development of the lecture materials. The overall project was managed by D. A. Crowl.

The course outline is shown in Table 1. It is divided into two major parts. The first part presents the fundamentals of safety and includes discussions of toxicology, fire, explosion, and toxic release. The second part deals with using those fundamentals in practice and includes a discussion of “designing for safety” and using various safety review procedures (such as hazards and operability studies). The course also includes a discussion on case histories and accident investigations.

The outlines for the five video lectures are shown in Tables 2 through 6. Except for video session 4, the videos are not dependent on the lecture material. The emphasis of the videos was to show the students how safety is practiced on real process equipment. The fourth video lecture on “Experiments for Safety” required some fundamental lecture material prior to broadcast.

<table>
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<th>ChE book reviews</th>
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<tr>
<td>INTRODUCTION TO POLYMER</td>
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<tr>
<td>VISCOELASTICITY, Second Edition</td>
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<tr>
<td>by John J. Aktonis, William J. MacKnight</td>
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<tr>
<td>Reviewed by Albert Co</td>
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<td>University of Maine</td>
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This book introduces various fundamental concepts in studying the viscoelastic behavior of polymers, with an emphasis on the molecular approach. The book consists of nine chapters.

Chapter 1 introduces the reader to several experiments that display the viscoelastic nature of polymers. In Chapter 2, viscoelastic material properties in transient and oscillatory experiments are defined and are illustrated clearly with simple experiments. The Boltzmann superposition principle is stated; its applications in relating the creep compliance and the stress relaxation modulus and in relating transient and oscillatory properties are demonstrated.

In Chapter 3, the regions of viscoelastic behavior are described and the effects of molecular weight, crystallinity, and plasticizing agents are explained. The concept of time-temperature superposition, the master curves, and the WLF equation are then presented. In Chapter 4, the phenomenon of glass transition is examined, and explanations based on free volume, thermodynamics, and kinetic theories are presented. The effects of structural parameters on glass transition temperature and the relaxation occurring in the glassy state are rationalized in terms of molecular motion and chain mobility. In preparing the reader for subsequent chapters, the statistics of a polymer chain are reviewed in Chapter 5.

In Chapter 6, various treatments of rubber elasticity and the structural factors that affect rubber elasticity are discussed. In Chapter 7, the behavior of typical mechanical models is analyzed and the Rouse-Zimm molecular theories for polymer solutions are discussed. Extensions of these molecular theories to bulk polymers are then considered and the reptation theories are briefly described. In Chapters 8 and 9, the phenomena of dielectric relaxation and chemical stress relaxation are examined, respectively.

Throughout the book, the mathematical treatments are maintained at a level comfortable for undergraduates. Advanced mathematics required for the discussion of a subject matter are elaborated in the corresponding appendices. The problems at the end of each chapter range from simple calculations to advanced problems requiring a certain degree of mathematical sophistication. Readers will find the solutions located at the end of the book to be helpful.

Overall, this book is an excellent introduction to polymer viscoelasticity. However, the treatise is restricted to amorphous polymers. The treatment on crystalline polymers is very limited, and topics such as solution behavior, melt rheology, and birefringence are not covered. Nevertheless, it is a good choice as a textbook for one of a series of courses on polymer viscoelasticity.

SUMMARY

This paper has presented both the industrial and university perspectives regarding the need for teaching safety in the chemical engineering undergraduate curriculum. We have also presented one approach to teaching safety and loss prevention. As a result of NSF support we had a unique opportunity to bring the students into an operating chemical pilot plant, through the use of live TV.

We hope that this approach, and others, will improve the engineers of the future and result in safer chemical process plants.

REFERENCES

tails they can ask you for them in the question period.)

- If you show data plots be sure the axes are clearly labeled.
- Rehearse your talk several times with a friend or in front of your mirror, and make sure the time it takes is within one minute of the time allotted for the talk. Running long can be a disaster in a formal presentation and running short may not win you any friends if you’re at a meeting where consecutive talks are scheduled at set times.

