PLEASE RETURN

SECTION II

ANNOTATED BIBLIOGRAPHY

INDEX TO ANNOTATED BIBLIOGRAPHY

The index is organized in the same fashion as the text. Particularly pertinent references have been underlined. Note that documents on specific technologies, such as Lurgi, may be found in several sections (e.g. Technology description under both Lurgi and General, Air Pollution, Water and Solid Wastes).

TECHNOLOGIES

Technology Description - Gasification

Technology Description - Liquefaction

Unit Process Descriptions

SOCIAL IMPACT

MISCELLANEOUS

001

Abbey, D.
Water Use for Coal Gasification: How Much Is Appropriate, LA-8060-MS, Los Alamos, New Mexico, Los Alamos Scientific Laboratory, 18 pages, October 1979.

Availability: Abstract only

Purpose/Topic:
Water Needs in Coal Gasification Useful

Reviewer's Comments: (N.Z.)
This report indicates the variation in estimated water requirements for coal gasification plants. Water requirements are highly dependent on the use of dry cooling and the moisture content of the coal. In the long run, economics (cost of water) dictate water requirements.

002

American Gas Association
Proceedings of Ninth Synthetic Pipeline Gas Symposium, Arlington, Virginia, American Gas Association, 648 pages, 1978.

Availability: Environmental Library

Purpose/Topic:
Gasification Technologies Useful

Reviewer's Comments: (R.E.)
I attended both the eighth and ninth symposia and summarized (for DNRC) the papers delivered at the eighth. As is usually the case for a rapidly developing technical field, the utility of the meetings (and the papers delivered) is transient. We do not have the most recent volumes but would advise DNRC to purchase the 1980 volume.

Examples from the 1977 symposium:

1) Five papers on the status of pilot plants.
2) Eight papers on methanation/combined shift methanation.
3) Status of SASOL II (notes that H_2S is emitted directly at 50 ppm and that their ash disposal system of ponding with impervious clays has never leached toxic substances into the groundwater for a 2-3 year operation period.)
4) Five papers on environmental consideration (includes two very good papers on sulfur-removal--one by W.M. Seward of C.F. Brown, who sets up a methodology for how to select a removal system, the other by W.J. Strycin, also of C.F. Brown, who compares systems. Also there is a paper on Guidelines for New Source Performance Standards for Lurgi plants).

003

Anastasia, L.J., et al.
Environmental Aspects of the HYGAS Process, Chicago, Illinois, Institute of Gas Technology, pgs. 79-87, 1977.

Availability: Environmental Library

Purpose/Topic:

Air	Not Useful
Health	Not Useful

Reviewer's Comments: (G.B.)

Preliminary report on proposed Hygas monitoring project. This document yields little or no specific information as it is only a progress report early in their monitoring program.

Part of this report addresses the composition of oil components in coal feed slurry (PNAs, toluene, benzene, BAPs, etc.) for the pilot plant converting Rosebud subbituminous coal. (There is also a section on solid wastes.)

004

Anastasia, L.J., W.G. Bair, and D.P. Olson
Environmental Aspects of the HYGAS Process: Presented at 175th National Meeting of the American Chemical Society, Anaheim, California, Chicago, Illinois, Institute of Gas Technology, 13 pages, March 1978.

Availability: Environmental Library

Reviewer's Comments:

Received too late for comment.

005

Anastasia, L.J., et al.
Environmental Characterization of HYGAS Pilot Plant Water Streams: Presented at the 87th National Meeting of the American Institute of Chemical Engineers, Boston, Massachusetts, Chicago, Illinois, Institute of Gas Technology, 19 pages, August 1979.

Availability: Environmental Library

Reviewer's Comments:
Received too late for comment.

Abstract:

This report discusses data acquisition and interpretation for process water characterization in the HYGAS® pilot plant. Emphasis is placed on the pretreatment and gasification sections, which are considered scalable to larger plants. Aqueous components with potential environmental impacts have been identified, quantified, and, where possible, related to processing parameters and coal type. Biological treatability characteristics are summarized for cyclone and quench waters obtained while processing bituminous coal.

006

Anastasia, L.J., et al., Institute of Gas Technology
"Environmental Characterization of the Hygas Process," in Sixth National Conference on Energy and the Environment, CONF-790571-6, Chicago, Illinois, Institute of Gas Technology, 9 pages, 1979.

Availability: Environmental Library

Reviewer's Comments:
Received too late for comment.

Abstract:

Process streams from the HYGAS® Pilot Plant have been systematically sampled and analyzed to obtain experimental data necessary to estimate the formation and fate of environmental species of interest in large demonstration- and commercial-scale HYGAS coal gasification plants. The HYGAS Pilot Plant uses a coal-oil slurry feeding system and operates at coal feed rates up to 3 tons/hr. The pilot plant units of interest include the pretreater and gasifier reactors which are considered scalable to the larger plants. The areas of interest reported here include water-soluble components, oil-soluble components, minor and trace element distributions, and gaseous non-methane hydrocarbon formation.

Anderson, G.L., Institute of Gas Technology
"Hot Gas Cleanup in Coal Conversion Processes," in IGT Symposium: Advances in Coal Utilization Technology, CONF-790598-3, Chicago, Illinois, Institute of Gas Technology, 24 pages, 1979.

Availability: Environmental Library

Purpose/Topic:
Unit Process Technology Description | Useful

Reviewer's Comments: (R.E.)

Hot Gas Cleanup is a very important developing technology. However, its main use will be for combined cycle power generation, a process which is unlikely to come to Montana for the next ten years.

Since current NSPS require only a reduction of 85% in sulfur content for combined cycle power generation, several technologies appear to be feasible (e.g., Battelle-Northwest's Molten Carbonate System, and the Zinc Oxide Process.)

Abstract:

THE PRIMARY INCENTIVE FOR DEVELOPING HOT GAS CLEANUP PROCESSES FOR COAL CONVERSION PROCESSES IS IMPROVED THERMAL EFFICIENCY. HOWEVER, MOST HOT GAS CLEANUP PROCESSES ARE STILL UNDER DEVELOPMENT AND UNPROVEN UNDER ACTUAL PROCESS CONDITIONS. A REVIEW OF POTENTIAL APPLICATIONS OF HOT GAS CLEANUP PROCESSES IS PRESENTED ALONG WITH A REVIEW OF SOME OF THE HOT GAS CLEANUP PROCESSES UNDER DEVELOPMENT. AS EVIDENT FROM THE ABOVE DISCUSSION HOT GAS CLEANUP TECHNOLOGY IS STILL IN ITS INFANCY. THE CAPABILITIES OF THE DEVELOPING TECHNOLOGIES ARE STILL UNCERTAIN. FURTHER IMPROVEMENTS IN HOT GAS CLEANUP TECHNOLOGY CAN STILL BE EXPECTED WITH CONTINUED SUPPORT, AND APPLICATION TO COAL CONVERSION PROCESSES MAY ONE DAY BE A REALITY.

Argonne National Laboratory, Energy and Environmental Systems Division
A Socioeconomic Assessment of Energy Development in a Small Rural County: Coal Gasification in Mercer County, North Dakota (2 Vols.) by T.E. Baldwin, D.D. Davis, E.J. Stenehjem, T.D. Wolsko, Argonne, Illinois, Argonne National Laboratory, 411 pgs., August 1976.

Availability: Environmental Library

Purpose/Topic:	
Impact Overview	Useful
Case Study and Assessment Methodology of Energy-induced Growth	Significant
Secondary Employment Impacts	Significant
Population Impacts	Significant
Employment Estimates	Useful

Reviewer's Comments: (J.C.)

This report describes a case study and a methodology that are part of an analysis of the overall problem of energy-induced growth in rural America. The case study approach delineates economic (fiscal) and sociocultural effects and attempts to identify and understand the character of the key underlying causal factors. It also serves to validate and improve the methodology for future studies. Volume I provides an overview of the content in which the research was undertaken. It summarizes the most important assessment conclusions draws, and describes a framework for interdisciplinary assessments of socioeconomic impact.

The study is divided into three portions: 1) Introduction, Background, etc., 2) Assessment of Economic and Sociocultural Impacts, and 3) A Framework for Interdisciplinary Assessments. Pertinent to social impact is Section 2.2, which analyzes the sociocultural impacts, by means of a social survey. The survey was conducted over the phone, and the accuracy of this method was checked by computer systems. The authors explain the strengths and weaknesses involved with this method as well as identify secondary sources from which additional data was obtained.

This section makes the assumption that this sort of development will have the greatest impact on three particular sociocultural dimensions of the town. These are: 1) demographic composition, 2) quality of life, and 3) expectations for the future. Each of these topics is addressed by certain questions from the survey, and appears to be considered adequately.

The analysis does point out that the population projections assume the development of a specific type of coal gasification plant--in a certain site--and should not be transferred or assumed to apply to all other areas. However, applicability to Eastern Montana is pertinent due to the similarities in geographic location, population size and common employment trends of the current populace.

008 (Continued)

Reviewer's Comments: (T.S.)

Vol. 2 is of particular interest, providing a detailed description of analytic methods used and results obtained. Technical data on the plant is based on a 1974 industry proposal referenced in Woodward-Environ Inc., Socioeconomic Characterization and Assessment of the North Dakota Coal Gasification Project Area (prepared for the Michigan-Wisconisn Pipeline Co., Sept. 1974).

Good discussions of induced employment projection methodologies, and of population distribution impacts.

Its general approach is relevant for eastern Montana because the prevailing socioeconomic characteristics in the study area are similar to those in eastern Montana coal counties. However, technological advances since 1974 probably have made the actual numbers in the study unreliable. It also fails to consider the potential for explicit state policy strategies in managing population impacts--i.e. active rather than reactive planning.

009

Atlantic Richfield Co., Colony Development Operation
An Environmental Impact Analysis for a Shale Oil Complex at Parachute Creek, Colorado, Volume 3, Denver, Colorado, Atlantic Richfield Co., 257 pages, 1974.

Availability: R. Gold

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (J.M.)
Study was done to determine present status of the region and to analyze any socioeconomic impacts as a result of shale oil complex proposal. Traditional treatment of most impacts, presented in clear, readable form (designed so casual reader can glean general facts). Scope of analysis is limited almost exclusively to the secondary impacts (infrastructure, economy, housing, etc.) induced by population increases in a three-county area.

ARCO also sponsored a public opinion survey in 1973, which was done by a market research firm. The survey involved 600 residents in a three-county area. A 22-page questionnaire was used. Public officials in a four-county area were also interviewed. No mention is made of any preliminary work done on a community level to prepare respondents for the study and no mention is made of whether or not they were well-informed of anticipated development and impacts to be expected from it. Most questions asked were closed-ended questions (agree/disagree--no intervals). Apparently only eight questions on a 22-page questionnaire dealt directly with residents' attitudes toward the proposed oil shale project--these questions tended to be exceedingly ambiguous, considering the close-ended nature of the questions.

Abstract:
The socio-economic discussion contained in this analysis is divided into three sections. The first relates to a historical inventory of the present status and facilities of Garfield, Rio Blanco, and Mesa counties. The second section of the analysis presents a brief summary of the environmental programs which have been conducted in connection with off-site development. The third section contains an analysis of potential socio-economic impacts upon the counties of Garfield and Mesa, which may result from various development patterns. In addition to the detailed information contained in the inventory and to some degree the analysis and the general information provided in the text, this discussion was meant to include a wealth of source material.

The document ends with a section of conclusions concerning land use plans, policies and controls, addressing potential land use conflicts and pointing to policies of federal, state and local governments as well as advisory planning agencies. Alternatives to oil shale development, unavoidable adverse environmental impacts,

009 Cont.

Abstract: continued
irreversible resource commitment, and national energy policy are among the items discussed, along with the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.

010

Baughman, G.L.
Synthetic Fuels Data Handbook, Denver, Colorado, Cameron Engineers, Inc., 438 pgs., 1978.

Availability: University of Montana Library

Purpose/Topic:
Solid Wastes | Not Relevant

Reviewer's Comments: (C.K.)
Contains almost no information of use on solid wastes from coal gasification or liquefaction.

Reviewer's Comments: (R.E.)
Excellent short descriptions of all potentially useful gasification and liquefaction technologies. Good description of basic chemistry engineering too. The total of 81 pages on pertinent synfuel processes (out of 435 total pages) may seem meager, but the data and accompanying words are well selected.

The remainder of the volume (oil shale, coal characteristics, and oil sands) is of value also.

011

Beavon, D.K., R.H. Hass, B. Muke
"High Recovery, Lower Emissions Promised for Claus-Plant Tail Gas," Oil and Gas Journal, Vol. 77, No. 11, pgs. 76-80, March 12, 1979.

Availability: Environmental Library

Purpose/Topic:
Unit Process - H_2S Removal | Significant

Reviewer's Comments: (R.E.)
Describes the Beavon Sulfur Removal/Selectrox I Process for Claus tail gas.

The process aims at recovering 98.5% to 99.5% of sulfur in gas streams and is now being used in Germany.

1) Claus tail gas is hydrogenated (converts SO_2 to H_2S and S) and hydrolized (to convert COS and CS_2 to H_2S).
2) Gas is cooled to condense water (small amounts of H_2S removed from this water and water re-used or discharged).
3) Gas stream oxidized (proprietary catalyst) to sulfur.

The process is cheaper than the BSR process, but does not remove all of the sulfur (BSR removes 99.99% of the sulfur).

012

Bender, L.D., L.C. Parcels
An Introduction to the COALTOWN Impact Assessment Model, Bozeman, Montana, Montana State University, 1980.

Availability: Montana State University

Purpose/Topic:

Describes Econometric Model Used to Determine Population, Employment and Fiscal Impacts from Coal-related Development in the Northern Great Plains	Significant

Reviewer's Comments: (T.S.)

Describes an econometric model developed at MSU for near-term prediction and assessment of socioeconomic impacts caused by energy development. The model simulates future employment, population, wage levels, migration, state and local tax receipts, and local expenditures for counties in Montana, Wyoming and North Dakota. The model has three principal uses: prediction of absolute levels of population, employment, migration and other impact variables for planning purposes; assessment of impacts due to a specific project for evaluation purposes; and assessment of sensitivity of results to various measures as an aid in policy analyses.

