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Project Summary

Synthetic Fuel Pollution Control Technical Manuals

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EPA's Office of Research and Development has prepared six technical handbooks on synfuels, entitled Pollution Control Technical Manuals.

These manuals are designed to help government officials granting permits to build synfuel facilities, synfuel process developers, and other interested parties. They provide technical data on waste streams from synfuel facilities and technologies capable of controlling them. Process technologies covered in the manuals include coal gasification, coal liquefaction by direct and indirect processing, and the extraction of oil from shale. The manuals offer no regulatory guidance, allowing the industry flexibility in deciding how to best comply with environmental regulations.

This Project Summary was developed by EPA's Office of Environmental Engineering and Technology, Washington, DC, to announce key findings of the research project that is fully documented in separate reports of similar title (see Project Report ordering information at back).

Overview

With careful planning, the Nation should be able to achieve its dual goals of producing more energy and protecting the environment. One element of this effort is the development of a synthetic fuels industry. If the planning process is to evolve successfully, however, information needs to be gathered and made available to permit officials, developers, and others involved with the energy industry. The U.S. Environmental Protection Agency (EPA), in keeping with the Congressional intent in legislation governing environmental activities, is working closely with the Department of Energy, the Synthetic Fuels Corporation, representatives of the synthetic fuels industry, and state governments to develop the kind of information that would ensure that these national goals can be met.

EPA wants to help see that the potential environmental concerns raised by this new industry are reduced in as thorough and cost effective manner as possible. One of the efforts to accomplish this is the preparation of the synthetic fuel Pollution Control Technical Manuals (PCTMs) by EPA's Office of Research and Development. For the past several years this Office has been characterizing the waste streams from various synfuels processes to determine which pollution control technologies can be applied to U.S. synfuels plants. A significant product of these studies is this series of PCTMs which provides technical data for government permitting officials, designers of synfuel processes, and other interested parties. The PCTMs contain no legally binding requirements, no policy or technological recommendations, and nothing that would relieve a facility from complying with existing or future environmental regulations or permit requirements.

PCTMs for Coal and Oil Shale Fuels

Synthetic fuels are generally understood to include liquid, gaseous, and solid fuels produced by converting coal, oil shale, tar sands, and various forms of biomass. Only coal and oil-shale resources are considered in the PCTMs. Environmental problems resulting from synthetic fuels production addressed in the PCTMs from these two resources include: waste originating from shale mining* and feedstock transport, multipollutant waste streams

*Coal mining waste problems are not addressed in the PCTMs

from the conversion processes, large scale waste handling and disposal needs, and a broad range of other environmental considerations posed by diverse geographic plant sitings.

The PCTMs cover a range of alternative fuel processes including coal gasification, coal liquefaction by direct and indirect processing, and the extraction of oil from shale. Both the coal and oil-shale PCTMs are based on specific conversion processes; the oil-shale manuals are also site specific. A single PCTM appendix volume describes the operation and application of approximately 50 pollution control processes and/or systems.

Process Technologies Covered by PCTMs

Each PCTM covers a process for converting coal or oil shale to synfuels. It examines the waste streams from that process and presents the available methods for controlling that waste. Although the six process technologies covered in the PCTMs are not exhaustive, they do span a wide range of waste streams and possible controls for these streams and are broadly representative of a number of plants currently being planned and under construction. The six process technologies are:

- Lurgi-Based Indirect Coal Liquefaction and High-Btu Gasification. The dry ash Lurgi gasifier was developed by Lurgi Kohle and Mineralotechnik GmbH, West Germany, to generate a synthesis process feed gas. Product-synthesis technologies used in the Lurgi process include: methanation to produce substitute natural gas (SNG), methanol synthesis, Mobil M-gasoline synthesis from methanol, and Fischer-Tropsch synthesis. The three coal feeds considered in the PCTM include Illinois No. 6 bituminous; Montana-Rosebud subbituminous; and Dunn County, North Dakota, lignite.
- Koppers-Totzek (K-T)-Based Indirect Coal Liquefaction. The K-T gasification technology is licensed by Krupp Koppers, GmbH, Essen, West Germany (Gesellschaft fur Kohle-Technologie for licensing within the U.S.). The manual examines the same three product-synthesis technologies for liquid products as the Lurgi PCTM: Fischer-Tropsch liquids, methanol, and Mobil M-gasoline. A single-coal feed (Illinois No. 6 bituminous) is considered throughout the manual, although there is some discussion of the impacts of alternative coal feeds.
- Exxon Donor Solvent (EDS) Direct Coal Liquefaction. The Exxon Research and Engineering Company has developed a direct coal liquefaction technology. To illustrate the effect of process design on possible discharge and controls, this manual considers two configurations of the EDS process (and briefly discusses a third). It also examines a single-feed coal (Illinois No. 6 bituminous), although it briefly discusses some effects of other coal types.
- Lurgi-Ruhrgas Oil Shale Retorting Process with Open Pit Mining. Lurgi Kohle and Mineralotechnik GmbH, West Germany, developed this retorting technology for use with western U.S. oil shales. This manual represents a commercial-scale Lurgi oil shale plant design, coupled with an open pit mine, proposed by Rio Blanco Oil Shale Company for use in the development of their federal oil shale lease in western Colorado.
- Modified In Situ Oil Shale Retorting Combined with Lurgi Surface Retorting. The Lurgi surface retorting technology was developed by Lurgi Kohle and Mineralotechnik GmbH, West Germany, and the Modified In Situ retorting technology was developed by Occidental Oil Shale, Inc. This manual describes applying this combination of technologies as proposed by Occidental and Tenneco Shale Oil Company for developing their federal oil-shale lease Tract C-b in western Colorado.
- TOSCO II Oil Shale Retorting with Underground Mining. The Oil Shale Corporation (a subsidiary of the TOSCO Corporation) developed this retorting technology. The TOSCO II oil shale facility described in this manual is the plant design proposed by Colony Development Corporation (joint venture of the TOSCO Corporation and Exxon Company, USA) for commercial development of its oil shale resources in western Colorado. The plant was to combine the TOSCO II retorting technology with underground room and pillar mining.

Process Technology Features

Tables 1 and 2 present the major features of the process technologies used for converting coal and oil shale to synfuels. The coal gasification and liquefaction PCTMs are prepared on a base-plant concept, and the oil shale PCTMs

Table 1. Major Plant Complex Features of the Coal PCTMs

	PCTMs		
Feature	*Exxon Donor Solvent*	*Lurgi*	*Koppers-Totzek*
COAL TYPE			
Illinois No. 6 (bituminous)	x	x	x
Montana Rosebud (subbituminous)		x	
Dunn County, ND (lignite)		x	
CONVERSION			
Coal to Product	*direct*	*indirect*	*indirect*
Temperature (°C)	*450*	*700*	*1430*
Pressure, MPa	*14*	*2.7*	*atmospheric*
Shift Conversion		x	x
PROCESSING			
Fischer-Tropsch Synthesis		x	x
Substitute Natural Gas		x	
Methanol Synthesis		x	x
Mobil M-Gasoline Synthesis		x	x
Product Separation and Upgrading	x	x	x
POLLUTION CONTROL			
Gas Cleanup	x	x	x
Process Water Cleanup	x	x	x
By-Product Recovery	x	x	x
WASTE DISPOSAL			
Discharge to Surface Waters	x	x	x
Discharge to Surface Impoundments	x	x	x
Discharge to Deep Well Injection	x	x	x
Surface Landfill	x	x	x

Table 2. Major Plant Complex Features of the Oil Shale PCTMs

Feature	PCTMs: TOSCO II	Modified In-Situ Lurgi	Lurgi-Open Pit
MINING			
Underground			
Room and Pillar	x		
Underground MIS		x	
Open Pit			x
RETORTING			
Aboveground	x	x	x
Underground		x	
Direct-Heated		x	
Indirect-Heated	x	x	x
Solid-to-Solid Heat Transfer	x	x	x
Gas-to-Solid Heat Transfer		x	
PROCESSING			
High Btu Off-gas	x	x	x
Low Btu Off-gas		x	
Oil Fractionation	x	x	x
Oil Upgrading	x		
Gas Upgrading (for sale)	x		x
POLLUTION CONTROL			
Retort Gas Cleanup	x	x	x
Process Water Cleanup	x	x	x
Excess Water Discharge			x
By-Product Recovery	x	x	x
WASTE DISPOSAL			
Surface Landfill	x	x	
MIS Retort Abandonment		x	
Open Pit Backfill			x

are keyed to developer-proposed designs. Although the oil shale designs may not fully reflect plants to be built in the future, the basic information in the manuals should generally still be applicable.

The PCTMs are organized similarly, describing the process technology, presenting the material and flow balances, characterizing the waste streams, and offering examples of technologies for controlling multimedia pollution. The examples are control technology applications both for individual process units and integrated control systems. They are taken in part from permit applications and therefore reflect specific plants. These examples are presented for illustrative purposes only, and are not intended to convey an EPA endorsement or recommendation. The selection of control technologies for application to specific plants is the exclusive function of the plant designers and permitters who have the flexibility to evaluate and concur on the most effective approaches. Throughout the manuals the emphasis is primarily on those features which are unique to synthetic fuels conversion processes.