Presentation

- Never read directly from prepared text—there is nothing more deadly to an audience.
- Make frequent eye contact with your audience throughout the talk. Do not stare at your notes or at the screen.
- Sound enthusiastic about your subject, or at least interested in it. Do not speak in a monotone. Gesture occasionally. If you seem bored by your material you can be guaranteed your audience will follow your lead.
- Make sure your watch is visible and check it occasionally to see how the time is running. If you see you are running short or long, try to adjust the speed of your presentation to compensate.

DISCUSSION

The improvements in the student presentations as the semester progresses are clear and frequently dramatic. Almost invariably poor speakers become adequate, adequate speakers become good, and good speakers become better. During the past six years a student from our department has won the regional AIChE student chapter paper award competition three times. We can’t prove it, but we are convinced that the seminar course has a lot to do with this record.

The oral critiques are a valuable and interesting part of the course. The natural student tendency is to be excessively polite, to avoid criticizing harshly lest they themselves come in for the same treatment when it’s their turn to speak. As a result, in the first few sessions the principal burden of criticism falls on the instructor. However, as the semester progresses the student criticisms become more and more germane and incisive, although courtesy is always appropriately retained. (We are Southern here, after all.) By the end of the semester the instructor is almost redundant: the points he is prepared to make in his critique are usually made first by the students.

Requiring each student to give a fifteen- or twenty-minute talk and subsequently a ten-minute talk seems to work very well. It is usually difficult (even for seasoned professionals) to present a significant body of technical material in twenty minutes; having to do so provides the students with excellent practice in preparing technical seminars such as those at national AIChE meetings. Cutting the material down to ten minutes presents a whole different set of problems, as the students quickly discover. The latter exercise is good preparation for, say, company staff meetings at which many people must summarize their work in a relatively short time.

Finally, it is critically important for the course instructor to remember that the students taking the course are particularly vulnerable: they are nervous about public speaking in general and they are especially not used to being publicly critiqued. If the criticism is destructive or unduly harsh, or seemingly arbitrary and unfair, the course has the potential of doing much more harm than good. However, as long as the instructor establishes firm ground rules about criticism and takes the lead himself in creating a supportive environment, the course can be among the most positive and rewarding educational experiences the students experience in their academic careers.

CATALYST DESIGN:
PROGRESS AND PERSPECTIVES
John Wiley & Sons, Somerset, NJ 08873, 288 pages, $47.50 (1987)

Reviewed by
R. J. Gorte
University of Pennsylvania

While there are a number of books on catalysis, it is very difficult to find a book which gives a balanced presentation of the many topics in this field. The problem is that everyone working in catalysis has a different view of what the subject is and what is important. People working in surface physics view catalysts as adsorption on single crystals in ultra-high vacuum, mathematical modellers view it as concentration and temperature gradients across a catalyst pellet, and traditional workers in catalysis view it as the turnover number or selectivity for a reaction carried out over a fixed bed. While not written specifically as a textbook, Catalyst Design: Progress and Perspectives has tried to give an overview of work carried out by...
all types of catalyst researchers by bringing together leaders from several of the important areas in the field and having each write a brief review of the important aspects of their particular area.

The book itself is a series of short review articles, each written by a different author. The first chapter, written by L.L. Hegedus, very briefly discusses the continued importance of heterogeneous catalysis to industrial practice and lists the applications which utilize the largest quantities of catalysts.

A microscopic viewpoint of catalysis on single-crystal, metal surfaces is presented by G.A. Somorjai in Chapter 2. The work cited is mainly from Professor Somorjai's own research and discusses the results of reaction and adsorption studies on single crystals, including topics such as the importance of crystallographic structure for reactions on metals and the influence of surface modifiers on several example reactions. It should be noted, however, that some of the conclusions reached in this chapter are still controversial within the surface science community.

The third chapter provides a discussion of supported, organometallic clusters by B.C. Gates. The chapter begins with a review of catalysis by transition metal clusters and continues with a discussion of work carried out to anchor these compounds to a support. This second part reviews the synthesis of supported complexes and concentrates on the spectroscopic techniques which have been utilized in characterizing these catalysts. Following the section on synthesis and characterization is a discussion of the catalytic properties for several example catalytic systems.