The model in its present form is a prototype. Although it has been used primarily for coal mining and power plant projects, it could be structured to assess synthetic fuel plants.

See Bender, et al. (1980), "Impacts of Coal Mining and Conversion in Northern Plains States" for additional information on the kinds of results generated by the model.

013

Bender, L., et al.
Impacts of Coal Mining and Conversion in Northern Plains States, Paper Presented at Land Use Issues of Nonmetropolitan America Conference, Bozeman, Montana, Montana State University, 1980.

Availability: Montana State University

Purpose/Topics:

Ancillary Employment Estimates	Significant
Population Impacts	Significant
Fiscal Impacts	Significant

Reviewer's Comments: (T.S.)

A good summary of the MSU/USDA COALTOWN econometric model projections: includes four energy development scenarios (including two scenarios involving synfuel plants) for three coal counties in the NGP (including Rosebud Co., MT.) Also includes an excellent discussion of thc long-term institutional (property rights) implications of western coal development.

Probably the only source of economic impact data that is specific to Montana. However, the model's projections should be considered rough approximations of the magnitudes involved; they are not precise enough for detailed planning and impact analysis.

014

Bozeman Daily Chronicle
"Synfuel Water Needs Lower," Bozeman Daily Chronicle, p. 20, June 3, 1980.

Availability: Montana State University Library

Purpose/Topic:
Water Requirements for Synthetic Fuel Plants   Useful

Reviewer's Comments: (N.Z.)
The assessment by the U.S. Water Resources Council, based on a report by the Missouri River Basin Commission, says construction of plants to produce synthetic fuels with the energy equivalent of 1.7 million barrels of oil per day would require up to 350,000 acre feet of water per year. The council's report conflicts with the U.S. Department of Energy's report prepared for President Carter a year ago. That report said that consturction of plants producing the energy equivalent of 1.8 million barrels of synthetic fuel a day from coal would consume 468,000 acre feet of water a year.

The assessment said "base" level development at 1.1 million barrels per day oil equivalent would use less water, about 250,000 acre annually.

The council's report said that water use by synthetic fuel plants would reduce hydroelectric power along the Missouri River by less than 1 percent and effects of navigation would be negligible.

The report lists seven water-supply options for synthetic fuel developments along the Tongue and Powder River basins on Montana and Wyoming, including the Gillette area of Wyoming. They include aqueduct systems diverting water from the Big Horn and Yellowstone rivers, the Moorhead Reservoir and Lake Oahe in South Dakota; reservoir storage; purchase of existing agricultural water rights and transfer of water use; and groundwater.

015

Cammage, R.B., and J.E. Turner
"Synthetic Fossil Fuel Technologies: Health Problems and Inter-society Cooperation," in Safe Handling of Chemical Carcinogens, Mutagens, Teratogens and Highly Toxic Substances, Volume I, Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., pgs. 313-327, 1979.

Availability: Environmental Library

Reviewer's Comments:
Received too late for comment.

Carson, D.H., Editor
Man-Environment Themes, No Address, Environmental Design Research Association, Inc., 205 pages, 1974.

Availability: R. Gold

Purpose/Topic:
Preparing for and Handling Impacts Not Relevant

Reviewer's Comments: (K.E.)
Although some substantive material concerning social impacts can be obtained from the articles, much of the collection serves as a means to understanding the roots of Social Impact Assessment and its place in wider, environmental concerns. Of significance to the field of SIA is the article "Cultural Change and Redevelopment: The South Wales Coalfield," authored by Shane Davies and Robin Doughty. The need for decision makers to consider citizen participation and advocacy planning in arriving at new sources of employment in the area is emphasized. Following descriptions of the mining community and the miner's job, changes in the communities with the substitution of light industry are discussed. Hence, the paper analyzes a situation once a major mining operation has been developed and then nearly completed. The methodology, magnitude estimation, which allows respondents to give numerical estimates of their perceptions, is presented as a way to investigate the weight people place on community values, i.e., quality of environment.

Abstract:
Propositions from general ecology and the requirements of human and urban ecology are reviewed in a number of articles. Following an introduction to the field of human ecology, an article concerning the broad social and economic constraints on environmental designers is presented. Also included are articles concerning social design for limited growth, energy forecasting, and local government provisions of environmental amenities and services. A socio-ecological study of classic Maya culture and a study of cultural change and redevelopment in a South Wales coalfield represent case studies included in the collection.

017

Changelian, G.P.
Synopsis of Interim Final Report Conceptual Design of a Coal-to-Methanol Commercial Plant Presented at Fifth International Conference on Coal Gasification, Liquefaction and Conversion to Electricity, Cambridge, Mass., Badger Energy, Inc.

Availability: Environmental Library

Purpose/Topic:
Commercialization Plan Useful

Reviewer's Comments: (R.E.)
Badger Energy Inc. has contracts with DOE to develop conceptual designs for plants to convert coal to methanol and to convert methanol to gasoline. This document is an announcement of the latter task and a review of the former.
It's a very big operation--1700 acres; 63,000 tons of coal/day; 58,200 tons methanol/day.
They suggest using a Rummel/Otto gasifier at atmospheric pressure to produce the synthesis gas for methanol production. Overall thermal efficiency projected (to methanol) is 59%.
The size of such enterprises is overwhelming. Particularly disturbing are emission figures given in relative rather than absolute terms. Thus, 250 ppm SO_2 doesn't sound bad, until one calculates the amount being spewed out.

018

Chapel, D.G.
Initial Operation at the Cresap Test Facility, Irvine, CA, Fluor Engineers & Constructors, 11 pgs., August 1978.

Availability: Environmental Library

Purpose/Topic:
Test Facility Not Immediately Relevant

Reviewer's Comments: (R.E.)
In 1968-70, Cresap was used to test the Consol Donor-Solvent system. Now Fluor (under a DOE contract) is operating the facility as a testing arena for various unit processes used in liquefaction. At the time of this report the plant had been operating for a very short time, and was still having various types of mechanical problems.

Clark, B.R., et al.
Biologically Important Compounds in Synfuels Processes, paper delivered at 179th National Meeting of the American Chemical Society (Houston, Texas), Oak Ridge, Tennessee, Oak Ridge National Laboratory, 24 pages, March 25, 1980.

Availability: Authors

Purpose/Topic:
Mutagenicity of Compounds in Synfuels Processes — Useful

Reviewer's Comments: (N.Z.)
This report details preliminary results of mutagenicity testing of compounds in synfuels processes. There is substantial information for anyone studying this topic and some general conclusions which are useful.

Alkaline constituents of the petroleum substitutes are often major contributors to their mutagenicity.

In contrast, the mutagenicities of petroleum crudes is determined almost solely by the neutral constituents as would be expected if polycyclic aromatic hydrocarbons (PAHs) were the determinant constituents.

Polycyclic aromatic primary amines (PAAs) are found to predominate in the mutagenic isolate and are found to exhibit exceptionally high mutagenicities. These results suggest that PAAs should be monitored in occupational and environmental assessment components of technology development programs. They also suggest that engineering steps capable of degrading primary amine functionalities or removing highly alkaline constituents may be effective in reducing the mutagenicity of petroleum substitutes.

Abstract:
Crude products, by-products and wastes from synfuel processes contain a broad spectrum of chemical compounds--many of which are active in biological systems. Discerning which compound classes are most important is necessary in order to establish effective control over release or exposure. Polycyclic aromatic hydrocarbons (PAH), multialkylated PAH, primary aromatic amines and N-heterocyclic PAH are significant contributors to the overall mutagenic activities of a large number of materials examined. Ames test data show that the basic, primary aromatic amine fraction is the most active. PAHs, multialkylated PAHs and N-heterocyclic PAHs are all components of the neutral fraction. In nearly all cases, the neutral fractions contribute the largest portion of the mutagenic activity, while the basic primary aromatic amine fractions have the highest specific activity. Neutral fractions are small by comparison; thus, the overall greater contribution of the neutral fraction to the mutagenic activity of most samples. Biologically active constituents are isolated in preparative scale amounts from complex mixtures utilizing combinations of liquid-liquid extraction and various liquid chromatographic column-eluent combinations. Fractions are characterized using a combination of spectroscopic techniques and gas chromatography/mass spectrometry.

020

Combs, L.P., et al.
Rockwell International Gasifier--Flash Hydropyrolysis prepared for the Fifth Annual International Conference on Coal Gasification, Liquefaction and Conversion to Electricity, Canoga Park, CA, Rockwell International, 16 pgs. + append., August 1978.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - Rockwell International Useful

Reviewer's Comments: (R.E.)
Excellent reviews of Rockwell progress through 1977. Work on Rosebud coal was less successful (less carbon conversion to gases) than with Kentucky coals or with peat.

021

Coon, R.C., et al.
The Impact of the Safeguard Antiballistic Missile System Construction on Northeastern North Dakota, Agricultural Economic Report No. 101, Fargo, North Dakota, North Dakota State University, Agricultural Experiment Station, 70 pages, April 1976.

Availability: R. Gold

Purpose/Topic:

Impact Overview	Useful
Preparing for and Handling Impacts	Useful

Reviewer's Comments: (K.E.)

Following an overview of the local economic situation and infrastructure of the community, a general treatment of socio-economic impacts is attempted in this report. An increase in population and the influx of construction workers is discussed, along with housing problems, upgrading public utilities, over-crowding and new construction of schools, expansion of law enforcement personnel and facilities, rise in crime rates, increase in hospital capacity. Stimulation of the area's economy with increased employment, business sales, and personal income, is noted. Changes in way of life are defined as follows: changes in community organizations (recreation, churches, leadership) which lead to changes in quality of life. While the discussion of impacts is not highly detailed, information regarding the planning and assistance provided to the community and the future of rapid decline of the area is not expanded on. Secondary and primary methods were employed in the study. Demographic and economic statistics are presented in the 26-page appendix. Costs of increased public services and facilities are cited. A survey consisting of two parts, i.e., a standard questionnaire administered to a population sample and a set of additional specific questions administered to officials and leaders, was conducted to obtain respondents' views as to the benefit/detriment of the project to the community and to the respondent's self. How the survey was conducted (i.e., by mail or personal interview) and the type of questions asked is not disclosed in the report. The characteristics of the survey sample are discussed, however.

This case study of a community in a geographically and culturally similar area is useful in its description of what impacts have actually occurred with a sudden and major technological development. Its significance is its depiction of a "boom town" situation within the Northern Plains region. However, the additional problems of an energy resource development will not be covered in this report.

021 Cont.

Abstract:
This report presents a case study of a region affected by a large federal defense construction project (the Safeguard ABM Project) undertaken to determine the changes in the local economy and community and the acceptance of these changes. The local economic situation before, during and after the construction project is described. The impacts of the ABM construction on public services, governmental units, and the way of life in the communities are evaluated. Data were obtained from personal interviews of local residents and community officials/leaders and from secondary sources.

022

Crawford, A.B., H.H. Fullerton, W.C. Lewis
Baseline Description of Socio-Economic Conditions in the Uintah Basin; Phase I of Impact Analysis of Proposed Oil Shale Development, Providence, Utah, Western Environmental Associates, Inc., 245 pages, June 1975.

Availability: R. Gold

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (K.E.)

The social aspects treated in this baseline include: facilities (housing, education, utilities and communication, and transportation) and services (public safety, health and welfare and recreation); socio-cultural environment (demographic profile, ethno-cultural groups, attitudes toward the area development, historical features); and population and economic activity, baseline projection. Quantitative data are provided concerning the demographic features; a qualitative sketch of the several cultural traditions (the Ute Indians, Mormon, Anglo) is included. The attitudes of the Basin's residents toward present living conditions and/or additional development are revealed, in part, by two recently completed surveys and an analysis of local newspaper editorials. The survey methodology entailed: in survey 1, personal interviews and questionnaire of closed and open questions; and, in survey 2, and mailed, formal questionnaires. Secondary and primary sources were used in data collection.

The report is valuable in its example of the baseline information gathered for the analysis of impacts of energy development. Although the collection of social data involved qualitative descriptions of cultures in the area, data obtained is primarily quantitative, i.e., population profile and projections, survey results. The treatment is an overview, covering several topics but not with great depth--from infrastructure to demography to culture.

Abstract:

This report constitutes the first of a two-phase study of the socioeconomic impacts of oil shale development in the Uintah Basin of Utah. Phase I report contains a socioeconomic description of the region and provides a "baseline" for the Phase II assessment of what socioeconomic changes might be expected as a result of oil shale development. Elements included as part of Phase I are as follows: economic characteristics, structure and growth; infrastructure and public service provision; availability and use of water and land; socio-cultural characteristics; selected legal and institutional factors related to energy development; and methodology and assumptions employed in preparing the project baseline.

023

Crawford, A.B., H.H. Fullerton, and W.C. Lewis
Socio-Economic Impact Study of Oil Shale Development in the Uintah Basin: Phase II of Impact Analysis of Proposed Oil Shale Development, Providence, Utah, Western Environmental Associates, Inc., 217 pages, November 1975.

Availability: R. Gold

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)

Two basic project development plans are considered: 1) support of a development of a commercial shale oil module development in Colorado, and 2) construction of a commercial module demonstration complex in Utah. The treatment of socio-economic impacts varies, therefore, because under Alternative Two some impacts in the construction and operation of the demonstration complex in Utah are considered. Primary impacts on employment, population, and income are outlined, using employment, population, and household multipliers to generate projections of indirect employment, population and number of households. Data from this analysis are used to generate impacts on other socio-economic conditions, i.e., infrastructure. The discussion of infrastructure impacts include projections of budgets of local governments, an overview of the budgeting process, demand on community facilities and services; and impact on recreational activities and opportunities. For example, housing demand, characteristics, and location are detailed. The analysis concentrates on the services provided by the public sector, i.e., water supply, waste treatment, energy, public safety services, health service, schools, and telephone services. The treatment of sociocultural impacts involves a detailed study of the attitudes of the local residents towards their communities, as they have been and are now, and also their attitudes towards the proposed action. An opinion survey was conducted and also involved an exploration of values pertaining to economic growth and rural lifestyle. Impact on the Ute tribe is briefly mention. The analysis concludes with the examination of a set of social indicators, i.e., selected crime rates.

