ChE letters

Sir: I read with great interest the article by Kenneth J. Bell (CEE, 6, No. 4, Fall 1972) detailing his views on the requirements for a course in Process Heat Transfer. The thinking of Dr. Bell no doubt influenced by his close association with some of the greats in this field, is closely parallel to that of members of the Department of Chemical Engineering at the University of Salford, England, who were influenced by those same greats through their writings.

Students at Salford during the final two years of their studies are required each week to attempt problems which require between six and twelve hours calculation for their solution. Many of these are concerned with process heat transfer calculations and are also used as a basis for developing computer programs for the routine solution of such design problems. We, too, were initially handicapped by the absence of a suitable textbook, a circumstance which led Heinemann Educational Books Ltd, London, to publish 'Heat Transfer' by F. A. Holland, R. M. Moores, F.A. Watson and J.K. Wilkinson in November 1970. The text consists of twenty calculations presented in full detail in Anglo-American units with a parallel presentation of key results in SI units. There is also a section on the estimation and correlation of physical properties of fluids presented in consistent SI units, with five fully detailed examples. To make the book self contained there are ten chapters which present an abridged theoretical treatment of all the methods used in the design calculations, including a chapter on conversion of units. The 612 page book has been made available in the USA through American Elsevier Publishing Co., Inc. for less than $20 for the hardback edition.

I hope this information may prove of interest to those in other Departments of Chemical Engineering who have felt the need for such a text. The book was reviewed in the International Journal of Heat and Mass Transfer, 14 pp 1879-1880, 1971.

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ChE book reviews

Polymers in the Engineering Curriculum. Proceedings of the Third Buhl International Conference on Materials, Pittsburgh, Pennsylvania, October 28-29, 1968, Hershel Markovitz, ed., Pittsburgh: Carnegie Press, Carnegie-Mellon University, 1971. 311 pages. Reviewed by W. R. Schowalter, Princeton University, Princeton, N.J.

This unusual volume deserves review if for no other reason than to publicize the fact that, in spite of the title, the book contains several concise, readable, and authoritative reviews on certain areas of polymer science.

Since 1963 the Buhl Foundation of Pittsburgh has supported a series of conferences on the subject of materials. Dr. Markovitz describes the origin of the third conference as follows:

> **The choice of the subject of the Third Buhl International Conference on Materials — Polymers in the Engineering Curriculum—grew out of the concern of the organizers that engineering schools, almost universally, had not been responding to the obvious upward trend in engineering applications of polymeric materials. There is little doubt that a large fraction of the graduates of engineering departments will have to deal with these materials during their professional lives. If it is granted that an important task of engineering schools is to prepare the student for his career, it is surprising that so few educational institutions had modified their curriculum in light of this fact.**

The conference organizers decided that it would be useful to devote the first day of the meeting to "an overview of the polymer industry and the underlying science important for the understanding of macromolecular behavior." It is this portion of the conference that generated the reviews mentioned above. One should not be surprised, given the origin of the volume, that an enormous difference in emphasis and style exists among the authors. The review talks are probably bounded in these respects by C. Truesdell's description of "Classical and Modern Continuum Theories" and A. V. Levy's address titled "Producer-User Cooperation to Utilize Polymers as Engineering Materials, A Necessity." Other papers of a review nature include

Some Fundamentals of Polymer Chemistry — W. H. Stockmayer and C. W. Pyun
Mechanical Behavior of Polymers — H. Markovitz
The Morphology, Properties and Structure of the Crystalline State of Polymers — R. S. Stein
Mechanical Analysis of Plastics Fabrication Processes — T. Alfrey, Jr.
Application of Modern Continuum Mechanics to the Design of Polymer Melt Processes — J. R. A. Pearson.

In addition there are some interesting statistics showing the impressive growth rates for production of various kinds of polmers. Historical notes about the polymer industry are also included.

