EDUCATOR: Stan Sandler

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industrial applications. For example, his research on calculational methods and equations of state has been used in the design many commercial processes and to achieve major reductions in computation time in reservoir simulation calculations.

Another important research effort has been his work on the generalized van der Waals theory. This work has led to a new understanding of the theoretical bases and assumptions that underlie the equations of state and activity coefficient models currently in use, as well as the development of completely new, theoretically based models. Perhaps the most significant product of his recent research has been a new, theoretically correct mixing rule that allows equations of state and activity coefficient models to be combined in such a way that equations of state can now be used to predict the behavior of highly nonideal mixtures over wide ranges of temperature and pressure. The manuscript describing this work was so enthusiastically received by the reviewers that it was published in the *AIChE Journal* within nine weeks of its original submission. Other recent work that Stan is especially proud of includes developing thermodynamic bounds for microbial growth processes, the use of quantum mechanics and other computational chemistry methods in chemical engineering thermodynamics, and (with Eric Kaler) on the separation of biological materials. His research activities also include phase behavior studies relevant to environmental protection which have included obtaining data for the reformulation of gasoline, the behavior of organic pollutants in aqueous solution, and (with Michael Paulaitis) on CFC replacements. All this work has been enthusiastically received by the international thermodynamics community, and in recent years Stan has been invited to speak on his research in France, Germany, Canada, Mexico, Denmark, China, South Korea, Italy, the Czech Republic, Poland, Australia, Argentina, and at many universities and companies in the United States. Recently Stan has been the Phillips Lecturer at Oklahoma State University, the Aston Hall Carey Lecturer at Georgia Tech, and the ICI Distinguished Lecturer at the University of Alberta.

ACADEMIC LEADERSHIP

Shortly after returning to Delaware from his 1981 sabbatical leave, Stan was named the H.B. du Pont Professor of Chemical Engineering and a short time later was asked to become chair of the department (in which capacity he served until 1986). His efforts as chair led to the successful nomination of five PYIs (Paulaitis, Dhurjati, Klein, Barteau, and Lenhoff). He may still hold the record for the ChE department chair, and perhaps any department chair, with the most successful Presidential Young Investigator nominations! He also rebuilt the chemical engineering faculty by hiring Antony Beris, Prasad Dhurjati, Hank Foley, Bramie Lenhoff, and Andrew Zydney. He remains a mentor to many of these, and other, faculty.

Stan has also given his time to the University. His service activities have included several terms in the University Senate, chair of successful search committees for the chemistry and electrical engineering department chairs, membership on the Provost search committee (twice), head of major University committees such as the Budget and Space Priority Committee and the Committee on Committees, and member of many other committees.

The University of Delaware recognized Stan's special campus role by bestowing on him its highest faculty honor, the Francis P. Alison Award. This nicely summarizes the high esteem in which he is held by colleagues, who continue to see him as the consummate scholar, educator, and mentor. ❐

ChE book review

PATTY'S INDUSTRIAL HYGIENE AND TOXICOLOGY

Volume II, Part A, 4th Edition
Edited by G.D. Clayton and F.E. Clayton
John Wiley and Sons, Inc., New York, NY; 945 pages (1994)

Reviewed by
Klaus D. Timmerhaus
University of Colorado

This is the first of six books of a well-respected industrial toxicology source book. Part A of this comprehensive compilation in Volume II contains fifteen chapters from a total of forty-six chapters covering thousands of chemicals. The first book of Volume 2 begins with an overview of industrial toxicology followed by the general criteria for identifying and clarifying toxic properties and recognizing occupational carcinogens of chemical substances. The following twelve chapters analyze a number of well-known toxins with their physical and chemical properties, industrial resources, analytical determination, physiological response in terms of toxicity and human effects, and exposure limits. The chemical substances covered in Part A of this revised series include:

- Occupational carcinogens
- Complex mixtures of tobacco smoke
- Acetone
- Aldehydes and acetals
- Epoxy compounds
- Ethers
- Organic peroxides
- Aliphatic nitro, nitrate, and nitrite compounds
- N-nitrosamines

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Business" (introduced at the same time as this course modification), will be modified to address some of the concerns arising out of this exercise. Specifically, a series of workshops on project management and communication will be run at the start of this laboratory project design exercise.

CONCLUDING COMMENTS

The modifications introduced in the chemical engineering laboratory subject have been well received. Students have received additional guidance in writing reports and analyzing data and have been required to undertake a laboratory project design exercise. This has necessitated the development and use of a range of skills not required in traditional laboratory and design exercises.

Introducing these modifications has meant a reduction (from twelve to nine) in the number of projects undertaken by each group. But this number reduction has been accompanied by an increase in report quality and the need to submit nine joint-author reports rather than six single-author reports. The possibility of introducing research-type experiments for the remaining laboratory projects, as described elsewhere,[5] will be investigated to further improve the quality of the remaining laboratory time. Such an approach has already been adopted for Level-4 students. A reduction in laboratory time at Level 3 has also led to a net reduction in subject resource requirements. The savings are being employed to offset the cost of improving existing experimental rigs (*e.g.*, by replacing chart recorders with data loggers).

The laboratory design project exercise has been particularly useful in fostering development of higher-level skills and reducing the reliance on reports handed down from previous years. Clearly, it will be necessary to restrict the choice of possible designs in future years to prevent copying. Although it would be possible to hand out a list of concepts, I feel it is more useful to allow students to develop their own concept and then disallow it if it is too similar to a previous concept. To this end I am retaining copies of the initial concepts submitted by students (2-3 pages). Given their brevity and diversity, future concept submissions can be easily compared to these filed copies at the concept-approval stage. This is sufficiently early in the exercise to identify possible plagiarists and invite them to submit a new proposal.

