e) **STRETCH: Scales either of both of the P, T axes relative to the composition axis for ease of viewing.**

f) **HELP: Summons the HELP text.**

g) **RESET: Voids all previous manipulations and resets the system to the beginning of the program.**

h) **SNAP: Produces a hard-copy image of the screen on a nearby plotter.**

i) **EGRESS: Allows the user to terminate his or her session.**

j) **T-X, P-X, P-T: Each of these windows allows a particular highlighted "cut" of the phase diagram to be chosen by the user as shown in Figure 3 for a T-x cut at 0.03 bars for the system methane-carbon tetrafluoride, and in Figure 6 for a P-x cut at 259.9K for C_5F_{12}-pentane.**

k) **CUT: Produces a P-x, P-T or T-x "cut" displayed alone (i.e. not superimposed on the whole phase diagram) depending on which of these three windows (P-X, P-T or T-X) was last active. Multiple cuts (of P-x at different temperatures for example) may be displayed simultaneously.**

l) **Produces an x-y plot at constant temperature, as shown in Fig. 5 for the system C_5F_{12}-pentane at 247 K.**

A 16mm movie lasting approximately thirteen minutes has been prepared to illustrate the capabilities of this graphics package; this was presented at the 1983 AIChE annual meeting in Washington, D.C.

SUMMARY

The interactive graphics package illustrating the phase behavior of binary mixtures which has been described in this paper has been used within the chemical engineering curriculum at Cornell since the fall semester of 1982. It has proven to be extremely popular with the students, and has raised the level of comprehension of this potentially difficult subject above that achieved previously using conventional means. The major advantage lies in the suitability of computer graphics as a means of visualizing three-dimensional objects (here the PTx phase space) ; the capability of the hardware to perform rapid and continuous rotations of the image; and, perhaps most importantly, the opportunity to interact, manipulate and control the image observed on the screen, brought about by flexible "user-friendly" software. All these features combine to contribute to the success of this technique in undergraduate instruction. □

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ChE book reviews

FOUNDATIONS OF BOUNDARY LAYER THEORY FOR MOMENTUM, HEAT AND MASS TRANSFER

by Joseph A. Schetz
Prentice Hall, Inc., NY (1983)

Reviewed by
O. T. Hanna
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This book on Boundary Layer Theory is indicated by the author to be applicable for students in mechanical, aerospace, chemical, civil, and ocean engineering. Some people would doubt that anyone could succeed in such a broad task. The author's stated goals for this book include (i) providing an understandable coverage of advances in turbulence modeling, (ii) presenting application of large digital computers to boundary layer problems, and (iii) treating mass transfer in an integrated manner with momentum and heat transfer. It would appear that the first goal has been met reasonably well; achievement of the second goal is questionable, and the third goal has definitely not been met to the satisfaction of chemical engineers.

The book is generally well written and well-organized. The coverage of laminar flows includes chapters on integral and differential equations of flow together with approximate integral solutions and exact similarity solutions. Unfortunately almost all of this material is available in a number of other sources and hardly any of it is more recent than 1960. The meager coverage of mass

transfer is likely to be of little interest to chemical engineers. Chapters 4 and 5 do contain some useful discussions of numerical solutions of boundary layer problems. However, there are no example problems or computer programs.

The major contribution of this book would appear to lie in Chapters 6 through 9, on turbulence modeling, which constitute more than half the length of the book. This material includes a useful historical perspective and spans the complete range of engineering approaches in this area up to the present time. The chronological discussion of work in turbulence modeling beginning with early mixing-length theory and progressing up to algebraic and various partial differential equation models should be of interest and value to chemical engineering. This discussion also integrates well the contributions to modeling from both experimental and theory.

In summary, the present book seems somewhat disappointing in its treatment of laminar boundary layers, but in contrast it contains material on turbulent momentum transfer which should be of interest to chemical engineers. In this context the book can be recommended as a useful reference. □

INDUSTRIAL HYGIENE ASPECTS OF PLANT OPERATIONS

by L. J. Cralley, L. V. Cralley, and J. E. Mutchler
Macmillan Publishing Company, New York, 1984: $60.00

Reviewed by
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This is the second volume of a new three-volume series that is being prepared to provide recognition, measurement, and control of potential hazards normally present in various industrial plant operations. The first volume covered process flows while the third volume will treat equipment selection, layout and building design.

This volume, divided into two major sections of unit operations and product fabrication, encompasses a broad range of industries with authoritative information contributed by specialists from these industries. In the first section twenty-three contributors discuss unit operations as distinct entities along an industry-wide concept. Some of the unit operations considered include filtration, clarification, mixing, blending, grinding, and spray, vacuum, freeze and fluidized bed drying. The second section includes thirteen contributions which cover the operations and procedures for assembling parts and materials into final products. The industries considered in this latter survey range from such basic industries as storage battery and tire manufacturing to the high technology industries of semiconductor and liquid scintillation counter manufacturing. One may argue with the manufacturing processes that were selected by the editors; however, the breadth of the selected processes and the hazards associated with these processes should provide a good introduction to the hazards associated with those manufacturing processes that were not included.

Even though most contributors to this second volume have adequately described each step in the unit operations and product fabrication flow of a specific manufacturing process and have included a discussion of the various health hazards that may be encountered with suggestions for their monitoring and control, many engineering readers will be disappointed by the qualitative approach taken by the contributors to this important subject. Only a few of the chapters in the volume have included quantitative information that would be necessary in the design and construction of process equipment that minimizes or eliminates identified industrial hygiene hazards. Where such quantitative information is included, it is generally quite sketchy and incomplete forcing the design engineer to consult other literature sources. Unfortunately, no guidance to such quantitative data is included by any of the contributors. Chemical engineers will also be somewhat disappointed in this volume because the "unit operations" portion of the title implies that some of the contributions will examine the conventional unit operations associated with heat, mass and momentum transfer. However, many of the key unit operations such as distillation, absorption, extraction, evaporation, heat transmission, etc. found in most typical petroleum and chemical processing plants have not been included.

Nevertheless, this volume does manage to bring together a wealth of experience in a broad range of industries and will aid engineers, managers, and industrial hygienists to more fully recognize potential hazards of industrial processes. This, in turn, will permit these professionals to evaluate such hazards and take the necessary steps to effectively control the problem. □