Chapter 4, by A.T. Bell, is a review of supported metal catalysis, with an emphasis on the effect that the support can have on the metal. The chapter reviews a wide range of topics, including support acidity, preparation procedures for introducing metals onto a support, and the influence that a support can have on a metal's adsorption and reaction properties. Most of this last section involves a discussion of the unusual properties which can be observed with titania supported metals. It should be noted that Professor Bell presents certain conclusions concerning the role of titania which are still being debated in the literature.

A discussion of reaction kinetics and the design of catalytic cycles is given in Chapter 5 by M. Boudart. Since most reactions involve several elementary steps, Professor Boudart suggests ways for logically designing catalysts assuming that the intermediate steps can be selectively altered by judicious choice of catalyst or operating conditions.

W.O. Haag and N.Y. Chen have written a review of acid catalysis by zeolites in Chapter 6. Their chapter starts by describing what zeolites are, followed by a discussion of zeolite properties including sorption behavior, diffusional phenomena, and catalytic activity. The chapter includes a concise introduction to preparation methods for zeolites, to techniques for characterization of the acid sites, and to methods for changing zeolite acidity. Following this introduction, the role of zeolites in several commercial processes is described, with a particular emphasis on the importance of molecular shape selectivity in those processes. The chapter ends with an overview of the design principles which were incorporated into the development of the first zeolite hydrocarbon cracking catalysts.

The section on mathematical modelling of transport properties in catalysis, Chapter 7, was written by R. Aris. The chapter begins with the history behind calculations of catalyst effectiveness and follows with a tutorial on how to determine the influence of catalyst geometry, reaction kinetics, and other factors on the observed reaction rates. The chapter includes a short section on methods for controlling the distribution of catalytic activity within a catalyst pellet and concludes with a discussion of rate multiplicities and stabilities.

The final chapter, written by J. Wei, presents the design considerations used for hydrodemetallation catalysts. The chapter begins by introducing the reader to the complex structure of metal-containing molecules which are present in petroleum. The rest of the chapter reviews the problems associated with dehydrodemetallation in the presence of hydrodesulfurization and discusses the principles used to design catalysts which have a high activity for long periods of time.

Over all, this book provides a good review of a wide range of topics in heterogeneous catalysis. While the book could be used as a text for a course in catalysis, it would be necessary to provide supplementary materials to provide background on the different techniques which are discussed. As with any book on topics for which research is ongoing, one should not consider any of the chapters as being the final word. However, each section does provide a good beginning for the interested reader. There is clearly a need for a book of this type.
dependent variable as it is in standard reflux columns discussed in the books. The second column pressure has to be controlled at the condensate drum, and the first column pressure would then find its own equilibrium value, much like it does in a double effect evaporator. Had the problem been terminated at the textbook stage, this “discovery” would have been lost.

CONCLUSIONS


LITERATURE CITED


ChE book reviews

DISTILLATION TRAY FUNDAMENTALS
by M. J. Lockett

Reviewed by
James R. Fair
The University of Texas at Austin

The distillation column continues to be the principal separation device for the chemical and petroleum processing industries. For many years it was characterized as a vertical, cylindrical column containing plates or trays upon which rising vapor and descending liquid were brought into intimate contact, for purposes of effective mass transfer. In recent years designers of distillation columns have shifted some attention to the use of structured (as opposed to random) packings as vehicles for effecting intimate phase contacting. However, such packings are considerably more expensive than trays, and their cost is often justified only when their lower pressure drop carries an economic advantage, as in some vacuum distillations. Thus, the tray column remains as the standard and basic device for vapor-liquid contacting.

Despite the title, this book deals not only with trays for distillation services but also covers applications in absorption and stripping. It covers all of the important aspects of tray design, those of a more hydrodynamic nature as well as those relating directly to the mass transfer propensity of the two-phase mixture on the tray. Considerable space is devoted to the characterization of this mixture: foam, emulsion, froth, spray, and so on. The overall coverage is quite complete, with no detail of design left unaddressed. Such important topics as phase flow distribution, capacity limits, pressure drop and interphase mass transport are dealt with on quantitative bases. A commendable effort has been made by the author to consider all historical approaches (mostly empirical) that deal with the various design parameters. The literature coverage is near exhaustive, and the reader will not find elsewhere as complete a bibliography on the distillation tray as is provided here. For each design consideration, a method with some fundamental and mechanistic support is provided—and for practitioners of distillation system design this is a welcome advance from the art and empiricism that have often prevailed.