Finally, an answer to the question posed in the title of this article. I firmly believe that traditional laboratory courses are an integral part of any curriculum and cannot be dispensed with. But they do have some shortcomings that can be partly overcome by providing formal communication training and by giving students a real engineering problem in addition to laboratory work—design it, don't just do it!

ACKNOWLEDGMENTS

I would like to thank all staff who took part in this exercise for their valuable input and comments. I would also like to thank the Department of Chemical Engineering at the University of Adelaide, and in particular Professor John Agnew, for encouraging innovative approaches to teaching.

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REVIEW: Hygiene and Toxicology

Continued from page 17.

- Organic phosphates
- Alkane materials
- Phosphorous, selenium, tellurium, and sulfur
- Silicon and silicates, including asbestos

A considerable amount of information on toxicology is detailed in part A of this series. Chapters 2 and 3 should be required reading for not only those who will be involved in the manufacture of any type of chemical but also for all who will be using chemicals in one way or another during their daily life. These chapters outline the care that should be exercised and the risks that could be encountered with various chemicals that have some toxic tendencies.

The usefulness of the twelve chapters dealing with various chemicals identified as toxins varies to a certain degree. Evidently there were no fixed rules provided by the editor to the authors of the various chapters. Thus, a number of presentations begin with an overall consideration of toxicity for the chemicals being reviewed, while other presentations begin with an analysis of specific chemicals and their toxicity properties. Some authors provide a tabular presentation of the physical and chemical properties of all the chemicals covered in the chapter. Other authors do this separately, requiring the reader to go through the chapter to make comparison of the properties. The former approach is more satisfactory since a comparison of the properties could give some guide to the increasing or decreasing toxicity level in a chemical family. Some authors provided more uniform details on the toxicity studies of the chemicals reviewed, while others summarized these all under the topic of physiological responses.

The attention to details was overdone in the chapter on acetone where details were included from the 535 references quoted through 1991. On the other hand, the chapter on alkaline materials appears to require a further update since the most recent reference of the 89

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provided at the end of the chapter is 1979. Finally, the chapter on the effects of tobacco smoke on the occupational environment seemed out of place with the following chapters that analyzed specific chemical families for their toxic effect. The location of the chapter might have been more appropriate if it had been grouped with other overall classes of materials (*e.g.,* radioactive materials, municipal wastes, etc.). Apparently the location of chapters, as pointed out by the editors, was directly influenced by the availability of the manuscripts prepared by the authors.

Despite these objections, the text provides an intensive evaluation of the toxicity effects of a number of widely used chemicals. Fortunately, the extensive subject index and chemical index of fifty-four pages simplifies the task of obtaining toxicity information on a specific chemical even in those chapters where the information is provided in a different format. In most chapters except the one noted above, the information provided contains data obtained through 1991. ❐

ChE book review

STATISTICS FOR ENGINEERING PROBLEM SOLVING

by Stephen B. Vardeman

PWS Publishing Company, Boston, MA 02116-4324; 712 pages plus appendices (1994)

Reviewed by

Charles H. Barron

Clemson University

Most academic curriculum builders have, in recent years, confronted the question of how to incorporate statistics into their efforts. This has been called for by our industrial feedback systems, both from industrial advisory boards and from alumni in industry; in addition, there is a mandate in the current ABET criteria that stipulates the need for evidence of proper statistical incorporation within our engineering laboratory and design courses. This book is an excellent choice as a textbook for a statistics course designed to help meet these needs.

There have been several problems with traditional statistics course offerings in the past. Frequently, the courses have been populated by students who do not have the mathematics background of the typical engineering student, and for this reason, many faculty advisors have been reluctant to recommend statistics as an elective course. The approach taken in this book by Professor Vardeman is one oriented toward solving problems by using statistical methods and thought patterns. This is exactly the approach needed in order for the course to appeal to most engineering students. No formal background in statistics is expected, but the material presented advances rapidly through the necessary techniques and methodologies.

After a brief review of variability and random error as they arise in data-collection processes, the author introduces simple descriptive statistics and some common experimental plans are described without belaboring the theoretical basis for their design. Standard numerical summary measures are discussed by using extensive graphical presentations of distribution functions and their moments, especially means and variances.

With this background the students moves on to introductory concepts of regression and computing and using residuals. This section of the presentation benefits from an extensive use of graphs. After introducing the fitting of curves and surfaces, a full discussion of the fitted effects of factorial data structures is presented. By this time, about a third of the way into the book, the student is becoming quite accustomed to the author's strategy of introducing statistical tools as they are needed in the context of the problems.

It is only at this point that the background notions of probability and the mathematics of randomness are raised. Chapter Five deals with discrete and continuous random variables and goes much further than previous coverage in the development of a number of distribution functions. Several of these functions will be new to the student, such as geometric, Poisson, exponential, Weibull, and the beta distribution. Each of these distributions arises in the context of an application, and the motivation to understand the distribution arises naturally. Joint probability distributions are discussed after this background work in completed. Chapter Six introduces the concepts of statistical inference, confidence intervals, and significance testing.

The next few chapters continue to expand the student's toolkit by describing multisample studies, simultaneous confidence intervals, analysis of variance, and variance decomposition. Control charts arise in this section of the discussion. Inference for multisample studies provides a platform for introducing the full factorial data structure of such systems. With this basis, the full inference methodology for general least squares curve- and surface-fitting is developed, and response surfaces are introduced. Finally, the book concludes with the elaboration of some of the more advanced concepts of experimental design.

The author has provided numerous examples and problems for the student at every step along the way. This textbook is highly recommended both to teachers of statistics courses for engineering students and to engineering faculty who would like to sharpen their own statistics skills in order to do a better job of using these tools in their engineering laboratory courses. ❐