1988 was reduced by 38% in the present subscription year. Each month, the number of pages ready for publication is published so that individual issues may vary widely in size. Thus a 250 page issue may be followed by a 1000 page issue in the next month, and so on. Any single issue which Dr. Levenspiel uses in his comparison is therefore likely to distort the results.

4. [sic] Furthermore, the comparison with CES is further distorted by other erroneous information. I cannot directly comment on the difference in subscriber bases and cannot comment on the differences in publication methods, except to say that unless a complete analysis of the subscriber bases and international markets are [sic] made, no cost comparison can be made. For example, a society publication, say, may have other sources of editorial funding such as page charges or distribution methods such as bulk society purchase would no doubt have other ways of generating revenue which would supplement the subscription price. Some publications accept advertising and are distributed on a controlled circulation basis, while others are not. In any event the scopes of the publication are quite different. Chemical Engineering Communications provides "a forum for the rapid publication of papers in all areas of chemical engineering." A recent issue of CES states in its scope "The object of the journal is to publish papers dealing with the application to chemical engineering of the basic sciences and mathematics...."

The other areas of distortion in a valid comparison can include such factors as complexity of typesetting and quality of materials. For example, CEC offers free publication of color photographs as well as other special services. In addition libraries subscribing to CEC can, for an additional nominal $5 per volume receive a photocopy licence [sic] allowing them unlimited photocopying thus providing a very low cost of dissemination.

The true current cost to subscribers of CEC is about half of that quoted in Dr. Levenspiel's letter and compares favorably with other commercial, international journals. In a major pricing study recently prepared by a major university library system our company was ranked 18th.

In fact, we are quite concerned about the current library budget crisis. We have been trying for some time now to find a way to defer or lessen the effect of inflation and currency problems on our regular subscribers. We are enclosing a press release of a program which we are announcing to further reduce the costs to existing subscribers. Our prices, after adjustment for changes in numbers of pages, have increased only 10% in the last three years despite a higher inflation rate and a falling dollar. Unfortunately, damaging false analyses like Dr. Levenspiel's serve only to raise prices by reducing units, not to lower them.

We work in an intellectual area with intellectual product and try to orient our services to the needs of the community. Libelous attacks made without fact or knowledge and without verification like those of Dr. Levenspiel serve no useful purpose in this enterprise.

Martin B. Gordon
Gordon and Breach, Science Publishers, Inc.

Editor's Note: The Press Releases enclosed with the above letter describe a "Subscriber Incentive Plan" (SIP) that would result in 10-20% discounts when certain conditions are satisfied. A basic membership earns a 10% discount which will be automatically granted for the 1988-89 period, with future discounts dependent on membership in SIP; a 5% discount voucher "credit memo" good on future renewals will be extended with enrollment in the SIP; and an additional 5% discount is offered to the subscriber if the order is placed through their preferred agent, STBS. The offer will initially be restricted to North American libraries.

DIRECT CONTACT HEAT TRANSFER
by Frank Kreith and R. F. Boehm
Hemisphere Publishing Corp., 1988

Reviewed by
Joseph J. Perona
The University of Tennessee: Knoxville

The term "direct-contact heat transfer" denotes the physical contacting of media for heat exchange purposes in the absence of a separating barrier, such as a tube wall. Some applications are quite old, e.g., cooling towers and barometric condensers. The concept is not mentioned by such modern textbooks on heat transfer as those by Lienhard and by Incropera and DeWitt. A chapter is devoted to it in Kern's book, published in 1950.

Direct contact operations are fundamental to chemical engineering. Nearly all mass transfer processes are direct contact operations. From an analysis or modeling standpoint, direct-contact heat transfer is not significantly different from nonisothermal mass transfer, unless radiation is important. The state-of-the-art is the same. For transfer between fluid phases, interfacial areas are usually not known and experiments produce volumetric coefficients, in which the transfer coefficient and interfacial area are lumped together. Similar contacting devices are used. Since mass transfer inevitably accompanies direct-contacting, its extent must be evaluated in any heat transfer application. It may or may not be desirable for the objectives of the operation.