There are some limitations to the treatment that should be mentioned. First, the author has not always found it possible to make a forthright recommendation when several alternate models or procedures are available for a particular design step. The reader must then make his own choice. Also, despite the title, all tray-type contacting devices are not considered. There is very little on valve trays, essentially nothing on bubble-cap trays, and complete silence on dualflow trays (those without downcomers). Emphasis is clearly on crossflow sieve trays, but this is not all bad. While there are still many bubble-cap tray columns in operation, very few new ones have been designed during the last few decades. The valve-tray is really a proprietary contactor, with design often left up to the proprietor. The dualflow tray is a rather specialized device (and tricky to design), used mostly for fouling services. On the other hand, the sieve tray is an efficient and relatively inexpensive non-proprietary device that has been the object of many basic studies, and its simple geometry (in effect, one or more sheets of perforated metal, joined to a downcomer for handling liquid passage) makes it reasonably amenable to fundamental modeling. Still, the title might have read “Distillation Sieve Tray Fundamentals.”

The book might have been improved by the inclusion of some worked-out design examples, some advice on laboratory or pilot plant scaleup procedures, and an author index. Still, the development of rational, fundamental-based approaches to the handling
of complex two-phase mixtures, as are found on trays, is refreshing and encouraging. The author has an extensive background in the research, testing and modeling of distillation devices, and his authoritative text reads very well. There is no equal to the book presently on the market. Anyone concerned with the design or analysis of distillation, absorption or stripping columns of the tray type will want to take advantage of the modern approaches presented in this book.

GAS SEPARATION BY ADSORPTION PROCESSES

by Ralph T. Yang
Butterworth Publishers,
80 Montvale Avenue, Stoneham, MA 02180;
352 pages, $52.95 (1986)

Reviewed by
D. M. Ruthven
University of New Brunswick

The importance of adsorption as a separation process in the chemical and petroleum industries has increased dramatically in recent years, but the subject is still not covered in any significant way in most chemical engineering curricula. There have been three recent books on the subject: Principles of Adsorption and Adsorption Processes, by this reviewer, published by Wiley in 1984; Large Scale Adsorption and Chromatography, by P. C. Wankat, published by CRC Press in 1986; and the present volume by Ralph Yang, published by Butterworth Publishers in 1987. None of these is really a textbook in the formal sense, but any of them could be used as the basis for a graduate level (or possibly a final year elective) course on the subject.

The coverage of the present volume is broadly similar to that of Principles of Adsorption and Adsorption Processes, and there is considerable overlap, which is probably inevitable since many of the source references are common. The emphasis is, however, different—reflecting the different areas of interest and expertise of the authors. The book provides a coherent and comprehensive account of the subject, including the basic physico-chemical principles as well as process technology. Although the title is Gas Separation by Adsorption Processes (and this is indeed the main focus), liquid phase separation processes such as the “Sorbox Process” and parametric pumping are also covered briefly. As with its predecessors, the emphasis is on fundamentals rather than on technological details, and the level of background knowledge which is assumed is also similar.


It is not a book for the undergraduate, but it should be easily understood by graduate students and those with some experience in research and development. Since most adsorption processes operate under transient conditions, some familiarity with partial differential equations is needed to follow the sections dealing with column dynamics and process modeling (Chapters 5 and 8). I found Chapter 3, which contains a review of the various approaches to the correlation and prediction of multicomponent adsorption equilibria, and Chapters 7 and 8, which provide an authoritative summary of PSA technology and modeling, to be most useful.

There is no discussion of membrane separation processes which compete directly with pressure swing adsorption in a number of applications. While membrane separations may not be included within the narrower definition of adsorption processes, some such discussion would have been useful to allow the reader to assess the relative merits of either approach, particularly in view of the publisher’s claim that this is a “complete treatise covering all aspects of adsorption processes . . .”

