BOOKS

Techniques of Process Control, Page S. Buckley, Wiley, New York (1964), 303 pages, $15.00.

Even though the subjects of process dynamics and process control are among the most popular in the field of chemical engineering today, the supply of textbooks covering this area has been extremely scarce until very recently. Thus we welcome the appearance of this new volume, particularly when it is authored by an industrial engineer who has, himself, been an acknowledged leader of the field for many years.

In the words of the author: "This book is intended to serve as a guide and source book for engineers engaged in process development and improvement, plant testing and trouble shooting, production, and plant maintenance of controlled systems. It will have value to equipment and process designers." The author does not particularly recommend it as a college text, and indeed its brevity, lack of mention of several modern topics, as well as its lack of a selection of problems for student use, severely limit its applicability to this use. On the other hand, this writer completely agrees with the author that this book will be an excellent study aid for the industry engineer who wishes to obtain a background in process control by self study.

The book concentrates on the study of linear systems. In its first section (5 chapters) it presents a basic outline review of the mathematics of these systems including the important topic of sampling. The second main section (8 chapters) develops briefly the use of the mathematical topics just covered to show how to determine the stability of a control loop, and how to compensate a loop to improve its response. It also describes each of the major elements of a process control system, including the concepts of dead time, of a distributed parameter system, and of control using sampled rather than continuous data.

The remainder of the book shows the application of the information previously learned to the control of each of the major types of process operations: fluid flow, heat transfer, and distillation.

The subject of distillation is thoroughly and particularly well treated. As one of the most common, yet at the same time most complex unit operations, it provides examples of all the possible topics that may arise in process control. The description given in this text is one of the best this writer has seen.

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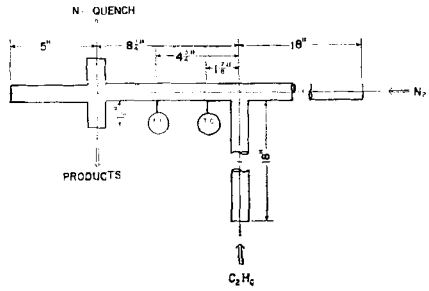

Fig. 1. Plan for quartz preheater-reactor assembly.

nected through a fuse to a manually operated *powerstat* for control.

The preheater-reactor was mounted horizontally on firebricks, and the entire assembly (except the quench cross and thermocouple port) was contained in a metal box that conformed roughly in plan to the preheater-reactor. The cross section of this box was about 11 in. in width and 12½ in. in height. The box was lined on the inside with aluminum sheet and was filled with firebricks. The space immediately above the quartz tube was filled with Johns-Manville Sil-O-Cel, coarse grade, and other void spaces around the bricks with ground firebrick. There is considerable heat loss at the joint of the tee of the quartz tube, since no heater could be extended quite to this point. An attempt was made to minimize this by adding one more heater, 20 ft. of B & S 20 g. Kanthal A-1 wound on an asbestos board about 3½ in. above the joint.

Nitrogen and ethane were introduced to the preheater-reactor via ⅜ in. O.D. x ¼ in. I.D. aluminum tubing connected with glyptal-sealed rubber couplings. Each gas was dried with Linde 5A molecular sieves placed in the annular space of a *vacuum trap* and cooled to ice temperature. These were frequently reactivated by heating. Flow rates were measured with Brooks Tru-Taper rotameters with spherical Pyrex floats. These rotameters with dry gases exhibited erratic behavior due to electrostatic charges. This problem was solved by wiping the outside of the tubes and the floats with Anstac M, made by Chemical Development Corporation.

The effluent gases were quenched with a metered stream of cold dry nitrogen. When sufficiently cooled, the combined gases were sampled with a hypodermic syringe, the needle of which pierced a serum stopper in the leg of an appropriate glass tee. Usually these gases were then vented to a stack, but sometimes they were sent to a gas collection system to permit volume measurement and a check of the flow rates.

An especially critical matter is the measurement of temperature. Four chromel-alumel thermocouples (B & S 30 g.) in 1/16 in. O.D. Inconel sheaths were used. The first was cemented to the outside tube wall 1¼ in. before the downstream end of the ethane preheater; the second was ½ in. from the tee joint. The third was embedded in alundum cement 1⅞ in. along the reaction zone proper and the fourth similarly embedded 4¾ in. along the reaction zone. A platinum-platinum 10% rhodium thermocouple of

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The book closes with an excellent set of appendices of tables of Laplace transforms, Z transforms, and signal flow diagram transformations. The tables of nomenclature, subject index, and author index are also well done.

This book is therefore highly recommended to the engineer who wishes to study process control on his own or who wishes an elementary reference text on the subject.

THEODORE J. WILLIAMS
MONSANTO COMPANY

Chemical Reactor Theory, Kenneth Denbigh, Cambridge University Press, London (1965), 184 pages, $6.50.

To anyone who has read one of his previous volumes, the appearance of a new book by Professor Denbigh is a noteworthy event. The readers of the present book will not be disappointed, since the very readable and lucid style is again apparent.

In such a short book, one would naturally not expect to find all the detailed information necessary for the design of a chemical reactor. The intent is rather to provide a survey of the entire field so as to enable the reader to get an overall view without getting too involved in details. This is not to say that there are no numerical examples, but usually they emphasize the problem statement and the interpretation of results rather than computational aspects. This makes the book especially valuable as a starting place for those not very familiar with modern reactor design methods. Also, in contradiction to Professor Denbigh's Preface, the reviewer feels that the audience that may find the book most useful is the busy practicing engineer who wants to find out about this important field. As one of the pioneers in chemical reaction engineering, Professor Denbigh is particularly qualified to discuss the many developments and their meaning in the field.

The topics covered are concerned almost entirely with chemical reactor performance rather than chemical kinetics. The first group of chapters covers the types of reactors commonly used with basic design methods for the plug flow and perfectly mixed cases. The emphasis is on the meaning and limitations of these models as illustrated by a few basic examples. The reasons for choosing one type over the other for the often crucial problem of selectivity with complex reactions completes the section.

The final two chapters discuss the more complicated topics of optimal design and temperature stability problems. The first topic is covered by using logical arguments rather than the extremely complicated formal mathematical apparatus of modern optimization techniques. The most important general principles are brought out in this way and sufficient references are given for the reader interested in further details. The same technique is used in the final chapter where the available published results are organized and discussed as to their practical meaning.

Thus, in summary, the book is a very readable introduction encompassing the vast area of chemical reaction engineering, and should be extremely useful for those who want a good general idea of the current status of the field.

KENNETH B. BISCHOFF
UNIVERSITY OF TEXAS