The primary advantages of direct-contact heat transfer over surface exchangers are the elimination of

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per week for twenty-six weeks is scheduled (78 hours). It is estimated that the total time that the students spent is closer to double this figure. However, the nature of these projects is such that much of the time must be spent at the end of the final term, which is, of course, when it is the most scarce. We were concerned that the students would be unable to complete the projects in the available time. This is probably the largest risk in such a venture. A high degree of success was achieved, however, with most students meeting the objectives of the work and producing a piece of laboratory equipment which worked. Shortfalls in the program occurred in testing and preparing detailed laboratory procedures. In most cases, additional work is needed in these areas so that the experiments can be used routinely in the undergraduate laboratory.

**Scheduling**

The time for equipment which was slated for upgrading and which was also part of a current laboratory course required careful scheduling. Fortunately, only one project (packed column gas absorption) fell into this category. We found that it was necessary to run all the laboratory course experiments on packed column gas absorption in one time block at the beginning of the first term. Once this was accomplished, the equipment was turned over to the thesis student and the upgrading proceeded without interruption.

**Type of Student**

The laboratory projects require that a student have a certain degree of mechanical know-how and dexterity. Since technologist time is limited, a major amount of actual construction is necessarily performed by the student. There were a few students who lacked basic skills in this area and who had no interest in learning them. The result of this situation was that the faculty member had to put in a fair amount of time doing the actual construction.

**Research Aspect**

One disadvantage of this type of project is that students wishing to pursue a post-graduate degree will not be exposed to some of the concepts or techniques of research. There is no doubt that development of skills in the areas of literature searches, experimental design and general research philosophy suffered. However, development of other skills relating to equipment construction, communications and general project management is also important in research.

**SUGGESTIONS**

In contemplating this type of project, the following important points should be considered:

- Only do as many projects for which there is adequate funding.
- The larger projects would probably be more successful with two students working together instead of only one.
- Do not have only laboratory-type projects available; research or theoretical projects should be provided for those students who have no interest in a laboratory project.
- Ensure that enough technical help is available. Machinists, plumbers, and electricians are necessary resource people.

**CONCLUSIONS**

An alternate approach to the undergraduate thesis has been described. This approach lies somewhere between the traditional research-oriented thesis and the work normally done in a process and plant design course. The size of our senior class has made it possible for us to offer this experience to all members of the group. In a large institution it would still be possible to adopt this scheme, but with a smaller percentage of the seniors. While a strategy of this sort is neither desirable nor feasible to implement on a continuous basis, our one attempt has brought numerous benefits to both the department and the students involved.

**REVIEW: Direct Contact**

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any wall resistance and low capital cost. In specialized situations these advantages certainly will lead to further commercial use of direct contact exchangers.

The book is the product of an NSF-supported workshop held at the Solar Energy Research Institute in 1985. It contains fourteen chapters written by the organizers and principal speakers. Five chapters deal with two-phase fluid systems. Three chapters treat heat transfer between particulate solids and gases. A chapter each concerns evaporation and condensation processes.

Several valuable functions are fulfilled by this book. At the most basic level it should serve to re-emphasize to the heat transfer specialists that this kind of heat exchanger is an option with certain strong advantages. The book is a good source of ideas and configurations for possible applications. A valuable feature of the book is a set of design examples included as six appendices. In the final chapter the editors present a summary of research needs.
CHEMICAL REACTOR DESIGN
by E. B. Nauman
John Wiley & Sons., $53.70 (1987)

Reviewed by
P. A. Ramachandran
Washington University

Chemical reaction engineering has evolved to a mature discipline in the last two decades, and this has resulted in a number of textbooks and monographs on the subject. The computer revolution has embraced this field in a big way, and the trend is towards detailed modeling and optimization studies of industrial scale reactors. The textbook coverage on the application of numerical methods in reaction engineering is, however, minimal and the present book fills this important gap. Thus the major contribution of the book is the detailed presentation of the computer aids as problem solving tools in reactor design. This naturally leads to application to more realistic problems as opposed to simplified artificial schemes such as A → B. This book is therefore able to focus on the applications to practical industrial problems.