Three significant points need to be kept in mind when using the data presented in the PCTMs:

- No fully integrated, well-controlled commercial plants of the type discussed in the PCTMs have been constructed to date. Thus, in using the data base presented, readers are cautioned to take careful note of the documented limitations. Further, engineering assumptions were made to resolve apparent differences in data obtained from test facilities having widely differing feedstocks, design, operational characteristics, and site specific constraints.
- The PCTMs do not attempt to address all of the issues that will be important in selecting and designing environmental control systems for new synfuels facilities. Since the PCTMs focus on streams that tend to be unique to synfuels facilities, waste streams similar to those routinely encountered in other industries for which regulatory precedents already exist are recognized but not treated in depth. Further, the PCTMs focus primarily on controls for point sources of pollution -- not on the ambient impacts of the waste streams -- and do not address issues related to worker's health and safety, noise, and socioeconomic or ecological impacts.
- Cost estimates for all control technologies were based on published data and vendor-supplied estimates. These data were extrapolated to 1980 to provide a consistent basis for comparing the costs of alternate controls. Although the cost estimation techniques used in the coal and oil shale manuals are somewhat different, the differences should not affect the reader's understanding of the relative cost of controls for each fuel resource.

Despite these limitations the PCTMs should be very helpful to the synfuels industry as they attempt to avoid costly retrofits by carefully designing their process technologies, understanding the waste streams created, optimizing their product outputs, and monitoring plant operations. The EPA is confident that environmentally acceptable U.S. synthetic fuels plants can be built in a timely manner and will work toward this goal. One of our efforts toward accomplishing this goal is the publication of these PCTMs.

Monitoring Reference Manual

While the PCTMs address the problems of controlling wastes from synthetic fuels plants, they do not address the issue of environmental monitoring. This issue is of particular interest to those plants which receive financial support through the U.S. Synthetic Fuels Corporation (SFC). Section 131(e) of the Energy Security Act of 1980 (P.L. 96-294) states "Any contract for financial assistance shall require the development of a plan, acceptable to the Board of Directors, for monitoring of environmental and health related emissions from the construction and operation of the synthetic fuel project. Such plan shall be developed by the recipient of financial assistance after consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, and appropriate agencies."

Therefore, as a complement to the PCTMs, EPA is also developing a Monitoring Reference Manual. This manual will discuss the pollutants that are expected to

be produced by a wide range of technologies and will outline various methods for monitoring them. Like the PCTMs, it will contain no new requirements of any kind, and should be useful to all those who are interested in designing cost-effective approaches for environmental protection. Final drafts should be ready in late spring, 1983, and publication is expected later in the year.

*This Project Summary summarizes seven reports and was prepared by EPA authors **Gregory G. Ondich**, Office of Environmental Engineering and Technology, Washington, DC 20460; **D. Bruce Henschel** and **William J. Rhodes**, Industrial Environmental Research Laboratory, Research Triangle Park, NC 27711; **Edward R. Bates**, Industrial Environmental Research Laboratory, Cincinnati, OH 45268.*

The seven reports are as follows:

"Pollution Control Technical Manual: TOSCO II Oil Shale Retorting with Underground Mining," (Order No. PB 83-200 212; Cost: $32.50)

"Pollution Control Technical Manual: Modified In Situ *Oil Shale Retorting Combined with Lurgi Surface Retorting," (Order No. PB 83-200 121; Cost: $32.50)*

"Pollution Control Technical Manual: Lurgi Oil Shale Retorting with Open Pit Mining," (Order No. PB 83-200 204; Cost: $28.00)

"Pollution Control Technical Manual for Lurgi-Based Indirect Coal Liquefaction and SNG," (Order No. PB 83-214 478; Cost: $46.00)

"Pollution Control Technical Manual for Exxon Donor Solvent Direct Coal Liquefaction," (Order No. PB 83-214 486; Cost: $41.50)

"Pollution Control Technical Manual for Koppers-Totzek Based Indirect Coal Liquefaction," (Order No. PB 83-214 502; Cost: $35.50)

"Control Technology Appendices for Pollution Control Technical Manuals," (Order No. PB 83-214 734; Cost: $52.00)

The above reports are available only from:

National Technical Information Service
5285 Port Royal Road
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Telephone: 703-487-4650

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