Primary and secondary sources were utilized. Quantitative measures, i.e., population projections and survey results, were emphasized. A range of impacts were assessed. Because an ethnographic study of sociocultural impacts was lacking, an in-depth look at impacts was not possible. (Information on impacts for the Ute is especially lacking.) Statistical measures are there for those individuals interested in that limited approach to SIA. The study's framework, i.e., the socio-economic and the socio-cultural involves that weakness of hyphenated impacts. That is, the purely social is not focused upon and often takes the back seat to economic or cultural concerns, The methodology employed in the survey involved problems, i.e., questionnaires administered by telephone, interviews conducted with community leaders used to check survey results, question phrasing.

023 Cont.

Abstract:
This report is the second of a two-phase study of the socio-economic impacts of oil shale development in the Uintah Basin of Colorado and Utah. Phase II report contains the identification and measurement of the probable impacts of the proposed shale oil mining and processing. The predicted impacts indicate changes in socio-economic patterns and characteristics that will occur as a result of the proposed action during both the construction and operation periods. Objectives met in this impact assessment are: 1) estimation of economic (income, employment, etc.) and demographic changes due to development plans, including those associated with possible new town development; 2) relating economic/demographic changes to changes in demand for, and supply of, local governmental services; 3) assessment of potential problems associated with the socio-economic impacts, as perceived by people in the area; 4) measurement of attitudes of local residents toward the proposed action; and 5) integration and organization of the information obtained in a form useful to policy makers.

024

Crow Impact Study Office
A Social, Economic, and Cultural Study of the Crow Reservation: Implications for Energy Development. Two Volumes, Summary Report and Final Report, Crow Agency, Montana, Crow Tribe, 1977.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
The report represents a first step in an analytical process necessary to provide the tribe with enough information upon which to base informed decisions about economic development. Statistical information regarding household composition, demographic characteristics, reservation economy, housing conditions, residential patterns and preferences, and Crow culture (i.e., language preference) is provided, as well as statistics concerning the expectations about environmental, economic, social and cultural effects of reservation coal development. The survey results involved the following social and cultural impacts: population changes, changes in crime, more drinking, inter-marriages, loss of Crow lifestyle, loss of relationships, money feuding, more services, better housing and schools.

The survey method involved the interviewing of Crow tribal members who were decided to be family heads. Criteria for the definition of family heads created problems with bias, i.e., one definition considered the male as the family head in the case of two married Crow tribal members. By the given definition, there could be several family heads, all related to one another, living in the same household. The survey sample of on-reservation Crow members consisted of all family heads who could be reached and who were willing to be interviewed. Different procedure was followed off the reservation. The questionnaire was made up of five parts, one of which included questions about household composition, demographic and labor force characteristics, housing conditions, residential preference, and farming and ranching. This section was administered to all 1,016 Crow family heads who were interviewed. The family heads were randomly assigned one of the other four sections to answer. The questionnaire encompassed "open" and "closed" types of questions. However, data obtained from either type of question was analyzed quantitatively.

The study's importance is due to its focus upon the Crow people, who may be involved in synfuel development. Its general treatment of social concerns in energy development (and lack of scope) results in a vague analysis. The survey methodology is incomplete in its failure to include qualitative data and in its general approach (i.e., interviewing a great deal of people without depth). Problems exist also in the application of the survey (i.e., in defining family head and in restricting parts of the questionnaire).

024 Cont.

Abstract:
The report describes a socio-economic survey of the Crow tribe, primarily reviewing survey findings. One-thousand-sixteen families on or near the reservation during 1976-1977 were interviewed concerning the following: household composition; demographic characteristics; labor force and employment characteristics; attitudes toward culture; residential patterns; and feelings about resource development, especially coal mining and conversion, and its effects. Due to the large volume of data collected, only the information of most general interest is presented. Included is a chapter describing demographic, economic, social and cultural conditions of the tribe as they now exist.

025

Culbertson, R.W., and S. Kasper, Dravo Corporation

Economic Advantages and Areas of Application of Small Gasifiers, Pittsburgh, PA, Dravo Corporation, 17 pgs. + append., 1977.

Availability: Environmental Library

Purpose/Topic:

Useful

Reviewer's Comments: (R.E.)
This paper is a relatively short (18 pages with a 10-page appendix) argument by the Dravo Corporation for small gasifiers (using Wellman Galusha process). Their argument is relatively simple. The technology is available, it's cheaper than high-BTU gasification (no oxygen plant, no CO shift), it's 15% more thermally efficient than high-BTU gas and because of inflation it's cheaper to buy now.

Their arguments probably hold for new industrial use, but retrofitting is a different story.

026

Davenport, J., and J.A. Davenport
The Boom Town: Problems and Promises in the Energy Vortex, Laramie, Wyoming, University of Wyoming, Department of Social Work, 212 pages, 1980.

Availability: R. Gold

Purpose/Topic:
Impact Overview Significant

Reviewer's Comments: (K.E.)
The variety of perspectives presented in this book enables consideration of a wide range of subjects: from descriptions of social impacts to ways of dealing with them. Each perspective, however, is presented in detail, thus allowing a more in-depth look at boom-town problems than most overviews. For example, the article addressing problems of women presents its hypothesis concerning the role of women as social integraters and stabilizers in communities and describes a preliminary study undertaken to test such a theory. Two Colorado towns, one a boom town and the other comparable to the first but with no rapid economic development, were investigated. Field methodology included: in-depth, semi-structure interviewing; informal interviewing; and self-administered questionnaires. The article on native American experiences with energy development is of interest because it summarizes Crow, Northern Cheyenne and Navajo experiences. Past experiences were reviewed, and some current developments were analyzed. Discussion of future obstacles and remedies sought by the Indians in their desire to prevent environmental degradation and maintain community stability. Social impacts of boom towns as they affect the elderly adds another dimension to SIA. Senior citizens face not just quality of life but survival issues. Boom-town effects on economic life, social services, housing, health services, and municipal services--from the perspective of the elderly--is detailed. An article defines the boom-town phenomenon--with the goal of presenting a workable framework for viewing boom-town problems. Four problem areas are depicted: increased demand on services, super inflation, stress, structural changes in communities. Following discussions of specific problems (each of which provides a detailed look); ways of dealing with the boom-town syndrome are discussed--from the perspective of a senator, of planners.

The book is significant because of the variety of subjects addressed and the variety of perspectives it represents. At the same time, an overview of the "boom town" is provided, as well as a detailed look at its problems, people, and potential solutions. The book includes not only studies based on field work and community observation, but also analyses reviewing and summarizing information on presenting a framework for understanding.

026 Cont.

Abstract:

This book contains a variety of perspectives from social and behavioral scientists, social workers, federal and state employees and academicians on the social consequences and human costs of rapid growth and development. Articles include those focusing on problems of select groups of people caught up in energy development: i.e., women, native Americans and the elderly. Specific problems (mental health, alcoholism, child abuse and community nursing) are described, and ways of addressing them are presented. Planning and policy concerns are the subjects of articles: "Energy Impact: A Perspective from the Senate on Federal Causes, Cures and Conflicts"; "Dynamic Needs Assessment: An Example"; and "Community Planning in Boom Towns: Why It's Not Working Very Well and How to Do It More Effectively." Also included are discussions pertaining to local employment and the development of comprehensive community helping systems informal in character.

027

Davenport, J.A., and J. Davenport
Boom Towns and Human Services, Laramie, Wyoming, University of Wyoming, Department of Social Work, 154 pages, 1979.

Availability: Institute for Social Research

Purpose/Topic:
Impact Overview — Significant

Reviewer's Comments: (K.E.)
The manual serves to familiarize a diverse audience with the general problem areas experienced by boom towns and possible responses. Of significant interest is the article, "The Sociological Analysis of Boom Towns," authored by Charles F. Cortese and Bernie Jones. Social impacts, as opposed to "socio-economic impacts," are considered to be generalizable social changes occurring with a "boom" situation. An overview of institutional impacts (effects on the government, local economy, education, helping services, religion, and recreation) is presented, along with a concentrated treatment of impacts on social structure and people's lives. Changes in roles and impacts on local culture (i.e., community characteristics) and on lifestyles are detailed. A thorough methodology was employed, involving four collection techniques: participant observation, surveys, historical records, and available documents such as census data. In-depth, semistructured, household interviews were conducted, in addition to long interviews with institutional representatives.

Michael H. Reese and John C. Cummings' article, "Energy Impacted Housing," focuses upon the housing problems of boom towns. Factors contributing to the housing shortages (i.e., community infrastructure) are described and private and public strategies to mitigate the problems are discussed. Data were derived from secondary sources.

The situation of "boom town" is a possibility for Montana, given the occurrence of large-scale technological development such as synthetic fuel processing. A sudden increase in population and a dramatic change of rural communities to an "urban" definition could bring about the problems outlined in the articles.

Abstract:
A number of articles on human service problems, issues and strategies in communities affected by rapid energy development, i.e., boom towns, are presented. Contributors represent a number of backgrounds, disciplines and occupations. Problems in the areas of education, health, housing and mental health are discussed, along with topics such as community planning, human service politics, grassroots organizing, team approaches and the role of the church.

028

Dickenson, R.L. and D.R. Simbeck, Stanford Res. Inst.
"SNG Plant By-Products Need Attention", Oil Gas J., Vol. 77, No. 11, pgs. 65-68, March 12, 1979.

Availability: Environmental Library

Purpose/Topic:
By-products — Not Very Useful

Reviewer's Comments: (R.E.)
Not particularly useful. One of their concerns is that there is little market for tars that are produced by several gasifiers and the idea (seen in other reports as well) is that certain gasifiers that use slurry feeds (Texaco or Koppers-Totzek) may be added to systems comprised mainly of other technologies, just to use the tars.

029

Dixon, M.
What Happened to Fairbanks? - The Effects of the Trans-Alaska Oil Pipeline on the Community of Fairbanks, Alaska, Boulder, Colorado, Westview Press, 301 pgs., 1978.

Availability: R. Gold

Purpose/Topic:
Impact Overview Significant

Reviewer's Comments: (K.E.)

The study constrasts the social impacts which happened to Fairbanks to the assumption in the Pipeline's EIS that primarily positive social impacts would occur. A variety of effects to the community are described in great deal. Problems of traffic and safety, and problems pertaining to inflation, wages, and hiring practices are considered. In discussing the influx of job seekers, the chapter on the "outsiders" to the Fairbanks community describes the migrants and presents accounts of individuals who are affected by high cost of living and housing problems. The boom/bust dilemma is examined by noting the arrival of specific crises, i.e., first the telephones, then housing shortages, then electricity . . . The character of Fairbanks infrastructure, based on the community's history of economic instability, is described, along with community attitudes towards providing services before/after critical level of need was evident. Another chapter presents the problem of conflicting views and values among community members, i.e., Chamber of Commerce versus church organization. Other chapters consider: the effect on community teen-aged members; those people, the very young and old, who are most hurt by community changes: the increase in prostitution; mental health problems, i.e., personal and family problems of adjustment. Impacts that were predicted to occur but didn't (i.e., increased student enrollment, increased public welfare services, creation of squatter communities) are discussed, along with the reasons why (i.e., because of community structure and structure of in-migration). The unexpected impacts, i.e., problems with medical services and local employment, are also considered. A framework for SIA is generated in the author's use of structural analysis in predicting impact. The author includes in her treatment of social impact an analysis of the failure of current planning models and a presentation of a more comprehensive, viable model. Lessons learned by the impact experience of Fairbanks and their application to social science research concludes the book.

Methodology involved data collection from secondary and primary sources. Quantitative information is complemented by information obtained in personal interviews, community observation, and the news media. The analysis is based on data collected by a Fairbanks research organization (which compiles but not interprets data).

The work is excellent in scope and in its detailed treatment of impacts. The author also takes the additional steps of presenting an analysis framework and reviewing models of dealing with impact, for planners and social scientists.

029 Cont.

Abstract:
The effects of the Alaska pipeline construction on the community of Fairbanks are the subject of this book, which describes the community during pipeline construction and how the community responded to the project. Unplanned negative effects that, in many cases, outweighed the positive ones are assessed. Included is the effect of the influx of job seekers outside the area on the city's ability to provide services such as housing, transportation, telephones, and electricity. Increases in prostitution and street fighting, decreasing family cohesiveness, and inflation caused by the high wages of pipeline workers are considered as contributions to Fairbanks' problems. The author concludes that official policy must require that resource development projects take responsibility for social effects and involve affected communities in planning for their future.

030

Eddinger, R.T. and R. Bloom, Jr.
The COGAS Process - A Promise for the Future, Princeton, N.J., COGAS Development Company, 6 pgs., June 1978.

Availability: Environmental Library

Purpose/Topic:
Technology Update   Not Relevant

Reviewer's Comments: (R.E.)
This is a brief progress report on the planning done by COGAS after they were chosen by DOE in 1976 for Phase I planning for a demonstration plant. COGAS yields both liquids and gases (the only technology designed to yield different products, and does so with relatively high thermal efficiency).
The paper has little to report. Of possible significance to Montana is the listing of the partners in the company--FMC Corporation, Consolidated Gas Supply Co., Panhandle Eastern Pipeline Co., and Tennessee Gas Pipeline Co., a subsidiary of Tenneco Inc.

031

Epler, J.S., et al.
"Analytical and Biological Analyses of Test Materials from the Synthetic Fuel Technologies. I. Mutagenicity of Crude Oils Determined by the Salmonella typhimurium/Microsomal Activation System," Oak Ridge, Tennessee, Oak Ridge National Laboratory, 22 pgs., 1978.

Availability: Environmental Library

Purpose/Topic:
Health   Useful

Reviewer's Comments: (G.B.)
This report exemplifies the type of research being undertaken at ORNL (Biology Division) which is oriented towards identifying the toxic substances in synfuel products and by-products and establishing the magnitudes of their toxicities (mutagencity, carcinogenicity, etc.). The author of this report is the key person undertaking most of the synfuel-toxicity studies at Oak Ridge.