Chapter 1 introduces the basic concepts as applied to simple reactions and ideal reactors. The rate of reaction is nicely defined on a unit stoichiometric basis, and the rate of formation of any given species is then related to this quantity by using the stoichiometric coefficients. Such an approach is necessary for computer based simulations of more complex systems.

Chapter 2 extends the basic concepts for more complex reaction schemes. The Runge-Kutta method for solving a set of differential equations is introduced here and then applied to a number of problems for plug flow reactors. The analysis to a general reaction network is introduced on the basis of a matrix formulation. The Concepts of rank of matrix and its use in determining the key limiting reactants is briefly presented. It would have been useful to elaborate on these concepts in somewhat more detail with additional solved problems because the students usually have difficulties in this area.

Chapter 3 introduces the solution methods for different reactor types. The Newton-Raphson method for solving a set of nonlinear algebraic equations is discussed and the application to a perfectly mixed reactor handling a complex kinetic scheme is nicely presented. Chapter 4 deals with the additional complications of thermal effects. Again, numerical methods are exten-Continued on page 49.
 seminar-style report in a conference room. A gratifying part of these presentations is the interest the other student groups show towards the various projects and the thoughtful questions that are asked during the discussion section of the presentations. In sum total, we feel that the overall experience is extremely beneficial to both the students and the instructors, and is definitely worth all of the work both parties have to do.

**NOTATION**

- \( C_p \) = heat capacity of ice (J/kg °K)
- \( h_b \) = boiling heat transfer coefficient (W/m² °K)
- \( L \) = length of ice formation (m)
- \( k \) = thermal conductivity (W/m °K)
- \( m \) = mass of ice at time \( t \) (Kg)
- \( \dot{m} \) = mass flow rate of CO₂ (Kg/s)
- \( r \) = radius described in Figure 2 (m)
- \( q \) = heat flux (W)
- \( t \) = time (s)
- \( T \) = temperature as described in Figure 2 (°K)
- \( T_a \) = average temperature of ice block (°K)
- \( \dot{V} \) = volumetric flow rate of sublimed dry ice (m³/s)
- \( \rho \) = density (Kg/m³)
- \( \Delta H_f \) = heat of fusion of ice (J/Kg)
- \( \Delta H_s \) = heat of sublimation of CO₂ (J/Kg)

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**REVIEW: Reactor Design**

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sively used in problem solving. This chapter introduces the concept of non-linear regression analysis and then illustrates its to the problem of kinetic parameter estimation.

Chapter 5 deals with the application of the concepts of earlier chapters to design and optimization. A number of case study examples are presented. The role of reactor design on selectivity is not discussed satisfactorily. Here an almost "Levenspielian" type of discussion would have been extremely beneficial from both a pedagogical and a practical point of view.

The coverage up to this point would probably fit nicely into a senior class in chemical reaction engineering. The instructor could assign a number of "end of chapter" problems in addition to assigning the case studies as computer simulation exercises. This would allow the students to get a fairly good grip on the use of modern computer based techniques.

The subsequent chapters cover more advanced topics. Chapter 6 discusses the laminar flow reactor, and this requires the solution of partial differential equation in two variables. The technique presented is a finite difference method. The chapter also discusses problems involving variable viscosity, which are important in polymer processing. This chapter would blend in nicely for those students simultaneously taking a graduate level transport course.

