## TROUBLE SHOOTING PROBLEMS

**Continued from page 92.**

receive a written answer immediately from the instructor. With the group format, the students choose a chairman whose role is to focus discussion on what question they want answered and forward the question through to the instructor for his response. About one tutor or instructor is required in the room for every ten students.

What problems do we use? We have an initial set of about 15 that we developed from our industrial experience. Now our former students send us sufficient industrial problems each year to supply new situations and challenges for subsequent classes. A set of such problems is available. We are currently exploring the appropriateness of running these sessions at the plant in a local industry, using problems they encountered and interacting with plant personnel.

The advantages of this approach are that the students begin to appreciate the cost implications of their decisions, and they can ask any question they like. There are two extreme approaches to solving these problems: the Kepner Tregoe approach (where the focus is on discovering when in time some change was made to cause the fault [11, 12, 13] and the hypothesis generation approach where all the current evidence is analyzed, alternative causes are created and most likely alternatives are tested. This format allows the student to use either method or a combination of these methods to solve the problem.

The main difficulties the students have are that they cannot accurately estimate the time required (and hence the cost) to answer some of their questions, they usually are not very organized in their approach to solving this type of problem, and they rely almost entirely on the hypothesis generation approach. To overcome some of these difficulties we have listed time and cost estimates for many commonly performed analyses, experiments or equipment modifications. To try to discover how to improve their approach to solve problems we have started a separate project. Details of this approach are available elsewhere [14, 15]. □

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## ChE book reviews

### CHEMICAL AND ENGINEERING THERMODYNAMICS

*By Stanley I. Sandler*
*John Wiley & Sons, N.Y.*
Reviewed by C. M. Thatcher
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Prof. Sandler sets forth two specific objectives in the preface to his book. The first is to provide a modern textbook, particularly relevant to other courses in the curriculum, for an undergraduate course in chemical engineering thermodynamics. The first part of this objective, at least, has been met in a most commendable fashion: The subject matter is up-to-date and the coverage is impressively thorough.

The desired relevance is also evident, though subject to one's own interpretation of relevance at the undergraduate level. Specifically, the text includes two appendices which treat pertinent principles from the microscopic viewpoint encountered in transport phenomena. It also presents the familiar balance equations in time-derivative form. And, finally, it relates thermodynamics to reaction kinetics and mass transfer to a somewhat greater degree than do most other, similar texts already on the market.

This leaves the question of the text's suitability for undergraduate use and of Prof. Sandler's stated objectives pertinent thereto: To organize and present the material in such a way that the student might obtain both a good understanding of principles, and proficiency in applying these principles to the solution of practical problems. Hopefully, he meant to imply the book's use by a competent instructor to achieve this objective. The typical undergraduate student would not get very far by self-study alone.

The first five chapters take up the thermodynamics of pure fluids. The material is well-organized, and includes numerous example problems. However, a few familiar topics—such as the Rankine cycle and turbine efficiency—appear only in end-of-chapter problems. Perhaps this exemplifies the statement that "Steady-state processes are of only minor interest in this book." The prevalence of such processes in industry makes this statement really surprising in a text which claims relevance as an objective.

It is the remaining four chapters, devoted to the thermodynamics of multi-component systems, which perhaps reveal Prof. Sandler's primary interest and orientation. Here, one finds extensive theoretical discussion and mathematical derivation, with but few of the illustrative problems which characterize Chaps. 1 through 5. For example, fugacity is first introduced on page 337, and an f/P plot appears on page 349; but the first of only two illustrative problems involving fugacity is on page 375. It is also noteworthy that most of the end-of-chapter problems for Chaps. 6 and 7 are of the "prove," "derive," or "show that" variety. Practical application is largely deferred to the Chap. 8 and 9 problems.

The order of theoretical development has interesting consequences with respect to some topics which are conventionally treated as being closely related. Henry's Law, for example, is introduced in Chap. 6, while Raoult's Law first appears in Chap. 7. Similarly, heat of reaction calculations, developed in Chap. 6, are finally applied to adiabatic reaction temperature problems in the concluding pages of Chap. 9. The only end-of-chapter problems involving heat of reaction are also to be found in Chap. 9, not in Chap. 6.

A few additional, specific observations may be of interest. (1) The existence of SI units is acknowledged initially but then essentially ignored thereafter. (2) Tables and charts are scattered throughout the book, making them hard to locate for reference purposes. (3) The extensive use of functional notation—e.g., H(T,P) vs simply H—tends to obscure the significance of relationships in which it appears. (4) Computer algorithms might have been offered for some practical applications—e.g., flash vaporization—which, instead, are dismissed with little or no consideration because the calculations are "quite tedious."

In summary, the text is not just a new version of the conventional approach to chemical engineering thermodynamics. It is distinctly different, and gives one considerable insight into the particular approach favored by its author—i.e., emphasis on rigorous theoretical development. Among those who espouse the same approach, the book may well be hailed as a long-awaited solution to the textbook problem. Only their post-use reactions, and those of their students, can establish the extent to which Prof. Sandler has actually achieved his stated objectives.

Unfortunately, there seems to be little consensus among thermodynamics instructors regarding the approach—and therefore the text—which is most likely to produce optimum levels of student understanding and proficiency. It follows that Prof. Sandler's text is not likely to be widely adopted by those who strongly prefer a more pragmatic approach to thermodynamics, nor will it prove wholly suitable to all who may adopt it, with reservations, on a trial basis.

Prof. Sandler should be prepared for the distinct possibility of disappointment if he was seeking popularity as evidenced by widespread adoption. One suspects, though, that he sought instead to write a good book to meet the needs of those, however many or few they be, who share his views re the most desirable approach to teaching chemical engineering thermodynamics. This he has done. □