectories. Models describing two-phase outflow or pool evaporation are for some reason not included. Heavy-gas dispersion is both described by the simple box model and by 3-D models with k–e turbulence closure and a variety of computational grids. Essential model equations are included but readers unfamiliar with these topics will probably have to consult the original works to understand all details.

The model recommended for passive dispersion is the traditional Gaussian plume model with dimensions parameterised by atmospheric stability classes, i.e. a French version of the classic Pasquill classification scheme simplified to two classes only. The authors are probably on safe ground when they promise that such a model could run on a PC in less than 15 min! Concentration fluctuations are ignored and the time-averaging effects on plume dimensions and centreline concentrations are included only as an empirical correction to the width of the Gaussian plume. The wind and turbulence fields are implicitly assumed to be steady and horizontally homogeneous, and the technique of linking Gaussian dispersion calculations to computer simulated flows over mountains or coastal areas is not mentioned. Nor is the fact that the research community generally prefers to parameterise Gaussian plume model by turbulence and similarity scaling ([1]).

A wide range of available computer programs is listed, but some of this information is obsolete. At least two of the listed heavy-gas box models are now able to calculate dispersion of two-phase mixtures or chemically reactive mixtures, and there have been suggestions for box models describing heavy-gas dispersion in simple topography or in the presence of obstacles. The checklist with criteria for selection of dispersion models is quite useful, but it is less certain that the principles of model validation are of general interest to safety professionals especially when this discussion is purely philosophical without reference to statistical model evaluation methods ([2]).

The authors emphasise numerical modelling and include only a brief introduction to dispersion experiments. Bag sampling and subsequent gas chromatography is described, whereas the time resolution offered by fast-responding concentration sensors and computerised data acquisition is ignored. This is unfortunate because data with temporal resolution question fundamental assumptions behind the recommended models. It is known that

1. the variable wind direction in the atmosphere sweeps the gas plume from side to side;
2. the centre-line concentrations in the sweeping plume are much higher than those of the long-time averaged one;
3. the time needed for the time-average concentration field to become truly Gaussian may well be longer than the release duration; and
4. peak concentrations are significantly higher than the average concentration.

Sampling problems like the effects of instrumental smoothing or difference between the ensemble average and the individual experiment are ignored. It is a pity that none of the recent EU-funded research projects ([3]) are mentioned.

The scaling laws of wind-tunnel simulations are summarised in brief, however, without mentioning the difficulties of simultaneous scaling of flow dynamics and heat transfer from the ground to a cold gas cloud. Both laboratory ([4]) and field experiments ([5]) show that the heat transfer to the typical pressure-liquefied gas release significantly alters the integrated cloud buoyancy during the dispersion.

Finally, it seems unnecessary to include a 14-page monograph with results of the relatively simple Gaussian plume model. The reader would probably prefer to download such information from the EPSC home page (www.epsc.org).

The information is generally sound but not up to date, i.e. the average publication year of the cited references is 1979 and there is only a single one after 1990. The new risk engineer gets an overview of basic concepts, but should be warned that in many respects the information is yesterday's state of the art.

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