Abstract:

We have assayed the mutagenicity of crude industrial products and effluents with the Salmonella/microsomal activation system. Test materials (crude products from coal-conversion processes and natural crude oils) were initially fractionated into primary classes by liquid-liquid extraction and then further fractionated by column chromatography. Prescreening was accomplished over a wide concentration range with the Ames tester strains. Active fractions (mainly the neutral fractions containing polycyclic aromatic hydrocarbons and certain basic fractions) can be identified, and dose-response relationships can be established. Standard values are expressed as revertants/mg of the test material assayed with frameshift strain TA98 including metabolic activation with rat-liver preparations. Total mutagenic activity of synthetic fuel samples was consistently higher than that of natural crude "controls." Activities of subfractions are roughly additive and presumably reflect the mutagenic potential of the whole test material. These results are being extended to other genetic assays. Chemical identification is carried out along with the bioassays.

032

Felder, R.M., et al.
"How Clean Gas Is Made from Coal," Environmental Science & Technology, Vol. 14, No. 6, pgs. 658-666, June 1980.

Availability: Environmental Library

Purpose/Topic:
Acid Gas Removal System (AGRS) Useful

Reviewer's Comments: (R.E.)
A feature article describing a pilot plant established by EPA at North Carolina State University in 1977. The purpose of the plant which is of interest to Montana, is the gas-cleaning test facility. The facility is new enough that little comparative data is available (e.g., they've used only one solvent (methanol) in their acid gas removal system).
The difficulty with such a facility is that the distribution of pollutants is so dependent upon the gasification system and the kind of coal employed that all of the data will be meaningless until internal comparisons (e.g., methanol vs. monoethanol amine for AGRS) are complete.

033

Feldman, R.J., C.B. Fogman, and N.R. Passow
Environmental Considerations in Coal Gasification Plant Design, paper delivered at 179th National Meeting of the American Chemical Society (Houston, Texas), Bloomfield, New Jersey, The Lummus Company, 21 pages, March 26, 1980.

Availability: Authors

Purpose/Topic:
Water Treatment for Lurgi Design Useful

Reviewer's Comments: (N.Z.)
The authors present a brief discussion of two methods for using stripped gas liquor as cooling tower makeup. These two methods are:
1) Pre-cooling tower treatment facilities, followed by a cooling tower blowdown evaporator.
2) Direct application of SGL as cooling water makeup, followed by cooling tower blowdown treating facilities.
Otherwise, this report has little new or unique information.

034

Fenton, D.M., and H.W. Gowdy
"The Chemistry of the Beavon Sulfur Removal Process,"
Environment International, Vol. 2, pgs. 183-186, 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - Sulfur Removal Useful

Reviewer's Comments: (R.E.)
The significant points about the Beavon process are that sulfur compounds such as COS and CS_2 are removed and 99.9% of the original sulfur can be removed. This article describes the chemistry of the process but does not delve into the problems of the Stretford system (of which Beavon is a part). These problems are a tendency to form thiosulfate (leading to additional expense) and possible loss of the vanadium catalyst to water streams.

Abstract:
The Beavon Sulfur Removal Process (BSRP) removes essentially all of the S compounds from Claus plant tail gases. The S-containing compounds, e.g., H2S, SO2, carbonyl sulfide and carbon disulfide, are converted to S in >99.9% efficiency. In the 1st stage the various S compounds are hydrogenated or hydrolyzed to give H2S, while in the 2nd stage the H2S is oxidized using the Stretford process to give elemental S of good quality. The process is a commercial success with 29 plants operating or under construction in the US and 4 in Japan. This process can also be utilized in synthetic natural gas plants, natural gas processing, and other similar applications. (MS)

035

Fluor Engineers and Constructors, Inc.
Coal Gasification Technology, SFR-101, Irvine, Cal., Fluor Utah, Inc., u.p., April 1977.

Availability: Environmental Library

Purpose/Topic:
Overview of Gasification Technologies Significant

Reviewer's Comments: (R.E.)
This is an industrial publication and about 20% of the document deals with Fluor's capabilities in gasification technology.
However, the document provides an excellent first view of coal gasification. There is a 26-page section comparing technologies and describing unit processes. Then there are good 1- or 2-page descriptions of all technologies that have reached pilot plant stage (20 processes).

036

Fluor Engineers and Constructors, Inc.
Coal Liquefaction Technology, SFR-103, Irvine, Cal., Fluor Utah, Inc., u.p., May 1977.

Availability: Environmental Library

Purpose/Topic:
Technology Description Useful

Reviewer's Comments: (R.E.)
Brief, two to three page descriptions of 16 liquefaction technologies and an excellent set of tables which compare them. The document also describes the capabilities of Fluor to aid in the development of commercial facilities.
There are many sets of brief descriptions. We find this to be one of the better sets.

037

Frantzen, J.E. and E.K. Geoke
"Petrochemical Developments/Gasify Coal for Petrochemicals," Hydrocarbon Processing, Vol. 55, No. 11, pgs. 134-138, November 1976.

Availability: Environmental Library

Reviewer's Comments:
Not received in time for review.

Abstract:
A SURVEY COVERS THE KOPPERS-TOTZEK (K-T) PROCESS, IN COMMERCIAL USE SINCE 1951; POSSIBLE APPLICATIONS OF THE K-T PROCESS, INCLUDING THE COAL-BASED MANUFACTURE OF HYDROGEN AND OF SYNTHESIS GASES FOR METHANOL, THE OXO SYNTHESIS, THE FISCHER-TROPSCH SYNTHESIS, AND AMMONIA; AND THE ECONOMICS OF SYNTHETIC AMMONIA PRODUCTION, SHOWING THAT, WITH FAVORABLE COAL PRICES, AMMONIA FROM COAL OR LIGNITE CAN BE COMPETITIVE WITH THAT FROM FUEL OIL OR NAPHTHA. DIAGRAM, FLOW CHARTS, TABLES, GRAPH, AND PHOTOGRAPH.

Gaddis, D.E.
Comparative Economics of Coal Based Energy Processes and Fossil Fuel Prices in the 1980's and 1990's, Pittsburgh, Pennsylvania, Fifth International Conference on Coal Gasification, Liquefaction and Conversion to Electricity, 16 pgs., July 27, 1978.

Availability: Environmental Library

Purpose/Topic:
Comparative Economics Useful

Reviewer's Comments: (R.E.)
Gaddis did this work for ANG in connection with their proposed gasification plant in North Dakota. First-year price of the gas (if on line in 1983) is $5.66/mcf. Average price over 25 years (constant 1978 dollars) is 4.13/mcf. Comparing these prices with low-BTU gas and methanol production, he calculates the low-BTU gas is considerably cheaper intially (3.14/mcf) but later becomes more expensive, while methanol is considerably more expensive (8.25/mcf) initially and remains so throughout the life of the plant.
The paper gives some detail but not much justification on the method for calculating prices.

039

Ganow, H.C.
"In Situ Coal Gasification at the Hoe Creek, Wyoming Field Site--An Overview," Earth Science Bulletin, Vol. 12, No. 3, pgs. 1-16, September 1979.

Availability: Environmental Library

Purpose/Topic:
In Situ Gasification Significant

Reviewer's Comments: (R.E.)
Emphasis is placed on the technical problem of "linking" boreholes in a controlled manner, at the base of a coal seam. The article describes a counter-current system that worked (2400 tons gasified - average gas 108 BTU/scf).
Extensive roof collapse occurred in the most recent experiments and a coal seam, 22-30 feet above the intended seam, was gasified. It is pointed out that such a happening drastically changes predicted water quality as new aquifers are affected.

Abstract:

The Lawrence Livermore Laboratory (LLL) is currently involved in the study of in situ coal gasification for the Department of Energy. This is a high risk but potentially promising technology that may see commercial development by the late 1980's. A principal coal source is the group of several thick, deeply buried western sub-bituminous coals of the Powder River Basin that currently cannot be mined economically. The gases produced by this process can be directly consumed in industrial boilers, upgraded to synthetic natural gas (SNG), or used as chemical feed stocks in lieu of petroleum.

In this paper, the concept of in situ coal gasification is briefly reviewed for those who may not be familiar with it. This is followed by a discussion of the Hoe Creek site geology and hydrology, and the results of Experiments I and II. Preparations are now underway for Experiment III which will be burned almost entirely with steam and oxygen, and should provide urgently needed data on process economics. Lastly, results from experiments designed to assess two major environmental concerns, cavity-induced subsidence and ground-water pollution, are presented.

040

Gilmore, J.S.
"Boom Towns May Hinder Energy Resource Development," Science, Vol. 191, No. 4227, pgs. 535-540, February 13, 1976.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful (Limited)

Reviewer's Comments: (J.C.)
Due to the fact that communities aren't able to furnish the services and facilities to accommodate western energy growth, Gilmore suggests government help in managing growth. He suggests a concept of four functions of growth management, which are at best generalizations. Then the article goes on to identify some systems utilized by state governments to combat problems associated with boom-type societal changes.

Overall, the information given might be useful to an economist attempting to visualize some management problems that could be projected to an upcoming development, but not to a sociologist. The data is sketchy and doesn't detail any true social impacts, but mostly economic data.

Abstract:
John Gilmore's article deals primarily with accelerated development of energy resources creating "Boom Towns" from formerly isolated rural communities in the Rocky Mountain West. He discusses the problems associated with the Boom Town phenomena from a basically economic standpoint. Suggestions are made regarding growth management and the role management may take in looking for solutions to the problem. In introducing the Boom Town situation, a hypothetical example of such a community is described. From this point, the problems cited are identified, and their origins are suggested. The example of "Pistol Shot," U.S.A., exemplifies a mental health problem in these communities.

041

Goelzer, A.R., et al.
Coal Liquefaction from a Refiner's Viewpoint, Houston, Texas, Fluor Engineers and Constructors, Inc., 39 pages, August 1978.

Availability: Environmental Library

Purpose/Topic:
General Useful

Reviewer's Comments: (R.E.)
A different perspective is often useful. The abstract indicates the direction of the paper, but the 39 pages include several intriguing pieces of information and/or opinions. For example:

1) The high aromaticity and Heteroatom content of coal liquids places new contraints on refineries.
2) It is suggested that liquefaction emphasize production of clean boiler fuels, that it should optimize hydrogen utilization and that the use of coal liquids for other refinery products be postponed.
3) It is noted that low grade bituminous and lignite coals are poor choices for donor-solvent schemes.
4) The amount of oxygen in a syncrude could adversely affect refineries.
5) It is pointed out that the hydrogen production process for liquefaction facilities is a very big operation, e.g., a) 3-6 times larger than now used by the biggest refineries, b) each complex will prduce 1/3 to 1/4 of all the hydrogen now produced by all U.S. refineries, or c) will represent the energy in 1/2 to 2/3 of a new 250x10^6 scf/day gasification plant. If the cost of that hydrogen is $2-3/1000 scf and a full-range liquid requires 6000 scf (SCR I may require only 3000 scf), a good portion of the price of syncrude is explained. Clearly, the heavy fuels (which require less hydrogen) will be more economical. (A table on hydrogen requirements is included in the appendix.)
6) Among the problems caused by the presence of heteroatoms are a) NO_x somewhat higher, b) carcinogenicity and toxicity in handling raw coal liquids potentially higher, and c) odor, solubility, and corrosion potentials require close attention.

042

Gold, R.L., et al.
A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming: Final Report, Missoula, Montana, University of Montana, Institute for Social Science Research, June 30, 1974.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Significant

Reviewer's Comments:
None

Abstract:
Social impact which the development of coal is creating for Montana and Wyoming residents is appraised by this study of the attitudes of the residents whose lives are affected by coal development. The ethnographical method of the study placed the researcher in close contact with those individuals and enabled investigation of what differences development makes to and in the lives of coal area residents. The communities of Forsyth, Colstrip and Gillette were studied; the reactions of townspeople and ranchers were gathered. The attitude of opposition to coal development of Montana ranchers is compared with Wyoming ranchers' attitude of accommodation. Ranchers' concern with "people" problems (i.e., the introduction of new and strange lifestyles and values) and the concern of townspeople with newcomers is discussed. The significance of values in the assessment of social impact is explained. That is, the fear of the ranchers of "people" pollution is understandable when one considers the effect a large influx of people will have on the ranchers' enjoyment of their valued isolation and attachment to the land. Other attitudes, e.g., feelings of helplessness in the face of imminent coal development, are detailed.

043

Gold, H., J.A. Nardell, C.A. Vogel
"Pollution Control Practices--Fuel Conversion and Its Environmental Effects," Chemical Engineering Progress, Vol. 75, No. 8, pgs. 58-64, August 1979.

Availability: Montana State University Library

Purpose/Topic:

Water Requirements of Synthetic Fuels Production	Useful
Water Treatment	Useful

Reviewer's Comments: (N.Z.)
This article is mostly a synopsis of the information contained in "Water Related Environmental Effects in Fuel Conversion," by Gold and Goldstein, EPA-600/7-78-0197a,b. However, it is a good summary of the important aspects of the report and there are some worthwhile comparisons of water requirement estimates by the authors to estimates by others.

044

Gray, R.W.
Industrial Fuel Gas Demonstration Plant, MLGW-DOE, Memphis, Tennessee, Memphis Light, Gas and Water Division, u.p., August 1978.

Availability: Environmental Library

Purpose/Topic:

Commercialization - U-Gas	Useful

Reviewer's Comments: (R.E.)
Gas supply to the city of Memphis has decreased from 93.4 billion cubic feet in 1970 to 45 billion cubic feet in 1980. They have turned to the concept of supplying industries with industrial fuel gas. DOE is funding the project, which is now in the conceptual design stage.

Connected with the project are a municipal utility, Foster Wheeler, IGT (developers of the U-Gas process) and Energy Impact Associates Inc. (environmental report).

U-Gas uses a fluidized bed gasifier at high temperatures. No liquid products are formed and the gas formed is medium-BTU (284 BTU/scf).

This relatively small plant will supply the equivalent of 50 million cubic feet per day of natural gas. That's one-fourth of Montana's need. It seems unlikely that such a development could fit Montana's need.

