Preface

With study of the engineering sciences now a dominant factor in the curricula of many academic engineering departments, only limited time is available for the creative application of theoretical fundamentals to practical chemical processing problems. In particular, the study of process design and financial evaluation is often either disregarded or given only cursory attention. As a result, the young engineering graduate frequently encounters difficulties in becoming acclimated to the environment of a commercial organization and in maximizing the benefits which can be generated from his technical background.

In order to prepare its students more fully for the challenges of industrial work, the M.I.T. Chemical Engineering Department has developed two specific programs. First, the department's School of Chemical Engineering Practice exposes graduate students to actual problems in an industrial environment under the direct and close supervision of a faculty member. This program has been in operation for over fifty years and has proven to be an effective contributor to a student's total academic experience. To complement the Practice School program, a senior-year synthesis course in process design has been developed. Professor Thomas K. Sherwood summarized his original work in the development of the M.I.T. process design course in his text "A Course in Process Design". The course, as conceived by him, is based upon a series of design cases; for each case the student is required to devise and analyze process schemes that might lead to the solution of the design problem.

The present text seeks to combine some aspects of the Practice School program with elements of Professor Sherwood's case-study approach to instruction in engineering design. It is hoped that the result of this combination will not only be useful as a text for academic process design instruction but will also serve as a reference book for the young engineer embarking on a career in industry.

An introductory chapter briefly describes the interaction and interdependence of market research, process design, and financial evaluation functions in commercializing a chemical product. Methods of planning and analyzing laboratory experiments, of utilizing market and financial information, and of preparing and presenting a chemical process design are discussed. The introduction is followed by a series of six case studies in engineering design, typical of those encountered by a young engineer in his initial industrial assignments. The need for accurate analysis and correlation of laboratory data is given great emphasis. Secondly, the need for devising creative and practical solutions to processing problems is given some discussion. Finally, each case illustrates methods of combining technical and financial information to provide a realistic evaluation of a proposed process. Each case is concluded with a recommended design as well as suggestions for further work that would be required in subsequent, more detailed, design efforts.

A great deal of emphasis has been placed on the use of the digital computer in the analysis and presentation of design problems; computer programs are presented for three of the cases discussed. These programs and others like them have proven to be particularly stimulating when used in a "computerized classroom," wherein the student can communicate directly with the machine. In preparing portions of the text, it has been assumed that the reader has at least some knowledge of the FORTRAN coding language.

The present volume was written while the author served as Director of the Bound Brook Station of M.I.T.'s School of Chemical Engineering Practice. This station is located with the Organic Chemical Division of the American Cyanamid Company, Bound Brook, New Jersey. The data used in the preparation of Chapter 3 were gathered by a student group as a part of a project at the Bound Brook Station. The author is grateful to American Cyanamid for its permission to use these data as well as for the company's hospitality during the 1965-66 and 1966-67 academic years.

Many individuals have contributed substantially to the case studies summarized in this book. First of all, thanks are due to Professor Thomas K. Sherwood, who has continued his guidance in the instruction of chemical process design at M.I.T. It was he who originally suggested the preparation of the present text, and Chapters 2 and 4 are based almost entirely on design cases developed by him for his process design courses. Sincere appreciation is expressed to Professor Robert York of Cornell University for his guidance in the economic evaluation of chemical projects and for his instructive review of portions of the present text. Professors C. J. King and Scott Lynn of the University of California in Berkeley were kind enough to review the entire text of this book. Their comments were particularly significant in giving additional breadth and meaning to several of the case studies. Dr. Howard Kehde and his colleagues at Dow Chemical Company, Midland, Michigan, very kindly reviewed the cases concerned with styrene production; their comments provided an invaluable dimension to those cases by bringing to bear the knowledge and sophistication of a major producer of styrene monomer. Professor Giles R. Cokelet of California Institute of Technology provided a valuable commentary on the sulfur transportation case. Professor R. G. Thorpe of Cornell University originally acquainted the author with some of the difficulties

associated with the vacuum fractionation of styrene-ethylbenzene mixtures; this information was most useful in the preparation of Chapter 6. The data used as a basis for Chapter 3 were gathered under the direction of Professor Michael Modell of M.I.T.; his cooperation in making this information available is greatly appreciated. Several former teaching assistants and students at M.I.T. contributed substantially to the development of computer programs for Chapters 5, 6, and 7. In this respect, special thanks are due to Robert L. Blumberg, Bruce Crocker, Avelino R. Rodriguez, and Robert L. Sandel.

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