The effect of non-idealities in the residence time is discussed in Chapter 7 where the axial dispersion model is discussed for both isothermal and non-isothermal reactions. The numerical solution strategy discussed here for the solution of the two point boundary value problem is the shooting method. The orthogonal collocation provides a more powerful solution method for these types of boundary value problems, but there is no mention of this method. A number of library packages such as COLSYS or PDE/PROTRAN could be directly used here, and it would have been useful to provide a brief exposure to the use of one or two commercially available software to reaction engineering problems.

Chapter 8 deals with unsteady state analysis of reactors. A number of examples are shown on the dynamics and control aspects. I found the examples both real and very illustrative.

Chapter 9 deals with the effect of mixing in continuous flow systems. In addition to providing the necessary mathematics, a valuable qualitative discussion on the mixing effects on reactor performance is presented. This should help the students to build a conceptual base. However, the Zwierling differential equation is introduced suddenly without any derivation or even a qualitative basis. More discussion here would have been useful.

Chapter 10 deals with heterogeneous catalysis, while Chapter 11 deals with multiphase reactors. Some applications to new processes such as biochemical reactors and electronic device fabrication are included. The treatment on three phase reactors is very sketchy. The emphasis on computer applications which was the theme in the first half of the book is unfortunately lacking here. For example, the author could have shown the use of single point collocation in the evaluation of effectiveness factors for nonlinear kinetics. A number of design problems in multiphase reactors can be solved by simple computer programs. (The Omnibook gives a rundown of typical examples.) These could have been useful.

The final chapter is exclusively devoted to polymer reaction engineering, which is unique since many books do not even mention this word.

The second part of the book (Chapters 9 through 11) provides sufficient content for a graduate course, although the instructor would have to supplement the text with additional reading materials or notes to provide further details on many of the topics. The coverage of emerging areas would be useful in such a course, and the book would motivate the students to read more on those topics. The incorporation of the computer methods in the teaching of reaction engineering is vital, and the book provides a valuable reference source in this field.
is oxidized and the cell population increases. Lastly, hydroxide is steadily consumed as acid is produced by the process.

ACKNOWLEDGEMENT

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REFERENCES


ADVANCES IN DRYING,
Volume 4
Edited by Arun A. Mujumdar
Hemisphere Publishing Corporation,
79 Madison Avenue, New York, NY 10016
421 Pages, $97.50

Reviewed by
E. Johansen Crosby
University of Wisconsin

The drying of solids is probably one of the oldest unit operations practiced by man. In the past, this process generally was considered to mean the removal of moisture from matter when the amount of same was relatively small. However, in the chemical processing industry of today, feedstocks to be dried may contain as much as ninety percent moisture, and that moisture many times may be nonaqueous and multicomponent. Moisture removal can be effected by (i) condensed-phase separation, (ii) chemical decomposition, (iii) chemical precipitation, (iv) absorption, (v) adsorption, (vi) expression and (vii) vaporization. Convection drying, i.e., moisture removal by vaporization with the drying medium being both the energy source and moisture sink, is by far the most common method used. The materials-handling considerations resulting from many different feedstock and product requirements inevitably resulted in the development of many types of equipment—each with its own operation idiosyncrasies.

In recent years, the number of monographs, handbooks, journals, proceedings and research reports devoted to this subject has increased markedly with the series entitled Advances in Drying which was initiated in 1980. In the preface of Volume 4, the editor indicates that this "... series is designed to allow individuals concerned with (various) aspects of drying to access relevant information in a carefully reviewed form with minimal time and effort." Like its predecessors, this work consists of a number of reviews, updates, and developments concerning theory, design, and practice in connection with moisture transfer through and/or removal from solids. Eight individual topics are addressed from various viewpoints by contributors from seven countries.

