has available. I have tried to consider options as to how to reduce the time that they, and I, spend on the course. However, everything I have considered would significantly reduce the learning experiences of the students.

Short problems certainly could reduce grading time since graduate students could do the grading. However, they do not show how every decision made in the scope affects the result. They don't illustrate the interrelation of all parts of the design. By failing here they don't succeed in illustrating the total process of design. They are often single answer problems. They usually tend to be nothing but extensions of the types of problems given in other courses. There is also a tendency of short problems to provide the students with all the required information rather than forcing them to find most of it. This will not prepare the student for the vaguely defined problem with little or no data which he will confront in industry or government.

Some instructors feel time may be saved by using a computer program to do routine calculations. This certainly is true in industry where numerous calculations of the same kind are frequently repeated. However, before any computer program is used, all the assumptions must be understood so the program is not misused, and the format for entering data into the computer must be learned. Each of these takes time. The former takes the most time. Since most calculations are not repeated very often and various good sources of quick estimates are available [1, 2, 3] it does not appear that any time is saved. The potential loss is that the student doesn't have to review previous course material. Students will very happily plug into programs without trying to understand them. This prevents them from achieving one of my secondary goals, reviewing previous course material. They will also happily spend hours manipulating the programs. This time could be more profitably spent elsewhere.

With computers a more accurate, consistent design will result. It will be much easier to make changes, to perform numerous sensitivity analyses, and to optimize the design. None of these, however, are goals for my course. It is important for students to understand that these tasks can be done; however it is not necessary this be done in the context of the total plant design. These goals can be achieved just as well with simpler examples where the concepts do not appear as mysterious.

In summary, the major goal of the course is to give the student an understanding of the process called plant design. This is done by having the student perform a plant design and by completing the design the student shows he has obtained this understanding.

In addition to the major goal there are also many important secondary goals. These are:

- **Learning to work with others.**
- **Improving report writing.**
- **Improving oral presentations.**
- **Learning to find what is available in the chemical engineering literature.**
- **Learning to obtain answers when little data are available.**
- **Correcting mistaken concepts.**
- **Reinforcing course material to which they have been previously exposed.**
- **Learning there is more than one way to approach a problem and there usually is more than one solution.** □

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ChE book reviews

LABORATORY ENGINEERING AND MANIPULATIONS

By E. S. Perry and A. Weissberger
John Wiley, 1979

Reviewed by John R. Hallman
Nashville State Technical Institute

For the individual who has acquired a chemical (2-year associate) degree (engineering oriented), the chemical engineering technician or the graduate chemist with mechanical ability, this book would serve well in the intended use. However, for the chemist who is not mechanically oriented, usage would be limited; but with careful study the latter person could use the material in

Continued on page 41.

obtain more data, while recognizing that they tended to defer decisions, sometimes longer than necessary.

EVALUATION

IN GENERAL, THE STUDENTS react very favorably to the course. They indicate that they are motivated because the problems are real and because the approach to the design process is applicable to the projects the students would encounter after graduation. The optimum atitude is typified by one student's comment; "I don't consider this work as course work anymore; it's something that I want to do." While some students feel that the time spent on group dynamics should have occurred after the design projects were assigned, all students felt that they had increased their self knowledge and their interpersonal relations during the personality typing portion of the course.

The industrial users all indicate a willingness to participate in the next iteration of the design course. They perceive the advantages of the course as 1) inexpensive engineering effort, 2) good corporate publicity and 3) an opportunity to evaluate potential employees. Within the limitations imposed by the effort, each company considers the group work comparable to that by new engineers working for them.

From the professor's standpoint, this type of design course has several benefits in addition to those previously mentioned. The students view the professor as a resource, not an adversary, to accomplishing the design project. The professor does not need to be the final expert on each design project, as he has the operating company as help with evaluation, guidance, and grading. The student's grades were based upon each company's judgments of the written and oral reports, peer evaluation by members of each student group, and evaluation based upon weekly oral reports and project notebooks.

The initial success of this course has aided in carrying out other iterations. The work done with the former companies was the basis for approaching other nearby companies for other real-world design projects. It is hoped that the benefits to the students as well as the benefits to industry will encourage wider interaction between academia and industry in the future.

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REVIEW: LAB ENGINEERING

Continued from page 29.

laboratory problems. I found the book to be well written, topical and of practical use for the engineering type laboratory systems. The typical chemical research laboratory would greatly benefit if the ideas contained in the book were used in systems design.

Specific comments on each chapter are:

Chapter I: Well written, good illustrations, good descriptions, good compilation of usable data.

Chapter II: Easy to understand if one is mechanically oriented; could use a few more illustrations rather than only written descriptions. I believe there is almost too broad a subject matter covered in so few pages. Basic calculus used.

Chapter III: Good description of topic, good illustrations and practical. Would be useful to lab person with a grinding problem, etc. Some calculus used.

Chapter IV: One of the best written chapters in the book. Excellent descriptions and diagrams for the pumping of fluids. Very practical with good ideas for help in the laboratory.

Chapter V: The only thing this chapter needs to be 100% are a few more diagrams of the techniques. Excellent.

Chapter VI: An excellent summary of a very difficult theoretical subject, but written for the lay person. Very useful in any engineering laboratory experiment or process system. Good illustrations.

Chapter VII: For the mechanical type laboratory oriented research person, this is a most practical chapter. Excellent descriptions and illustrations; most useful to anyone engaged in vacuum processing and systems design.

Chapter VIII: Good treatment of very complex subject matter. Simultaneous mass and heat transfer is not the easiest subject to learn or to adapt the theory to practical usage. This is the most difficult material for the non-engineer to understand unless the user has an excellent background in mathematics and good mechanical aptitude. Would suggest that whenever possible, more diagrams and sketches be added to simplify the material. Extensive calculus used.

Since all chapters are written by different authors, it is suggested that in the next edition a section be added that lists all of the nomenclature for all chapters.

In comparing the stated role of the book against the included techniques in the included chapters, it is found that in some instances there is little laboratory technique discussed. Also, the level of mathematical derivations is not consistent in the several chapters. □

PROCESS DESIGN SEQUENCE

Continued from page 37.

than they have seen before.

It is almost commonplace now to emphasize the importance of communications in professional advancement, and, at the risk of being trite, I must add my endorsement. Design courses usually require good report writing which students usually detest as an apparent over-emphasis on what they see as style as compared with substance. If anything is true, there must be more emphasis put on good writing and speaking. Facility in these areas is far more useful in practice than glibness with the computer.

Finally, one of the first skills a chemical engineer learns is how to do material and energy balances. These are also among the first steps in most design exercises. I feel strongly that these steps should be among the first in nearly any engineering assignment associated with processes. It may sound obvious, but it is too often forgotten how useful a simple balance can be in operations and research. Many of the steps taught in design sequences really do have other applications, and students should learn that fact.

In general, the chemical engineering taught in universities is more sophisticated than that practiced in many industries. Certainly, this is true for the food industry! Are students over-educated, as one might be tempted to say? I do not believe so.

Chemical engineering, culminating in the design sequence, is a grand education in analytical skills, modern science and technology. It is interesting enough to attract intelligent students and challenging enough to stimulate even the best. Furthermore, the influx of new concepts brought by products of this fine education will gradually change the industries they join. Far better that education continue to stress the new and sophisticated than the old and familiar—how else will we ever grow?

Having now been on both sides of the process design course "debate" (if there is such a thing!), I feel strongly that a varied, challenging and comprehensive course is essential to a complete chemical engineering education. I tried to provide such an experience when I taught and I look for the results in those I hire today. □

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