BOOKS

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Fuel Cells: Their Electrochemistry, John O'M. Bockris and Supramaniam Srinivasan, McGraw-Hill, New York (1969). 659 pages. $20.00

In July, 1964, an editorial in this journal emphasized the importance of scholarly works, "the authors of which must act as interpreters and judges of the burgeoning periodical literature." This book aims at such a high ideal. Unfortunately, it fails to interpret the more sophisticated and difficult to understand papers that have appeared during the last five years. For example, the discussion and criticism of the intersecting-pore model on page 281 is six years out of date. Burshtein, Pshenichnikov, and others of the Academy of Sciences of the USSR have lifted many of the assumptions the authors criticize in papers that have appeared in American publications as long ago as 1966. Although the poorly written Russian papers have the most realistic models that can help the design engineer to build better electrodes they have gone almost completely unnoticed by both the fuel cell manufacturers and until recently even by the academic investigators in this country. The importance of such models, original counterparts of which have appeared in the United States recently, is evident from the pride of some advanced fuel cell developers in showing their agreement of model predictions with experiment. Although these comparisons remain unpublished in company files, this book does not convey the excitement and the sophistication of some of the basic engineering achievements.

The book has a short chapter on the usual thermodynamic aspects of electrochemical devices. A considerably longer chapter gives a good introductory treatment of electrochemistry. Despite the reasonably thorough treatment of basic concepts and the expla-

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Predicting fractionator dynamics by using a frequency domain solution technique, Bollinger, R. E., **AIChE Journal, 16,** No. 4, p. 673 (July, 1970).

Key Words: A. Simulation-8, Fractionators-8, 9, High Purity-0, Linearization-10, Laplace Transformation-10, Control-4, Feed-6, Products-7, Design-4, Controllers-2, Feedforward-0, Mathematical Model-10.

Abstract: Methods are described for predicting the dynamic behavior of high purity fractionators. The paper shows how to model both the composition and hydraulic response in towers with many trays and in towers which are subject to a variety of disturbances. The paper includes a description of the model formulation, solution and validation, and applications including the design of feedforward controllers.

Invariant imbedding, iterative linearization, and multistage countercurrent processes, Lee, E. Stanley, **AIChE Journal, 16,** No. 4, p. 679 (July, 1970).

Key Words: A. Solution-8, Boundary-Value Equations-2, Difference Equations-2, Invariant Imbedding-10, Quasilinearization-10, Design-4, Columns-2, Processes-2, Extraction-4, Distillation-4, Multistage-0, Countercurrent-0.

Abstract: The equations for multistage countercurrent operations are difference equations of the boundary-value type, which are generally solved by trial-and-error or iterative procedures. The invariant imbedding concept is used to solve these boundary-value problems as initial-value problems. It is shown that by the combined use of invariant imbedding and iterative linearization, a sequence of estimator equations for the missing terminal conditions is obtained. These estimator equations can be used to obtain the desired terminal conditions and the number of stages required to perform a specified separation.

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nation of the special language of electrochemistry, the reader may on occasion be compelled to refer to Professor Bockris's other books for more complete explanations. It is interesting to point out that even in the chemistry orientet text such as this, the authors present solutions to the one dimensional diffusion equation to obtain a variation of voltage with time or to calculate the time necessary to cover an electrode with some adsorbed species. To the annoyance of this reader, however, they write the diffusion equation using ordinary derivative Leibnitz notation and occasionally forget to state the necessary conditions to define the mathematical problem. For example, on page 106 they neglect to say that initially the electrode was uncovered. Convective diffusion is nearly dismissed with the statement that at planar electrodes the value of the Nernst diffusion thickness is about 0.05 cm. after steady state behavior has been set up.

There are also chapters on electrocatalysis, electrochemical combustion of organic substances, and electrodic reactions of oxygen. A one hundred page chapter covers various types of fuel cells. Principles of operation advantages, and disadvantages are stated. Performance curves are given, and pictures of hardware are shown. This chapter is up to date and covers a broader area than other books on fuel cells that have been recently published.

Despite the failure to review much of the recent literature, commercials for electricity (page 4), inevitable typographical errors, and some technical inaccuracies, this book is a worthy and scholarly contribution to the literature.

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