Inevitably in a book which covers such a wide range of subjects, one can expect controversy over the treatment of certain topics. For example, in the discussion of surface diffusion and intracrystalline diffusion in zeolites (pp. 113-121) it should probably have been pointed out that the kinetic treatment (which is emphasized) and the quasi-thermodynamic treatment (which is criticized) are not necessarily in conflict, but merely represent different ways of looking at the same phenomenon. The advantage of the quasi-thermodynamic treatment is that it allows meaningful transport co-efficients to be derived without knowledge of the detailed diffusion mechanism. This may not be obvious to the casual reader. Such criticisms are, however, minor, and any lack of balance is more than offset by the advantages in the presentation of coherent perspective.

Taken as a whole, the book presents a concise and readable summary of the voluminous literature of the subject. It will no doubt become required reading for those working in this area, both in universities and in industry. At US $52.95 it is (just about) within the affordable price range for individuals.
REQUEST FOR FALL ISSUE PAPERS

Each year Chemical Engineering Education publishes a special fall issue devoted to graduate education. This issue consists of 1) articles on graduate courses and research, written by professors at various universities, and 2) ads placed by chemical engineering departments describing their graduate programs. Anyone interested in contributing to the editorial content of the 1988 fall issue should write to the editor, indicating the subject of the contribution and the tentative date it can be submitted. Deadline is June 1st.

ChE book reviews

CATALYST SUPPORTS AND SUPPORTED CATALYSTS
by A. B. Stiles
Published by Butterworths,
80 Montvale Ave., Stoneham, MA 02180;
270 pages, $54.95 (1987)

Reviewed by
John B. Butt
Northwestern University

The title of this book is interesting enough since most of those who deal in catalysts, particularly of supported metals, often have an uneasy feeling that the “support” (dispersive phase, contact phase, carrier, holder — i.e., any number of names) has never been given enough attention. This book is a good start in trying to rectify this situation, and Dr. Stiles has collected a good group of reviews concerned with this. I particularly enjoyed the first five chapters, devoted to alumina, oxide supports other than alumina, activated carbon, and the associated information on their preparation and properties. The surface chemistry involved in catalyst-support interaction is probably not as extensively dealt with here as in other sources, but the overall treatment considered together with preparation techniques is quite a satisfying and useful one. Chapter 7, on organic polymers, also falls into this category.

The remainder of the book sort of strays from the announced title. Khoobiar has done a good job in Chapter 9 of “Spillover,” and while significant opposing points are ignored, this is still a good review. Less satisfying are chapters on the “Commercial Application of Molecular Sieve Catalysts” and “Multifunctioning Catalysts.” This is all old stuff, it seems rather qualitative, and it strays far from the announced title of the volume.

The book is not very well proofread, as illustrated on page fourteen as well as many other places in the text. This makes me wonder how good the numbers in the many tables and illustrations are. The publisher should be more careful.

In spite of these reservations, I would say that this is a book worth having. Get it, and learn about supports.

MASS TRANSFER WITH CHEMICAL REACTION IN MULTIPHASE SYSTEMS
Vol I: Two-Phase Systems (679 pages)
Vol II: Three-Phase Systems (399 pages)
Edited by E. Alper; Martinus Nijhoff Publishers,
The Hague, Netherlands, 1983. $140

Reviewed by
Arvind Varma
University of Notre Dame

This two-volume book constitutes the proceedings of a NATO Advanced Study Institute held in Turkey in 1981. It includes thirty papers, primarily of a review type, by twelve invited lecturers, and nine other contributions. Various topics in the area of mass transfer with chemical reaction in gas-liquid, liquid-liquid, and gas-liquid-solid systems are covered. These topics arise in the context of either separation processes or reaction engineering. Some of the papers treat the general problem of multiphase contacting and reactor design. Others deal with the modeling of specific types of contactors or reactors, and include methods for obtaining or estimating physicochemical and other data. Finally, some papers deal with a specific application, e.g., facilitated transport, bioreactors, or reactors for coal conversion technology.

The invited lecturers are experts in the area (mostly from Europe) who have written other reviews as well. The material is somewhat dated by now, and other more recent reviews and books have appeared in print. Nevertheless, these volumes constitute a rich source of information for this relatively narrow but important area, and they should prove quite useful to those involved with multiphase chemically reacting systems.

The volumes were printed from camera-ready copy. For this type of production, the cost of the book is high.