Gulf Oil Corporation and Standard Oil Company of Indiana
Rio Blanco Oil Shale Project: Social and Economic Impact Statement, Tract C-a, Denver, Colorado, Gulf Oil Corporation, u.p., March 1976.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (J.M.)
Statement outlines socioeconomic growth management program for an oil shale leasing program. At the time this report was written, the program had been going on for 18 months--this report involves impacts not yet addressed or resolved to date.
The growth management program outlined in this report involved a high degree of citizen participation; also the formation of Community Development Study Teams to coordinate activities and assist local governments in dealing with change.
The management program appears to be thorough and effective, offering some innovative approaches to dealing with population influx and community change. Providing a community with planning assistance and front end money is no panacea to avoiding problems with large-scale energy problems, however. Thus, this report should not be read without backup documents dealing more specifically with qualitative social impacts.

Abstract:
This addendum is designed to update information and present necessary revisions brought about by modification of Rio Blanco Oil Shale Project's (RBOSP's) Detailed Development Plan (i.e., change to Modified In Situ development of Federal Prototype Oil Shale Tract C-a). The Detailed Development Plan is the result of geotechnical and environmental data collection programs designed to establish baseline conditions in the Tract C-a area and provide input to engineering studies leading to the selection of mining and processing plans for Tract C-a development. Changes in the Social and Economic Impact Statement are noted on a chapter-by-chapter basis. Included in this addendum is information pertaining to: impacts of RBOSP's presence prior to full Tract C-a development; impacts and mitigations for Tract C-a development; recommendations for public policy concerning community development in Northwest Colorado; Detailed Development Plan abstract; and human resource inventory of 10 counties in Northwest Colorado.

046

Hand, J.W.
"Picking Coal Deposits for In-Situ Gasification," Oil and Gas Journal, Vol. 77, No. 22, pgs. 119-121, 1979.

Availability: Environmental Library

Purpose/Topic:
Solid Waste — Useful

Reviewer's Comments: (C.K.)
Author states that solid waste is not a problem with in-situ gasification, and gives the characteristics of mine sites desirable for such an operation.

047

Hand, J.
"Selecting a Deposit for In-Situ Gasification," Coal Mining and Processing, Vol. 16, No. 6, pgs. 62-64, June 1979.

Availability: Environmental Library

Purpose/Topic:
In-Situ Gasification — Significant

Reviewer's Comments: (R.E.)
A short but significant paper. It gives the general guidelines for selecting coal deposits for in-situ gasification (e.g., seam thickness greater than 6 feet with no upper limit, depth between 65 and 2000 feet, gas price). Using the methodology established in this paper (three relatively simply nomograms), it should be easy to make a first-cut estimate on which Montana coal fields might be exploited by UCG.

048

Harbes, S.E., C.W. Gehrs, G.R. Southworth
Organic Contaminants in Aqueous Coal Conversion Effluents: Environmental Consequences and Research Priorities, Publication No. 880, Oak Ridge, Tennessee, Oak Ridge National Laboratory.

Availability: Summary only

Purpose/Topic:

Chemical Constituency of Effluent	Significant
Effects of Chemicals on Aquatic Environment	Significant

Reviewer's Comments: (N.Z.)

This is a preliminary report on what is needed in research to determine potential acute and sub-acute effects of potentially hazardous effluents constituents, and to evaluate their transport and persistence in aquatic systems.

Five major classes of organic compounds have been operationally defined: 1) phenols, 2) arylamines (organic bases), 3) aliphatic hydrocarbons, 4) mono- and polycyclic aromatic hydrocarbons (PAH) and 5) sulfur-containing compounds.

This report points out the gaps in understanding and future research needs are identified.

049

Higginson, G.W., and R.R. Maddocks
Using Chemical Comminution to Ease Solids Separation in Coal Liquefaction, Philadelphia, Pennsylvania, Catalytic, Inc., 11 pgs., July 21, 1978.

Availability: Environmental Library

Purpose/Topic:

Unit Process - Coal Cleaning	Useful

Reviewer's Comments: (R.E.)

After noting the technical problems involved with solids separation in the SRC processes, the authors suggest that chemical comminution could be used in conjunction with other technologies to solve the problem. It seems to us that the technology (essentially a coal cleaning operation) could be used to advantage with other coal uses too. It is not obvious that the technique has great relevance to Montana.

The process involves treatment of raw coal with ammonia, which penetrates the coal along the natural fault planes where most pyrite and ash are found. Separation occurs but coal particles are about the same size as before (mechanical separation leads inevitably to coal fines--which usually means loss of utility).

050

Hill, R.F., Editor
Energy Technology V: Challenges to Technology, Proceedings of the Fifth Energy Technology Conference, February 27 - March 1, 1978, Washington, D.C., Washington, D.C., Government Institutes, Inc., 1063 pages, April 1978.

Availability: Interlibrary Loan

Purpose/Topic:
Utility - General | Useful

Reviewer's Comments: (R.E.)
An excellent set of conference proceedings, with overwhelming amounts of information and opinion on every facet of energy technology. There are perhaps 200 pages of information relevant to this paper, but the entire volume should be useful to DNRC (or any other group) looking for an overview of what's new in energy technology. We have decided to order this series for our Environmental Library because it is so useful. For example, there are:

19 papers on coal liquefaction or coal gasification;
14 papers on "environment";
22 papers on solar energy; and
Other specific papers, such as:
1) A glowing account of an energy park being planned for Kentucky;
2) Thoughtful perspectives on coal liquefaction from an international perspective.

We have chosen to reproduce three slides from the document for the appendix.

The 1978 proceedings would also be classified as "useful," but clearly all conferences have their utility in providing perspectives and updates.

The 1980 conference proceedings (not yet available) should be read.

051

Hill, R.F., Editor
Energy Technology VI: "Achievements in Perspective," Proceedings of the Sixth Energy Technology Conference, February 26-28, 1979, Washington, D.C., Washington, D.C., Government Institutes, Inc., 1152 pages, April 1979.

Availability: Interlibrary Loan

Purpose/Topic:
Utility - General | Useful

Reviewer's Comments: (R.E.)
See Volume V Comments.

Institute of Gas Technology
Advances in Coal Utilization Technology, Symposium Papers, Chicago, Illinois, Institute of Gas Technology, 784 pages, 1979.

Availability: Environmental Library

Purpose/Topic:
General Useful

Reviewer's Comments: (R.E.)
Certain papers from this volume have been reviewed separately. The conference had several other good papers that demand brief review or abstracts.

1) Coal Gasification Technology Overview - A really excellent 24-page overview of gasifiers--their chemistry, their status of development and their distinguishing characteristics.

2) Small Gasifiers in Industry--A good listing of all small gasifiers in or planned in the United States as of 1979 (mostly Wellman-Galusha or Woodahl Duckham, no Winklers). Some detail on the problem the University of Minnesota was having with its Foster-Wheeler STOIC unit was given.

Abstracts:
Burwell, E.L., "Underground Coal Gasification Technologies"

The recently enacted national energy act calls for accelerated development in the use of our abundant domestic coal reserves as a viable alternative to imported oil. Any technology developed will have to meet increasingly severe economic, socioeconomic, logistical, and environmental criteria in order to become a commercial reality. Underground coal gasification (UCG) promises to become one of the viable alternatives. This paper presents the current U.S. program which is addressing the production of energy by UCG from coals of widely varying geologic characteristics. The production of low and/or medium Btu gas from flat, thick subbituminous seams; the gasification of steeply dipping coal seams; and preliminary field tests in deep bituminous coal seams are all under current investigation.

These technologies, if developed, could quadruple the amount of coal recoverable in the U.S. by addressing coals economically inaccessible by current surface and deep mining techniques. Based on the field tests already completed, underground coal gasification technologies should reach the point of commercial decision by the late 1980's.

Fisher, D.H., R.E. Hildebrand, "Transportation Fuels from Synthesis Gas"

The Department of Energy (DOE) has formulated a program to develop improved processes to convert synthesis gas from coal to quality transportation fuels. The program involves four elements.

1. Improved integration of gasification with liquefaction. This involves the use of low ratio H to CO synthesis gas in the hydrocarbon formation step. Low ratio H to CO can be converted to hydrocarbon by means of the Kolbel-Engelhardt reaction. The net result is considerable energy savings in steam.

052 Cont.

Fisher, D.H., R.E. Hildebrand, (Cont.)

2. Improved selectivity by use of shape selective catalyst. Normal Fischer-Tropsch reaction chemistry is subject to inherent limitations due to the chain growth mechanisms. Use of shape selective catalysts can result in circumvention of this limitation by the use of an intermediate that can be formed in high selectivity (methanol) or by inhibition of the chain growth mechanism.

3. Use of improved thermally efficient liquefaction reactors. Use of the liquid phase reactor can result in singled pass conversion, elimination of recycle, improved temperature control, and recovery of the heat of reaction at higher temperatures.

4. Simplified upgrading methods. Conventional methods for upgrading Fischer-Tropsch liquids lead to a very complex process sequence. Use of new catalyst systems may result in greatly simplified upgrading methods.

It is concluded that success in these areas could make indirect coal liquefaction a very competitive method for converting coal to quality liquid fuels.

Holighaus, R., "Coal Gasification Program in the Federal Republic of Germany"

The non-nuclear energy R&D program of the Federal Republic of Germany was started in 1974. Within this program main emphasis was given to coal conversion processes. Due to the fact that a proven German technology already existed in the past, our efforts were mainly directed towards improving these processes by applying new components, materials and control methods meanwhile developed in other technical fields. This is especially true for coal gasification. Based on the different types of gasifiers such as Lurgi, Koppers-Totzek, Winkler, Rummel-Otto, improvements were aimed at with respect to thermal efficiency, unit capacity, reliability, investment costs and environmental acceptability. Meanwhile the respective pilot plants with capacities of up to 15 t/h were either just in the start-up phase or were already being operated successfully.

The paper gives technical descriptions of the processes, deals with the objectives and the schedule of the different projects and reports the results and experiences so far gained.

Besides the improvement of existing technology, new processes develcpments were started which shall enable the incorporation of nuclear process heat. Based on conceptual considerations, two different processes were designed and tested on a semi-technical scale. The results obtained were used for the design of a pilot plant, which will start operation within three years.

The overall concept of the process using nuclear process heat will be presented and discussed, the results so far obtained from the test plants will be included.

Lloyd, E.A., "High BTU Coal Gasification Demonstration Program"

The High Btu "Pipeline" Gas Demonstration Program is one of the major elements of DOE's efforts to create a strategic technological position with respect to the nation's gas supply.

The Process and Program Management organization is designed to provide the more formal management structure required for effective management of large programs like the High Btu Coal Gasification Demonstration Program which includes two competitive projects; one proposed by the CONOCO Coal Development Company and the other proposed by the Illinois Coal Gasification Group. These projects are candidates for selection as the project and process that is to proceed to final design for construction of the single High Btu "Pipeline" Gas Demonstration plant for which funds have been appropriated by the Congress.

The present demonstration plant program is to complete construction of one demonstration plant in 1983, incorporating the best technology available so that the commercial, private, interests can build profitable gasification plants with confidence.

The High Btu Coal Gasification Demonstration projects have three phases. Phase I is a design phase, already underway; Phase II will be a construction phase; and Phase III will be an operation phase. Phase I is funded by DOE; Phases II and III will be funded equally by DOE and the industrial partner selected. The CONOCO process uses an adaptation of the Lurgi gasifier with a British gas developed bottom to produce a slag rather than dry ash. The ICGG process combines the COED-staged pyrolysis process with the COGAS gasification process.

Mujadin, M.J., "Great Plains Gasification Associates Coal Gasification Project"

The Great Plains Gasification Associates Coal Gasification Project is a commercial sized demonstration plant designed to produce 125 MMCFD of pipeline quality gas from North Dakota lignite utilizing Lurgi technology. The project is sponsored by five of the largest gas pipeline companies in the country and has the support of the state government of North Dakota and the U. S. Department of Energy. After six years of technical, environmental and economic studies, this project has acquired nearly all the required permits to begin construction. Under the name ANG Coal Gasification Project, over $30,000,000 has been spent to reach this point. Only an acceptable FERC Certificate which would permit project financing to proceed is still required to set in motion the final phases of the project: detail design and procurement; construction and start-up. The FERC Administrative Law Judge is currently deliberating on the evidence for and against this project. His ruling and the ultimate Commission certificate, if positive and timely, should result in the first large volumes of SNG from coal being produced in late 1983.

This paper presents an overview of the Great Plains Project past and present and describes those features which make this project unique

Neuworth, M.B., "Development of a Two-Stage Liquefaction Process"

The Department of Energy is investigating two-stage liquefaction, involving hydroextraction of coal, solvent deashing and expanded bed catalytic hydrocracking to distillate fuels. The Lummus-Cities Service commercial LC-Fining process is being utilized for the second stage hydrocracking. Standard SRC I and high throughput coal extracts have been converted to high quality naphtha and fuel oil in a prototype LC-Fining unit. A commercial NiMo catalyst was used for periods in excess of 30 days with modest catalyst deactivation. Hydrogen consumption in the two-stage should be comparable with other direct liquefaction processes.

052 Cont.

Patel, J.G., "U-Gas Technology Status"

The U-GAS Process has been developed by the Institute of Gas Technology to produce a low- to medium-Btu (150 to 300 Btu/SCF) fuel gas from coal in an environmentally acceptable manner. The process accomplishes decaking, devolatilization, and gasification of coal in addition to separation of ash in a singla-stage fluidized-bed reactor. A 24 ton per day pilot plant has been successfully operated on a variety of feedstocks including a high-sulfur, caking Illinois basin bituminous coal. The total operating time for the pilot plant has been over 5600 hours, during which more than 100 test runs have been conducted. A raw product gas having a heating value of 280 Btu/SCF and ash agglomerates containing 95% ash have been produced in the pilot plant. This corresponds to an overall gasifier coal utilization efficiency of up to 94%. Recent operation of the pilot plant has firmly established process feasibility, safe and reliable operability, and provided a strong data base for the preliminary design of a demonstration plant. The U-GAS Process has been selected by the U.S. Department of Energy and Memphis Light, Gas and Water Division (City of Memphis) for the preliminary design of a demonstration plant. The plant, proposed for construction in Memphis, will produce 50 billion Btu of an industrial fuel gas daily from 2800 tons of coal. Currently, based on successful pilot plant tests, the demonstration plant preliminary design is underway and is to be completed in November 1979.

053

Institute of Gas Technology
High-Btu Coal Gasification Processes, ANL/CES/TE 79-2, by C.F. Blazek, N.R. Baker, and R.R. Tison, Institute of Gas Technology, Springfield, Virginia, NTIS, 92 pgs., January, 1979.

