

HANDBOOK OF SYNFUELS TECHNOLOGY

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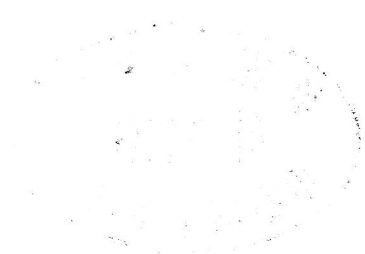
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PREFACE

Within the next twenty years, world petroleum and natural gas production will level off and begin a slow decline, even though there will be both new discoveries and application of advanced recovery methods. However, increasing world population and aspirations toward improved quality of life require increased utilization of liquid fuels for transportation and gaseous fuels for heating and chemicals production.

Synthetic fuels from coal, oil shale and oil sands are needed to make up the shortfall in liquid and gaseous fuels. Plants producing these synthetic fuels are expected to provide on the order of five million barrels/day ($8 \times 10^3 \text{ m}^3$ or $8 \times 10^8 \text{ L/day}$) of liquid fuels by the year 2000 and an even larger energy equivalent of synthesis, medium-Btu and synthetic (substitute) natural gases.

This Handbook is international in scope and presents chapters on each of the synthetic fuels technologies which are either presently on stream or at pilot plant or demonstration plant scale. Most of the technologies are presently licensable and will be heavily utilized in meeting future global fuel needs.

Technologies developed in the Federal Republic of Germany, England, the Netherlands, Canada, and South Africa are presented along with the latest systems developed in the United States.

The Handbook is intended to become the major basic source of synfuels technology information. Engineers and scientists in government and industry who are performing research or planning projects will use the Handbook to provide comparative data on synfuels technology and economics. Managers and legal, advocate, and media personnel will use the Handbook as a reference for evaluating proposals, performing planning functions, assessing information, and for preparing presentations to higher management or to the public.

All of the oil, coal and natural resource companies should have access to this Handbook at a number of levels: central engineering, corporate research, technology and licensing and commercial development. Engineering, design and construction companies as well as consultants must also have copies of this book. Finally, the book will serve as a resource text for college courses on synthetic fuels production.

Insofar as is appropriate for each technology, the technology chapters were prepared by the process developers or the licensors in accordance with the following chapter format.

1. General process description and block flow diagram
2. Process chemistry and thermodynamics for each major process unit
3. Pilot plant description and data (This section of each chapter is applicable to processes not yet proven on a commercial scale.)
4. **Process Perspective.** Developers, sponsors, location, and specifications of all test and commercial plants; near-term and long-term plans.
5. **Detailed process description.** Process flow diagram(s) with mass and energy balances for major process variations and feeds; details of unique or key equipment; illustrations of each major unit operation and the internals of special equipment with legends and annotations; and photographs of total plant, if constructed.
6. **Product and By-Product Specifications.** Detailed analyses of all process synfuels and by-products as a function of processing variations and feeds, product stability, and interchangeability with conventional fuels.
7. **Upgrading technology.** Conversion of raw product to refinery feed grade, as appropriate.
8. **Wastes and emissions.** Analyses of process solid, liquid, and gaseous emissions as a function of processing variations and feeds.
9. **Process economics.** Installed capital cost by major section for one or more developer-selected plant sizes; total capital investment, with the basis of each factor stated; operating costs by category, with utility and feedstock costs defined; annualized capital costs with basis; price for each synfuel and by-product on a stated basis.
10. **Summation.** Process cost per unit of product; energy efficiency; cost of water, electricity, and other utilities per unit of product.

Advanced technologies for the production of liquid fuels from coal and a chapter on the important Sasol synfuels complex in South Africa are presented in Parts 1 and 2 of the Handbook. These processes produce, variously, synthetic petroleum crudes, refined synthetic petroleum liquids, methanol, and gasoline.

Part 3 contains twelve gasification technologies; of these, several have been in operation at many sites for a number of years and others are at major pilot plant scale. In addition, there is a concluding chapter on synthetic gas treatment. Part 4 of the Handbook contains separate chapters on five shale oil processes, a chapter on preretorting beneficiation, and a survey chapter comprising the history of shale oil production and descriptions of additional technologies.

Oil from oil sands (Part 5) is presented in two chapters: one on the single technology now in commercial application and a survey chapter on the large number of emerging technologies in this field. The final section of the book deals with the upgrading and refining of the synthetic fuels obtained in the various processes. The four chapters of this section present major licensable upgrading technologies.

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A distinguished group of more than sixty scientists and engineers from twenty-seven firms and a research institute prepared the thirty-three chapters of this Handbook. These contributors are listed on pages ix to xi, and we wish to acknowledge the support of their sponsoring organizations.

An Advisory Board was established whose members contributed to the guidance documents which were supplied to each of the chapter authors. The members of this board are listed on page vii.

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