ChE **book review**

PLANT DESIGN AND ECONOMICS FOR CHEMICAL ENGINEERS

4th Edition

by M. S. Peters and K.D. Timmerhaus; McGraw Hill, Inc., New York, NY 10020; 910 pages, $60.45 (1990)

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The fourth edition of this classic text retains the same layout and philosophy as its predecessors. The first third of the book covers the principles of process design development and plant design and safety in four chapters: 1-Introduction, 2-Process Design Development, 3-General Design Considerations, and 4-Computer-Aided Design. The second third of the book, economics, is covered in the next five chapters: 5-Cost and Asset Accounting, 6-Cost Estimation, 7-Interest and Investment Costs, 8-Taxes and Insurance, 9-Depreciation, and 10-Profitability, Alternative Investments, and Replacements. The remaining third deals with the technical design problem: 11-Optimum Design and Design Strategy, 12-Materials Selection and Equipment Fabrication, 13-The Design Report, 14-Materials Transfer, Handling, and Treatment Equipment: Design and Costs, 15-Heat Transfer Equipment: Design and Costs, 16-Mass Transfer Equipment: Design and Costs, and 17-Statistical Analysis in Design. Chapters 11, 17, and 13 could be dealt with, in that order, as a sequence in setting up and representing the solution to a design problem.

Most of the solved problems and most of the charts still use engineering units despite the stress on SI. Surely the sample problems could have at least incorporated both sets of units, since this was a problem with the third edition and the authors have had ten years to work on it! To the authors' credit, many of the unsolved problems at the end of each chapter are in SI. The extensive lists of references at the end of each chapter that added to the utility of the third edition have been deleted in this edition. Perhaps these will be compiled and added as an appendix in a future printing. They will be sorely missed in this one.

The first two chapters remain unchanged from the third edition, with no new problems. The third chapter has been greatly expanded with much new material on health and safety hazards, including sources of exposure, exposure evaluation, exposure hazard control, fire and explosion hazards, personnel safety, and safety regulation. In each of the subsections, relevant material on measures and standards of hazards, measures and standards of safety, and pertinent references to codes and regulations and the agencies which administer them have been made. A new section on HAZOP studies has been added which is clear, concise, and comprehensive, and the material on environmental protection and pollution control has been updated. The rest of the chapter is generally unchanged, with the exception of the section on patents, which has been streamlined. There are twenty-five new problems at the end of this chapter on hazard prevention which are simple, but instructive. Many of them have been adapted from *Safety, Health, and Loss Prevention in Chemical Processes: Problems for Undergraduate Engineering Curricula* (copyrighted by the AIChE in 1990).

Computer-Aided Design, Chapter 4, is a concise, comprehensive, well written and referenced section on the various aspects of computer-aided design and covers everything from the use of spreadsheets in material and energy balance calculations to flowsheeting software. The eight problems at the end of the chapter vary from fairly straightforward material and energy balances to fairly complex evaluations of alternative process designs.

The material in the economics section of the book is virtually unchanged, with the following exceptions: the section on evaluating interest has been expanded into a chapter with fifteen elementary but illustrative problems at the end, and one new problem each has been included at the end of Chapter 6 and Chapter 8 (neither is complex). A section on the accelerated cost recovery system (ACRS) and the modified accelerated cost recovery system (MACRS) has been included in Chapter 9, along with three related unsolved problems and a solved sample problem. Some of the unsolved problems at the end of the chapters in the third edition have been deleted here.

All the cost data and charts have been updated. Some of the charts for costing are now smaller than their predecessors and thereby are harder to interpolate. The example on reactor design has been updated and includes programs in BASIC, FORTRAN, and PASCAL. There are no new problems in this section of the book. Five new unsolved practice session problems have been included in Appendix C.

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$$(2.31 \pm 0.26)\exp(-1.31 \pm 0.08)$$
$$= 2.31\exp(-1.31)$$
$$\pm\left\{[\exp(-1.31)\times 0.26]^2 + [-2.31\exp(-1.31)\times 0.08]^2\right\}^{1/2}$$
$$= (0.6233 \pm 0.0861)$$

Summary of Suggested Approach to Calculating and Expressing Uncertainty in Decimal Numbers

1. All mathematical numbers such as e, etc., should be expressed using the significant numbers convention.
2. Enough extra digits should be carried in all arithmetical calculations that the rounded result would not be changed if more were carried. This usually requires two or three extra digits.
3. The significant numbers convention should never be applied for the purpose of expressing uncertainty in measurements or the results of calculations on them.
4. Measurements and the results of calculations on them should be presented by showing the decimal number plus or minus its uncertainty. The best way to determine this uncertainty is by statistical treatment of the data. Many people will, however, use their engineering or scientific judgement, formally or informally, to establish it.
5. The uncertainty in the sum or difference of uncertain numbers is found as the square root of the sum of the squares of the uncertainties in the individual numbers.
6. The relative uncertainty in the product or quotient of uncertain numbers is the square root of the sum of the squares of the relative uncertainties in the individual numbers.
7. Providing the numbers used in expressing uncertainty are arithmetically correct, there is no harm except awkwardness in showing too many figures; if too few are shown, however, the uncertainty may not be shown precisely enough. Ordinarily, the uncertainty should be shown with two to four arithmetically-correct figures, disregarding leading zeros, and the number itself shown with a total number of figures to conform with the uncertainty.

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REFERENCES

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Some of these have been developed from previous AIChE Student Contest Design problems. They provide the instructor with a good source of fairly complex class assignments that he or she can then build upon. The student may be able to use these as practice problems in order to prepare for a design contest problem.

Although this book is as complete a design text as is possible in a single volume, it is intended to supplement coursework rather than take its place. This leaves each design instructor many opportunities to embellish the material and give his or her design course its own distinct flavor and personality. What this text does not do (and does not claim to do) is emphasize the importance of choice in design: the alternatives involved in defining the problem, good and bad design choices and how to tell the difference between them, and process integration alternatives and how to evaluate them. Design problems in the less traditional areas of chemical engineering, such as bioseparations, polymers, pharmaceuticals, or food, could be presented in order to give the student a realistic idea of the variety, complexity, and inherent similarity of design issues in chemical engineering practice. The text does not stress the importance of thermodynamic principles in good process design and with the exception of the HAZOP study, neglects the importance of the principles of process control. The instructor must take over where the book stops.

Plant Design and Economics, in its fourth edition, ntinues to provide a comprehensive source of esign principles and information that could be use to both students and professionals. As a text, it includes a wide variety of instructive problems, both solved and unsolved, and many charts, logic flowsheets, and worksheets which aid the student in setting up and solving a design problem. The text is lucid and readable. It serves as an excellent aid to teaching a one- or two-term design sequence as well as a handy reference of up-to-date information on regulations and cost. This would be a good text for someone who does not already possess the third edition. We would recommend this text to an owner of the third edition because of the updated and expanded material. We would be happier still if an updated bibliography were included and dual units were incorporated in a future printing. This text remains an excellent buy in terms of value for money. ❐