Availability: DNRC

Reviewer's Comments:
Not received for comment.

Abstract:

THIS EVALUATION PROVIDES ESTIMATES OF PERFORMANCE AND COST DATA FOR ADVANCED TECHNOLOGY, HIGH-BTU, COAL GASIFICATION FACILITIES. THE SIX PROCESSES DISCUSSED REFLECT THE CURRENT STATE-OF-THE-ART DEVELOPMENT. BECAUSE NO LARGE COMMERCIAL GASIFICATION PLANTS HAVE YET BEEN BUILT IN THE UNITED STATES, THE INFORMATION PRESENTED HERE IS BASED ONLY ON PILOT-PLANT EXPERIENCE. PERFORMANCE CHARACTERISTICS THAT WERE INVESTIGATED INCLUDE UNIT EFFICIENCIES, PRODUCT OUTPUT, AND POLLUTION ASPECTS. TOTAL INSTALLED PLANT COSTS AND OPERATING COSTS ARE TABULATED FOR THE VARIOUS PROCESSES. THE INFORMATION SUPPLIED HERE WILL ASSIST IN SELECTING ENERGY CONVERSION UNITS FOR AN INTEGRATED COMMUNITY ENERGY SYSTEM (ICES).

054

Institute of Gas Technology
Low- and Medium Btu Coal Gasification Processes, ANL/CES/TE-79-1
by N.R. Baker, C.F. Blazek, R.R. Tison, Institute of Gas Technology, Springfield, Virginia, NTIS, 69 pgs., January, 1979.

Availability: DNRC

Reviewer's Comments:
Not received for comment.

Abstract:

COAL GASIFIERS, FOR THE PRODUCTION OF LOW- AND MEDIUM-BTU FUEL GASES, COME IN A WIDE VARIETY OF DESIGNS AND CAPACITIES. FOR SINGLE GASIFIER VESSELS GAS ENERGY PRODUCTION RATES RANGE FROM ABOUT 1 TO 18 BILLION BTU/DAY. THE KEY CHARACTERISTICS OF GASIFIERS THAT WOULD BE OF IMPORTANCE FOR THEIR APPLICATION AS AN ENERGY SOURCE IN INTEGRATED COMMUNITY ENERGY SYSTEMS (ICES) ARE EVALUATED HERE. THE TYPES OF GASIFIERS CONSIDERED HERE ARE SINGLE- AND TWO-STAGE, FIXED-BED UNITS; FLUIDIZED-BED UNITS; AND ENTRAINED-BED UNITS, AS PRODUCERS OF BOTH LOW-BTU (LESS THAN 200 BTU/SCF AND MEDIUM-BTU (200 TO 400 BTU/SCF) GASES. THE GASIFIERS ARE DISCUSSED WITH RESPECT TO MAXIMUM AND MINIMUM CAPACITY, THE EFFECT OF FEED COAL PARAMETERS, PRODUCT CHARACTERISTICS, THERMAL EFFICIENCY, ENVIRONMENTAL EFFECTS, OPERATING AND MAINTENANCE REQUIREMENTS, RELIABILITY, AND COST. SOME OF THE MOST RECENT DEVELOPMENT WORK IN THIS AREA OF COAL CONVERSION, AND USE OF THESE GAS PRODUCTS ALSO IS CONSIDERED. EXCEPT IN SMALL PLANT INSTALLATIONS (< 10$SUP 9$ BTU/DAY) THE ANNUAL OPERATING COSTS FOR THE VARIOUS GASIFIER TYPES ARE APPROXIMATELY THE SAME. THIS IS SOMEWHAT SURPRISING IN VIEW OF THE PERSONNEL REQUIREMENTS, EFFICIENCIES, UTILITY REQUIREMENTS, HEATING VALUE OF THE PRODUCT GAS, AND OPERATING CHARACTERISTICS ASSOCIATED WITH EACH. OPERATING COSTS TEND TO INCREASE WITH A POWER FUNCTION EXPONENT OF 0.92 (I.E., A DOUBLING IN PLANT CAPACITY INCREASES THE OPERATING COST BY ABOUT 1.9).

055

Institute of Gas Technology
Synthetic Fuels Technology from the Industrial Point of View,
By B.S. Lee, presented at 1979 Symposium on Instrumentation and Control for Fossil Fuel Energy Processes, Chicago, Illinois, Institute of Gas Technology, 9 pages, August 20-22, 1979.

Availability: Environmental Library

Purpose/Topic:
Synfuels - General Useful

Reviewer's Comments: (R.E.)
This is another interesting short paper by Bernard Lee, president of the Institute of Gas Technology. He first makes an economic argument; the externalities of reducing oil imports such as improved trade balance, lower oil prices and decreased supply disruptions should be added to the base cost of imported oil. Then we would see how cheap synfuels really are. Next, he argues for a particular commercialization scheme (see appendix for table) which emphasizes development in the East (23 plants in West, 36 in the East).

056

Jackson, D.M., and B.K. Schmid
Commercial Scale Development of the SRC-II Process, presented at Fifth Annual International Conference on Commercialization of Coal Gasification, Liquefaction and Conversion to Electricity, Pittsburgh, Pennsylvania, University of Pittsburgh, 11 pages, August 1978.

Availability: Environmental Library

Purpose/Topic:
Technology Description - SRC II — Useful

Reviewer's Comments: (R.E.)

More recent, more complete descriptions of SRC II exist elsewhere.

It is noteworthy that SRC II is proud of their days-on-stream record vs. SRC I. The latter was on stream 60% vs. 85% for SRC II.

They note that clinical surveillance of workers at the Fort Lewsi pilot plant "has found no serious or permanent occupationally related diseases, although a few cases of mild transient photodermatitis have occurred."

It is expected that commercialization of SRC II will occur on the East coast where there is a market for fuel oil.

057

Jorgensen, J.G., et al.
Native Americans and Energy Development, Cambridge, Massachusetts, Anthropology Resource Center, 89 pages, 1978.

Availability: Environmental Library

Purpose/Topic:
Impact Overview | Not Relevant

Reviewer's Comments: (K.E.)
The collection represents overviews of social, economic, political and historical concerns in energy development for Indian communities. It does not present detailed examinations of socioeconomic impacts per se, but merely calls for the consideration of Native American needs and culture in any energy development. The only article reporting on a case study of energy development involved primarily anglo-Americans in six communities. Three variables--attitudes towards energy projects, rationales for attitudes, and expectations--were investigated with the administration of open-ended interview schedules. Methodology also involved statistical analysis to confirm similarity of the four communities in Utah and allow for comparison of the data obtained in the Utah communities, and the Page, Arizona, and Hardin, Montana, communities.

The focus upon Native American concerns is important since synfuel development will affect at least two Montana reservations. A detailed substantive and methodological presentation of Indian socio-economic problems with energy developments is lacking in the collection. The only study per se involves an analysis, primarily statistical, of attitudes of non-Indian residents of "boom towns."

Abstract:
A number of essays describing the issues confronting Indian people due to energy development on their reservations is presented. Jorgensen's article, "Energy, Agriculture, and Social Science in the American West," considers what social science can contribute to fulfilling the information needs of Native American and Anglo communities and criticizes the failure of environmental impact statements to address questions about the fabric of culture that are vital in the daily life of rural areas. "Black Mesa and the Hopi," an article by Clemmer, presents a subjective narrative of the Black Mesa coal development. Following a brief description of Hopi communities and culture, the author's investigation of mining, pipeline shipping, and plant expansion projects and his participation on behalf of the Hopis in responding to the proposed developments is discussed. Included in Robbins' article entitled "Energy Developments and the Navajo Nation" are some of the ways in which the expropriation of Navajo energy resources has affected the Indians' economic, domestic and political life. Tribal council responses to the Black Mesa and Page Projects, and to coal mining

057 Cont.

Abstract: continued
in the Burnham District are briefly described, along with local responses (i.e., by American Indian Movement) and tribal responses (i.e., creation of offices such as the Office of Program Development) to energy development as a whole. The article "Can Tribes Control Energy Development?", by Owens, examines a variety of means to control development: jurisdictional, financial, and managerial controls, and control through diversification of the tribal economy. The Northern Cheyenne are the Indians considered here, with some references made to the Crow and Navajo tribes. Little's article, "Energy Boom Towns: Views from Within," concerns a study of six communities in the Lake Powell and Big Horn County, Montana, regions. The data presented here provide insight into how residents in these towns think about past energy projects, why they think the way they do, and what they expect from energy projects in the future.

058

Josephson, J.
"Synfuels Scale-Up," Environmental Science & Technology, Vol. 14, No. 6, p. 652-656, June 1980.

Availability: Environmental Library

Purpose/Topic:

Technology Overview	Useful (?)
Environmental Overview	Useful (?)

Reviewer's Comments: (R.E.)
1) A summary review of the current status of several technologies.
2) Some specific environmental problems are listed:
   a) NO_x problem for Exxon Electron Donor Solvent system,
   b) High boiling product ("Flaked Residuum" 975° F) from H-Coal will be stored for future research.
   c) Phenolic wastes, fugitive emissions and water reuse are all listed as concerns for SRC II plants.
3) All in all, not too useful an article.

Koppenaal, D.W. and S.E. Manahan
"Hazardous Chemicals from Coal Conversion Processes?", Environmental Science & Technology, Vol. 10, No. 12, pgs. 1104-1107, November 1976.

Availability: Environmental Library

Purpose/Topic:

Hazardous Substances	Useful
Hazardous Chemicals in Synthetic Fuel Plant Waters	Useful

Reviewer's Comments: (R.E.)

For the most part, this article reviews information covered better elsewhere. However, there is a useful emphasis on the possible production of organometallics that may be formed in the synfuel production process. For example, metal porphyrin compounds, metal carbonyls, metallocenes, arene carbonyls, metal alkyls, organo hydrides and metal chelates are suggested as by-products.

Other than some mention of metal carbonyls in the existent literature, this is a relatively new list. The questions are: has anyone found such substance in effluents, and have they been sought?

Reviewer's Comments: (N.Z.)

The report defines the constituency of coal and the dangers of certain compounds. The report is relatively old (1976) and most of the information is contained in more recent reports. However, the information would be useful to anyone studying carcinogenic compounds in synfuel production.

060

Lee, B.S.
Synthetic Gas from Coal, Chicago, Illinois, Institute of Gas Technology, 14 pgs., November 2, 1978.

Availability: Environmental Library

Purpose/Topic:
Gasification Overview Useful

Reviewer's Comments: (R.E.)

Bernard Lee is always worth reading. Here he argues for gasification over liquefaction (for DOE funding and for commercialization). Gas is ready to use as it's produced (liquids usually require further treatment), it's cheaper, and it's ready for commercialization. Second generation plants should offer significant price reductions, but (partially because of inflation) Lurgi plants should be built now. He also argues that third generation plants will not significantly decrease price or increase efficiency.

Within the context of his argument and given his view of the nation's "requirement" for gas, Lee is probably correct. His major concern is not about the impacts of plants.

061

Leistritz, F.L., and T.A. Hertsgaard
Environmental, Economic and Social Impacts of a Coal Gasification Plant in Western North Dakota, Bulletin No. 509, Fargo, North Dakota, North Dakota State University, Agriculture Experiment Station, 160 pages, February 1980.

Availability: R. Gold

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (K.E.)
Useful in its treatment of infrastructure and inclusion of information qualitative as well as quantitative. The quantitative aspect of the report, however, represents judgments by the researchers who rely on theory and observations reported for other areas experiencing growth. No ethnographic research was conducted.

Abstract:
This study of a coal gasification plant describes the soil and overburden resource, meteorological and air quality, and biological resources of the area. Discussions of economic and social effects are included, along with explanations of the chemistry of Lurgi Gas Liquor with respect to biodegradability and the biooxidation of coal gasification wastes. Chapter 6 focuses upon social effects, such as the following: schools and education; social services; recreation; medical facilities; political organization; the criminal justice system; and community organizations. Impacts associated with the plant construction phase and the operation phase are considered. The chapter presents descriptions of the current status of community services and systems, which are followed by an evaluation of possible effects. Quantitative changes, e.g., school enrollments, expected to occur with the population influx, are projected. A second type of impact projection is a qualitative one based on the professional judgment of the researchers. Methodology included compilation of secondary sources data, as well as the questioning of key leaders in community organizations who were asked to identify perceived impacts on their organizations.

Leistritz, F.L., and T.A. Hertsgaard
Environmental, Economic and Social Impacts of a Coal Gasification Plant in Western North Dakota (Continued)

Purpose/Topic:

Employment Estimates	Useful
Population Impacts	Not Relevant
Fiscal Impacts	Not Relevant

Reviewer's Comments: (T.S.)

This generally useful recent publication attempts to secure baseline data and explore potential environmental, economic and social impacts from constructing and operating a gasification plant in western North Dakota. Technical data is based on a 1974 industry proposal for a 250 mmscfd plant (by Natural Gas Pipeline Co., for Dunn County). The rest of the data were collected in 1974 and 1975.

Of particular relevance to a Montana assessment, because of the prevailing socioeconomic conditions considered. Specific estimates of employment needs are based on 1974 and cannot be considered reliable. Fiscal impacts are not relevant because of the different state tax structure.

Important in that it attempts a regional impact analysis, rather than a county-based perspective.

062

Little, R.L.
Some Social Consequences of Boom Towns, Logan, Utah, University of Utah, Dept. of Sociology, 34 pgs., 1976.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Significant

Reviewer's Comments: (A.W.S.)
This publication documents the social problems created by rapid population growth in Western small towns and the difficulty of reconciling social costs and economic benefits. To avoid problems associated with large-scale energy problems, the usual recommendations are to provide the community with planning assistance and front end money. Historical examples show that these measures do not eliminate social problems. The social consequences of development have not been adequately addressed in EISs, and, until they are, both in-migrants and oldtime residents will have limited options.

(Authors of the social impact section of the TER would do well to read this paper.)

Pages 10-21 describe impacts on divorce rates, school achievement, alcoholism and crime; value conflicts between in-migrants and locals; and shifts in personal and institutional interaction patterns. Pages 31-34 are a summary of conclusions. (Also includes significant tax and other economic information.)