The wide assortment of talks and audience backgrounds led to some amusing discussion exchanges, most of which were transcribed. For example:

> **A: . . . did you vary only a single variable at a time?**
> B: It was done on a statistical basis.
> **A: I'm asking for that basis if you can give it.**
> B: I dont remember the details of which variables were varied . . . .
> **A: In other words you were assuming a simplicity here, no interactions of these variables, or you really**

wouldn't be able to hold so many constant while you varied a few. I gather your results pretty well justify that there were only several of these that were quite influential. Is that correct?

B: Yes.

C: The procedure in most laboratories is to set up what you want to do and then send it over to the math group. They set up the statistically designed experiment so that they can analyze the results properly.

A: I'd like to point out that that is a rather dangerous procedure.

C: Our math group has some chemical engineers.

A: That certainly helps a lot.

Given the broad range of outlooks typified by this discussion, one doesn't expect, and doesn't find, uniform agreement on educational objectives or procedures in the second half of the volume, which is devoted to papers and discussion on present and future polymer curricula. An oversimplified but perhaps reasonably accurate summary is that an undergraduate *major* in polymer science is unwise, but that elective courses should be available. At the graduate level there is no *best* approach since local conditions will determine the optimum structure of a polymer program, department, or institute. It is clear that there is no unique solution to the "materials science" *vs.* "polymer science" problem that is especially acute when a materials science group, probably composed primarily of metallurgists, is encouraged to expand its scope to include polymers. One speaker noted that in such cases the *band* theory all but excluded the *bond* theory.

The second section of the proceedings could be a useful sourcebook for university faculty and administrators who are wondering how best to fashion a polymer program into the educational structure. The reader will not find the answer, but he can at least be exposed to the hopes, fears, successes, and frustrations of some who have wrestled with this problem.

From Electrocatalysis to Fuel Cells, Edited by G. Sandstede, University of Washington Press, Seattle, 1972, 415 pp, $12.50. Reviewed by R. E. Meredith, Oregon State University, Corvallis, Ore.

This book contains more than thirty papers which were presented at a three day seminar, under the same title, at the Battelle Seattle Research Center. Unlike many publications of this nature, the articles are well grouped and edited to give the book the appearance and utility of a text on the subject. The participating authors include Bockris, Cairns, Kordesch and others who have worked extensively in the field for many years. Emphasis is placed on presenting the latest developments and applications along with the current standing of research

The coverage given in this book to the studies in developing inexpensive catalysts to compete with the heretofore unchallenged domain of the platinum family should be especially interesting to the investigators who have developed an almost economic fuel cell except for the cost of the catalyst. Disclosures are presented on the behavior and properties of inexpensive and novel catalysts such as tungsten carbide, bronze compounds and organometallic complexes. It is pointed out that the stimulating work in this area has encouraged the examination of a great many other compounds and these studies may very well lead to cheap electrodes for acid electrolyte fuel cells in the near future.

The section on fuel cells is categorized not only as to whether the system is acid or alkaline but also with regard to fuel and application. The problems associated with each system are covered in discussions and summaries. For instance, it is noted that in spite of the fact that the electrochemical problems of the hydrazine cell have been practically solved, the cost of hydrazine continues to make that unit uneconomical. It is also mentioned that although the alkaline systems appear to have the advantage on the state of development at the moment that recent advances in the acid electrolyte cells promise to place them in a strong competitive position in the near future. As an example of the completeness of fuel cell coverage, a rather short but interesting section is devoted to the state of development of implantable fuel cells in the body for the operation of pacemakers.

Not to be excluded are topics such as solid electrolytes, thermocatalytic hydrogen generation, power generation using coal, organic cathodes, metal-air systems, and the use of fuel cells for practical energy conversion systems.

The book concludes with a section on "Developmental Goals and Prospects" which state the restrictions on fuel cell applications in a realistic manner. It is suggested that anti-pollution forces are going to have to become a lot stronger or else the country will have to be very concerned about "hydrogen ecology" before applications would be created to cause industrial capital to be spent in the volume needed to develop and market fuel cells in large quantities. Fuel cells would appear to find their best application in areas now covered by combustion engines but they fail to adequately compete because of unfavorable "power density" and "value per dollar."