Computer-aided design of convection dryers is discussed in Chapter 1. The classification of mathematical models according to contact zones and flow patterns, the systematic application of the overall mass and energy balances, and the simplification of drying mechanisms is presented. Most of the chapter is devoted to examples of recommended calculation procedures for different types of dryers with the coverage of spray and rotary dryers being especially minimal. Chapter 2 deals with recent advances in the drying of wood. A review of drying theory and modeling is followed by a good summary of recent developments in lumber and veneer drying. Recommendations for future work are presented. Chapter 3 contains a condensed theoretical review of the drying of porous solids with stress on the internal mechanism of moisture and energy transfer. Coupled heat and moisture transfer in soil is reviewed in Chapter 4. Written from Continued on page 43.
modified and used by laboratories in Mechanical and Chemical Engineering and Engineering Technology at Texas Tech. It contains a descriptive five-item scale on each of eight team and technology performance attributes. It also has a section for other comments. I will compile the evaluation data, use that to assign a team member grade, and share the compiled results with the team member. There are several advantages to such an approach. Student leaders can check off attributes without the bias that grading carries and, consequently, may produce a more accurate measure of their team member's performance. Additionally, discussion of the compiled data with each individual may aid coaching for improved performance. Initial feedback is positive.

The second negative evaluation concerned the variable difficulty of the projects, and a typical comment was, "How do you grade a hard program compared to an easy project?" "... all projects should be either programs or reports." "Don't compare apples and oranges." Students perceive that the computer projects are more difficult than the technology reports. Considering the level of computer programming expertise of our juniors, I must agree. Perhaps two-thirds of the class have forgotten both the programming language and the systematic approach to programming learned in their freshman course. They tend to write the entire program at once (without having performed hand calculations for familiarity with the procedure), then become extremely frustrated as they debug simultaneous and interconnected syntax and logic errors. Although I preview this, it remains a problem, and I plan to reducing my expectations on the computer assignment scope and strengthening my message to the computer simulator project leaders.

SUMMARY

In an attempt to integrate project management and interpersonal skills development into a junior level transport course, student project exercises were structured with one accountable leader who plans, coordinates, and grades the work of three team members. The exercise structure achieves its objectives and is received well by the students. The course professor must be prepared for the degree of subjectivity introduced and be able to manage personnel problems. Student-to-student evaluations may improve with a non-grade rating form.

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REVIEW: Advances in Drying
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the viewpoint of the soil scientist, the equations of change for mass and energy transport, formulation of the relevant mass fluxes, consideration of the transport properties, and choice of boundary conditions are covered. Experimental measurement of the transport properties also is considered and the drying of soils by buried heat sources is discussed. A mathematical model for convective drying with the incorporation of sorption isotherms is presented in Chapter 5. This chapter is not a review but rather a research paper concerned with the drying of a porous capillary body and accompanied by a very limited bibliography. Chapter 6 is primarily a descriptive review of the solar drying of crops. After a brief discussion of drying principles, the status of solar drying technology together with equipment description is presented. This is followed by a discussion of the design features and typical performance characteristics of solar heaters for air. A very brief consideration of the relevant economics concludes the review. Certain principles of operation and design considerations for spouted-bed drying are presented in Chapter 7. Emphasis is placed on the selection of a spouted-bed system and its fluid-mechanical characteristics. Three previously published models for describing the performance of this type of dryer are summarized and compared. Chapter 8 is a nontheoretical review of press drying. The principles of operation are summarized and performance data are presented. The mechanical features of existing pilot machines and proposals for full-scale dryers as well as alternatives for improved paper densification are given.

Those persons interested in drying should find the individual contributions to this volume to be of some interest. The authors of most of the chapters are generally recognized authorities in their field. Unfortunately, much of the material seems to have been edited and/or proofread very rapidly and/or poorly as there are a number of instances of quite awkward grammar, misspelling and, something especially disconcerting, incomplete nomenclature. The text is type-set and production is good except for those few figures which are reproduced by direct photocopy. As with similar publications of this type, the price is high. Because of its restricted technical content, this volume should be perused prior to purchase.