Abstract:
This publication identifies factors which classify a community a "boom town." Boom-town problems are detailed and exemplified by presentations involving many communities. Included in the discussion of economic factors is taxation. The problems pertaining to mental health and health facilities are considered. The discussion of value conflicts examines values from the following perspectives: religious doctrines, personal interaction patterns, and institutional interaction patterns. A section presenting an overview of boom towns is also included.

063

Loran, B.I., and J.B. O'Hara, Ralph M. Parsons Company
Specific Environmental Aspects of Fischer-Tropsch Coal Conversion Technology, presented at Third Symposium on Environmental Aspects of Fuel Conversion Technology, Pasadena, California, Ralph M. Parson Company, 19 pages, September 15, 1977.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful

Reviewer's Comments: (G.B.)

This brief and somewhat outdated report highlights the environmental (air, water, solids, health) problems associated with the Fischer-Tropsch technology. Control measures and expected emissions from a proposed commercial-scale plant are described.

Abstract:

A preliminary design of a commercial-scale Fischer-Tropsch plant producing liquid hydrocarbons plus substitute natural gas by indirect coal liquefaction has been completed. The units and processes utilized are reviewed to highlight the progressive removal from the streams of compounds or materials capable of contributing to air and water pollution. All final effluents released to the environment are estimated to be in compliance with applicable or related Federal and State standards.

Methods of environmental control for the following specific areas are discussed:

- Fate of trace elements present in coal.
- Formation and destruction of metal carbonyls.
- Cyanide formation, partitioning among effluent streams, and final decomposition.
- Formation of coal-tar carcinogens and biohazards involved.

There still exist some environmental aspects specific to coal conversion for which additional experimental data are required. Research and development programs that can provide this additional information are defined.

064

Ludtke, R.L.
Human Impacts of Energy Development: A Survey Study of Dunn, McLean, Mercer and Oliver Counties in North Dakota, Grandforks, North Dakota, University of North Dakota, Social Science Research Institute, 204 pages, 1977.

Availability: R. Gold

Purpose/Topic:
Impact Overview

Not Relevant

Reviewer's Comments:
None

Abstract:
This report includes a descriptive analysis of the population's responses to energy development in four North Dakota counties, along with a cross-sectional analysis of relationships from which inferences may be made regarding the determinants of people's responses to energy development. A survey seeking measurement of some 18 variables (e.g., attitudes toward coal industrial development, commuting behavior, and projections of the future with and without energy development) was conducted. Personal interviews with 467 individuals were carried out and involved the completion of a formal questionnaire.

065

Mead, S.W., J.W. Campbell, D.R. Stephens
Ground-Water Quality Effects of Underground Coal Gasification Experiment, Livermore, California, Lawrence Livermore Laboratory.

Availability: Summary only

Purpose/Topic:

Effects on Ground-Water Quality of Underground Coal Gasification	Significant

Reviewer's Comments: (N.Z.)
This experiment was conducted near Gillette, Wyoming. The researchers sampled water from more than 12 wells in the vicinity of the underground gasification experiment before, during and up to six months following gasification. Water samples were analyzed for a variety of compounds--phenolic materials, dissolved organic carbon, volatile organics and the presence of 70 inorganic elements and compounds. The results showed a greatly increased concentration of phenolic materials (450 mg/1) just outside the burn boundary, and a variety of inorganic species issuing from within the residual ash bed. All contaminants decrease rapidly with distance, although above-background levels of some species were detected 100 feet from the burn zone. Several important contaminants showed a large decrease in concentration with time, possibly a result of adsorption.

066

Miller, S.G., Thomas E. Carroll Associates
Environmental Impacts of Alternative Conversion Processes for Western Coal Development, Washington, D.C., Old West Regional Commission, 181 pages, 1974.

Availability: Montana State University Library

Purpose/Topic:

Water Use in Gasification and Liquefaction	Useful
Water Pollution in Gasification and Liquefaction	Useful

Reviewer's Comments: (N.Z.)
A useful report despite the date (1974) of publication. It summarizes the technologies of synfuel production and the needs for water for each process. The report is brief and easy to read and is a good start for investigating the environmental effects of synthetic fuel production. However, some of the information is outdated and a number of the technologies mentioned are no longer considered viable.

067

Montana Energy Advisory Council
Coal Liquefaction: Technology, Impacts, and Technical Suitability for Montana, by J.R. McBride, Helena, Montana, Montana Energy Advisory Council, 87 pages, September 1976.

Availability: Environmental Library

Purpose/Topic:

Liquefaction Technologies	Useful
Suitability for Montana	Significant
Water Use, Availability and Pollution	Not Relevant

Reviewer's Comments: (R.E.)

The only problem with this volume is that it is four years old. Nonetheless, it offers an easily readable set of short descriptions of liquefaction technologies and those basic descriptions really haven't changed much. The author includes Synthoil (which has been dropped) and doesn't include Mobil's gasoline from methanol process, but the short descriptions of several processes not investigated in this report (e.g., Garrett, Zinc Chloride) might prove useful.

The section on suitability to Montana is short (five pages) but useful. He points out that in addition to resource availability (water and coal), the crucial technical questions are 1) the suitability of the specific technology for Montana coals, 2) the suitability of the pipeline systems to move syncrude to Montana refineries and 3) the suitability of Montana refineries to use such syncrudes. The last question is a particularly good one. We have done no research on the question and further information is needed.

Reviewer's Comments: (N.Z.)

This report has very little information relating to water use and water pollution in liquefaction plants. There is some information useful in evaluating the different technologies of liquefaction but, in general, this report is of little value.

Montana State Department of Natural Resources and Conservation
Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 & 4, 500 Kilovolt Transmission Lines and Associated Facilities, (6 volumes), Helena, Montana, Energy Planning Division, DNRC, November, 1974.

Availability:

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
Social concerns are included in the various steps of the assessment. In the consideration of social aspects in the determination of need of the facility, load growth is discussed, noting energy conservation efforts and the effects of utility promotional activities. Changing lifestyles and differentiation between need and demand is also mentioned. Included in the section comparing alternatives of plant site requirements is the impact of the numbers of construction workers and their families with each alternative. The socioeconomic inventory and impact analysis of the power plant itself and the proposed transmission lines involve: population projections for Rosebud County and growth curves computed for high population increase categories; social structure; and social service. The population discussions includes three projections for the county's population and subpopulations; each indicates differing rates of population increase. The projections utilized the categories, base population, direct employed permanent population, and construction population, and involved the social perspective in growth projection (as opposed to the economic perspective which entails a multiplier for growth associated with secondary employment). The assessment of changes in social structure describes changes in way of life and sense of community, shift in established power structure, introduction of new values and lifestyle with newcomers' arrival, and changes in town life, i.e., law and health care services, churches, schools, and taxes--from the perspective of ranchers, townspeople, and newcomers. Methodology used in this assessment included interviewing (ethnography) and conducting a public opinion survey in the study area and statewide. The study area survey involved interviews and questionnaire results analyzed quantitatively. The statewide survey involved mailed questionnaires of which 35.4% were utilized in the quantitative analysis. The inventory of social services describes those concerning health care, welfare, fire protection, law enforcement, transportation, water and sanitation, schools, housing and projected demand on the following services (based on previous population projection): school, housing, health care, water and sanitation. The social impacts of transmission lines consider similar kinds of impact; i.e., population increases with construction and maintenance, statewide public opinion survey to ascertain attitudes, impact on housing and education services.

068 Cont.

Reviewer's Comments: (K.E.) continued
Variety of data is available--quantitative and qualitative. Problems exist, i.e., failure in population figures to include secondary employment projections.

Abstract:
This volume is a summary of a multi-volume draft environmental impact assessment concerning the construction of a coal-fired generating facility and associated facilities, i.e., transmission lines. Separate but interrelated social, economic, environmental and engineering studies were involved in the assessment. The steps undertaken in the analysis included: 1) evaluation of need of facility, considering technical, social and legal sides to the determination of need; 2) comparison of the applicants' proposed electricity sources with alternative sources of electricity, based on the availability of plant sites and resources for each energy source, existing technology, time constraints of licensing and construction, and impact on the social, economic and natural environment; 3) analysis of mine-mouth generation versus the load center approach, including a cost-benefit analysis of shipping the coal to the load center versus transmitting electricity; 4) evaluation of alternative plant sites, by means of a cost-benefit analysis of impact on the human and natural environment; 5) evaluation of impact on the preferred site and location-related measures to minimize the impact (for mining activity, power plants, and transmission lines). No recommendations, i.e., the approval/disapproval of the proposal, are presented in this draft statement.

Morris, S.C., et al.
"Coal Conversion Technologies: Some Health and Environmental Effects," Science, Vol. 206, No. 4419, pgs. 654-662, November 9, 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful
Water Pollution	Not Relevant
Water Use	Not Relevant

Reviewer's Comments: (G.B.)
This is an extremely enlightening article if one can persist in analyzing the many complex results. The purpose of the investigation was to compare various fuel cycles with each other, from energy extraction to end use, not only in terms of delivered BTUs but also in terms of total air, water and solid wastes. For example, comparisons are made between using coal-derived products (SRC II and Lurgi gases) and using natural petroleum or gas. Comparisons are made between direct uses of these products and uses in central power stations. The authors also attempted to quantify and compare health and safety risks associated with different energy fuel cycles. Overall results indicate that fuel cycles using coal will have greater health and environmental consequences than those with natural oil and gas. In general, central station use of coal or coal conversion products produced more wastes relative to direct combustion of these products or of natural gas or oil. The discussion of the energy scenario for the United States, based on these results, is extremely interesting.
The authors conclude that if these increased environmental "costs" and health/safety risks are recognized and minimized, a coal-base energy scenario does not need to be precluded.

Reviewer's Comments: (N.Z.)
This article is very general and has no unique or new information regarding water pollution from synthetic fuel plants or water consumption by synthetic fuel plants.

Abstract:

SEVERAL TECHNOLOGIES TO CONVERT COAL TO LIQUID AND GASEOUS FUELS ARE BEING DEVELOPED IN THE UNITED STATES. SOME WITH SUPPORT FROM THE DEPARTMENT OF ENERGY. SUBSTITUTION OF THESE TECHNOLOGIES FOR THOSE CURRENTLY BEING USED WILL PRODUCE DIFFERENT HEALTH AND ENVIRONMENTAL HAZARDS. IN THIS ARTICLE. SELECTED HEALTH AND ENVIRONMENTAL EFFECTS OF FOUR COAL CONVERSION AND FOUR EXISTING TECHNOLOGIES ARE COMPARED. FOR EACH TECHNOLOGY. THE EMISSION ESTIMATES FOR COMPLETE FUEL CYCLES. INCLUDING ALL STEPS IN FUEL USE FROM EXTRACTION TO THE END USE OF SPACE AND WATER HEATING BY ELECTRICITY OR DIRECT COMBUSTION. WERE PREPARED BY MEANS OF THE BROOKHAVEN ENERGY SYSTEM NETWORK SIMULATOR MODEL. QUANTITATIVE OCCUPATIONAL HEALTH AND SAFETY ESTIMATES ARE PRESENTED FOR THE EXTRACTION, TRANSPORTATION, DISTRIBUTION, PROCESSING, AND CONVERSION ACTIVITIES ASSOCIATED WITH EACH TECHNOLOGY; ALSO INCLUDED ARE SOME PUBLIC HEALTH DAMAGE ESTIMATES ARISING FROM FUEL TRANSPORTATION AND AIR POLLUTION IMPACTS. QUALITATIVE ESTIMATES OF HEALTH DAMAGE DUE TO POLYCYCLIC ORGANIC MATTER AND REDUCED SULFUR ARE DISCUSSED. IN GENERAL. ENERGY INEFFICIENCIES. ENVIRONMENTAL RESIDUALS. AND HENCE IMPLIED ENVIRONMENTAL EFFECTS AND HEALTH DAMAGE INCREASE IN THE ORDER: (1) DIRECT COMBUSTION OF NATURAL GAS AND OIL; (2) DIRECT COMBUSTION OF SYNTHETIC GAS AND OIL; (3) CENTRAL-STATION ELECTRIC POWER PRODUCED FROM SYNTHETIC GAS; (4) CENTRAL-STATION ELECTRIC POWER PRODUCED FROM COAL; AND (5) CENTRAL-STATION ELECTRIC POWER PRODUCED BY THE COMBUSTION OF SYNTHETIC LIQUID FUELS. THE COMPLIANCE AND CONFLICT OF THESE TECHNOLOGIES WITH THE AMENDMENTS OF THE CLEAN AIR ACT AND OTHER LEGISLATION ARE DISCUSSED.

Mountain West Research, Inc.
Construction Worker Profile, Community Report, Forsyth and Colstrip, Montana, Washington, D.C., Old West Regional Commission, 61 pages + appendix, December 1975.

Availability: Environmental Library

Purpose/Topic:
History-background Information Significant

Reviewer's Comments: (J.C./A.S.)
The community report on Forsyth and Colstrip is part of the construction worker profile series covering a number of construction sites in a nine-state region. Two questionnaires were done in Colstrip in 1975, a Project Survey of Construction Workers on Colstrip power plants 1 and 2, and a Household Survey of the town. The Household Survey was also done in Forsyth. Unfortunately the project survey had only a 21.5% response rate. Of this survey, the report states "of the 748 questionnaires distributed to the Bechtel employees, Bechtel management reported that approximately 320 were returned; however, only 161 of these were forwarded to be used in the study because the others apparently contained no useful information." No member of the project survey study team visited Colstrip, and the questionnaire was slightly different from that used in the other study areas; consequently, the report states " . . . the results for this project should be considered suspect."

The community survey is more useful because the communities of Forsyth and Colstrip can be compared to each other as well as to the construction sites reported in separate volumes of the series.

Although the Project Survey has obvious problems, the publication is rated "Significant" because this primary comparative data is rare.

Abstract:
The community report on Forsyth and Colstrip is part of the construction worker profile series covering a number of construction sites in a nine-state region. Two questionnaires were used in Colstrip in 1975, a Project Survey of Construction Workers on Colstrip Power Plants 1 and 2, and a Household Survey encompassing the whole town. The Household Survey was also done in Forsyth. The household surveys allowed for comparisons between the two communities to be drawn.

071

Murphy, M.J., S. Maeder, J.I. MacIntyre
Northern Great Plains Coal: Conflicts and Options in Decision Making. A Future Choices Project of the Upper Midwest Council, Minneapolis, Minnesota, Upper Midwest Council, 275 pages, 1976.

Availability: R. Gold

Purpose/Topic:
Impact Overview

Not Relevant

Reviewer's Comments: (K.E.)

The document presents general discussions of the issues pertaining to the themes of planning and decision-making, growth and limits to growth, and private enterprise and government regulation. An in-depth analysis of social impacts is lacking. Each section of the report, however, includes some limited treatment of the social problems associated with coal development. The section on utilities emphasizes the use of investigating impacts to avoid error in choosing between alternatives, suggests the inclusion of cumulative impacts in investigations, and criticizes the superficial treatment of values and views of those people affected by energy developments. In the second section, environmental and socioeconomic impacts are compared for two plant sites, one a mine-mouth operation, the other load-center. No primary data are utilized in the analysis, which examines how the decision of plant-siting was made and the analyses conducted by the decision-makers. The discussion of socioeconomic impacts considers the prior situation of the two communities (i.e., land use, employment and population) and addresses problems concerning housing, schools and commuting. Although the "boom town" phenomenon is defined, emphasis is placed on the economic impacts, i.e., the communities' ability to absorb new population in terms of municipal costs and revenues. The socioeconomic impacts described in the section on energy transportation alternatives mention briefly only those experienced by construction workers versus operating workers. Included in the section of understanding growth and limits is a discussion of social limits. A note is only made of the conflicts of people's values with technologic and economic solutions and the inability to cope with the frequency and variety of change, i.e., change in lifestyle. The final section on coal on Indian lands considers only the possibility of social and cultural impact; it does not detail it.

Abstract:

The costs and benefits of coal production in the Northern Great Plains region are the subjects of this report, which consists of six sections: 1) utility decisions and regulation; 2) comparing two plant sites; 3) energy transportation alternatives; 4) regional planning and decision making; 5) understanding growth and limits; and 6) coal on Indian lands. Findings and recommendations for each section address the following: 1) broad policy

071 Cont.

Abstract: continued
questions; 2) decision-making alternatives; 3) energy and other resource policy; and 4) economic, social and cultural values.

072

National Academy of Sciences, Academy Forum
Coal as an Energy Resource - Conflict and Consensus, Washington, D.C., National Academy of Sciences, 324 pgs., 1977.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
The discussion of the Northern Great Plains is concerned with the social, economic, government and political issues of coal development. The mayor of Gillette, Wyoming, describes the under-provision of services (water, sewer, schools) and fiscal problems and how they were addressed. An applied psychologist explains why he considers the town of Wheatland, Wyoming, a positive experience in anticipating and planning for growth, and finding the financial means to deal with rapid growth. Concerns with impacts other than those involving services are presented in the discussions by Montana speakers. Ranchers' attitudes towards the change in lifestyles is considered, along with the dual concerns of Montana Indians in energy development, i.e., tribal identity and values versus tribal economic needs. A speaker from a Montana agency presented hitherto unmentioned issues: some impacts are not remediable, what happens after coal development, is coal development compatible with agriculture, the social and economic uncertainties, and the need to acknowledge our dependence upon natural and social systems and values and make a commitment to preserve them. A workshop, "Habitat," as reported by Raymond L. Gold, outlined nine aspects of coal development concerning the local people, i.e., stripmining as inimical to a ranching way of life, as seen by western ranchers.
The document is useful in its representation of the many-faceted field of social impact. Not only are the problems of services and population growth discussed, but the concerns of the rural way of life and values are also addressed. It provides information on the variety of opinions involving the multi-issue problem of energy development. For example, dealing with impacts, i.e., planning at the local level or examining our national energy needs, is an issue considered in various ways.

Abstract:
The report is a record of an Academy Forum which addressed the problems and promises of coal development. A theme which emerges from this forum in all the case analyses and workshops is: "How can we reconcile our local and regional aspirations and way of life with national needs and purpose?" With strip-mining in the northern Great Plains, the issue is the supply of coal and energy to metropolitan areas versus the price of social displacement experienced by

072 Cont.

Abstract: continued
Indians and ranchers along with the problems of land reclamation and boom towns. The viewpoints of adversaries and advocates for increased coal production are both represented to allow for discussion of the required trade-offs between them.

073

National Academy of Sciences, National Research Council
Report of the Conference on Synthetic Fuels, Washington, D.C., National Research Council, 56 pages, October 1979.

Availability: Environmental Library

Purpose/Topic:
National Policy on Synfuels — Useful

Reviewer's Comments: (R.E.)
1) This report suggests "going slow," e.g., half a dozen plants soon, but allow them to be tested commercially, rather than rushing to Carter's 1990 goal.
2) It suggests "uncertainties" on environmental impacts because of sparseness of data. Coal liquids (possible carcinogens) and solid wastes are said to be the major problems.
3) Social impacts on undeveloped areas "must be recognized." Suggests the need for more research.
4) Good rationale for several policy suggestions.

The value of the document lies more in the prestige of the National Research Council than in the novelty of their proposals. There is no new data in the document.

074

National Technical Information Service
Pollution and Environmental Aspects of Fuel Conversion, NTIS/PS-77/0212, 1964-March 1977, Springfield, Virginia, NTIS, 167 pages, April 1977.

Availability: Environmental Library

Purpose/Topic:
Air

Somewhat Useful

Reviewer's Comments:
None

Abstract:
Abstracts dealing with environmental impacts related to fossil fuel conversion processes (primarily coal gasification) are presented. A few citations concerning environmental considerations pertaining to future energy growth are included. (This updated bibliography contains 167 abstracts, 80 of which are new entries to the previous edition.)

Nehring, R., et al.
Coal Development and Government Regulation in the Northern Great Plains: A Preliminary Report, Santa Monica, California, Rand Corporation, 169 pages, August 1976.

Availability: R. Gold

Purpose/Topic:
Impact Overview — Not Relevant
Economic Aspects — Perhaps Relevant

Reviewer's Comments: (J.C.)
Main point: government regulations as related to energy development in the Northern Great Plains Region.
Secondary emphasis: economics; focus on costs, specifically external costs.
Content:
Section I: a basic framework for understanding the problem (an overview).
Section II: describes the characteristics and development of the strippable Northern Great Plains coal resource.
Section III: describes the significant adverse effects associated with three phases of the coal fuel cycle:
a) extraction
b) conversion
c) transportation
Section IV: addresses the question "Who Should Regulate?", describing four key areas of potential confict between national and state governments.
Impacts covered:
-- mainly environmental and economic impacts addressed;
--makes qualitative judgments concerning water quantity, water and air quality;
--generalizations tend to gloss over the effects to the social environment;
-- claims social objectives are efficiency and equity--these are definitely not social concerns;
-- states "social costs" as: investment costs, operating costs, insurance costs, and negative spillovers;
--"negative spillovers" is an attempt to introduce some social problems, but not to any consequence.
The statement " . . . crucial focus for energy supply developments is the distribution of benefits and costs among and within regions . . ." characterizes the tone of the document. Confuses socioeconomic findings as economic-oriented and not social!

Abstract:
The report is concerned with government regulations as related to energy development in the Northern Plains region. Its secondary focus is on external costs. Section I presents a basic framework for understanding the problem. The characteristics of the coal

075 Cont.

Abstract: continued
resource are described in Section II, along with its development. Section III discusses the significant adverse effects associated with the phases of the coal fuel cycle (extraction, conversion and transportation). The question "Who Should Regulate?" is addressed in Section IV, which describes four key areas of potential conflict between federal and state governments.

076

Nelson, S.G.
Application for Industrial Fuel Gas: U.S. and International, Cleveland, Ohio, Arthur G. McKee and Company, 6 pages, 1978.

Availability: Environmental Library

Purpose/Topic:
Low-BTU Gas — Useful

Reviewer's Comments: (R.E.)
This brief paper suggests some of the ways low-BTU gas can be used.

1) The plant must be of suitable size (needing at least 50 million BTU/hour) and should have a steady requirement for fuel.
2) He suggests that paper mills and non-ferrous smelters are both good candidates for such gases.

At some stage, Hoerner-Waldorf may go to gasifiers--but it may well be wood-wastes which are gasified. The economics don't point to coal gasification as an immediate technology for them.

077

Nobles, J.E., J.W. Palm, and D.K. Knudtson
"Plant Performance Proves Process," Hydrocarbon Processing, Vol. 56, pgs. 143-145, July 1977.

Availability: Environmental Library

Purpose/Topic:
Technology Description - Tail Gas Sulfur Removal — Useful

Reviewer's Comments: (R.E.)
A description of the Cold Bed Adsorption (CBA) process for tail gas sulfur removal. The process follows a Claus plant, using considerably lower temperatures, but the same chemistry as the Claus process. Low temperatures allow a) a more favorable equilibrium composition and b) adsorption of sulfur on the catalyst. The process is being used by AMOCO in Canada and removes 99.3% of the sulfur in the stream.

No mention is made of the exact COS or CS_2 content of the final vapor effluent.

078

Nordstrom, J., et al.
The Northern Cheyenne Tribe and Energy Development in Southeastern Montana. Vol. I: Social, Cultural, and Economic Investigations, Lame Deer, Montana, Northern Cheyenne Research Project, October 1977.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (K.E.)
The important aspects of this volume for the social impact assessment field is the introduction, which gives background information on the Cheyenne community, and Chapters 3 through 7. Further information concerning the Cheyenne is provided in the chapter describing the survival and importance of native culture to the Cheyenne. One part of SIA is fulfilled in Chapter 4 with its treatment (pages 179-186) of attitudes concerning impacts. The list of 13 guidelines to be considered in development options represents a means to prepare for and handle impacts. Chapter 5's concern with a theoretical framework provides the "differentiation" theory as a way of understanding local values and way of life. The response to impacts is the subject of Chapter 6, which considers the management and development of tribal resources with cultural and social concerns in mind. Specifically, policy implications should consider the tribe as a whole, the native language and religion, as well as community development and social problems (alcoholism, poor services, crime, unemployment, communication). The presentation of baseline demographic research in Chapter 7 outlines information available to the Tribe (but not reported herein) regarding population of the reservation, population projections for 1980, 1985, and 1990, and education figures.

Methodology involved secondary sources (i.e., review of literature) and five surveys (from which quantitative and qualitative data was obtained). Elders of the tribe were talked to as well to put information gained from the surveys in a cultural context.

The volume is useful because the focus of its topic, the Northern Cheyenne, could become major players in the synfuel development. Since it does not treat social and cultural concerns in depth, the volume serves as a general introduction to social and cultural impact.

Abstract:
This volume (part one of two volumes) presents the results of a study of social, cultural and economic aspects of life on the Northern Cheyenne reservation. Following a look at Northern Cheyenne history, an economic picture from a regional perspective is described. A local rural area's difficulty in controlling its economic development, which is undertaken by interests outside the area, is considered. The reservation's place in the regional

078 Cont.

Abstract: continued
economic picture is reviewed historically, described statistically, and evaluated in terms of the kinds of economic development available to the tribe. The survival of Cheyenne culture and its importance to the Cheyenne is the subject of Chapter 3, which presents individuals' expressions. Chapter 4 concerns Cheyenne attitudes about alternative kinds of economic development and focuses upon the Indian people's thinking of the good/bad effects of stripmining coal (based upon a 1975 survey). Thirteen guidelines in evaluating the compatibility of development with Cheyenne culture and attitudes are outline. The theoretical approaches of acculturation and "differentiation"* are explained and analyzed in Chapter 5. Concluding Chapters (6 and 7) consider policy implications (i.e., tribal participation in policy decisions) and present demographic and economic baseline data research.

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* Acculturation Theory: when two cultures come into contact, the traits of one or both cultures change until the two cultures have become alike.

Differentiation Theory: (Note: James P. Boggs' own term.) how interacting cultures remain different from one another.

079

Northern Great Plains Resources Program
Columbus/Noonan Study: The Impact of Coal Development and Decline on Two North Dakota Communities, Discussion Draft, by K.L. Lemmerman, Denver, Colorado, NGPRP, 104 pages, June 1974.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
Descriptive narratives of each of the following factors in the communities' development are presented (the narratives include statistical information): population trends, employment and general welfare, market and trade sectors, government services and policies, non-government services. The past and current situation (i.e., one of decline) is depicted. Attitudes surveyed involved the residents' position towards industrial growth, i.e., if it is possible to have industrial growth and a prosperous agricultural community.

The study employed several methods: survey, field work, compilation of basic data, and newspaper analysis. The survey involved mailed questionnaires to all heads of households in the two communities (as obtained from telephone directories). Of the 209 questionnaires, 47-48% were returned. The responses were statistically analyzed (descriptive statistics and correlations). Field work entailed individual-group interviews, involving 75 people. Traditional leaders in the community, as well as housewives, students, and newcomers were interviewed. Basic statistical data--concerning demography, education, taxation, services, business, recreation, religious activities, civic/voluntary organization--were compiled using secondary sources. In-depth, historal analysis of three area newspapers provided an historical dimension, i.e., community development, community and coal-related events, attitudes of residents of earlier days. This approach of including a variety of methodologies represents a strength in the study: the methods provide supplemental data and a means of cross-checking data and analysis. This is particularly important for research with time constraints and which is multi-disciplinary.

Although the descriptive narratives of communities which have undergone development can prove useful in considerations of changes for similar communities undergoing similar development, the information pertaining to the question of what happens to a coal town when the mines/power plants close is only preliminary. Two weaknesses in the analyses--the lack of verification of study results with other research and the lack of placing the findings within a theoretical framework--inhibit the application of the study beyond North Dakota. The report, however, stresses the preliminary nature of the investigation and calls for further research. The strengths of the research--its multi methodology--should be noted.

079 Cont.

Abstract:

This preliminary report is concerned with a community study with the objectives to: 1) write a socio-economic history of Noonan and Columbus (two communities which have experienced coal mine and power plant development and decline); 2) assess the impact of mine and/or power plant closings on coal mining communities; 3) determine the impact of coal development on population, governmental services and non-governmental services; and 4) assess the attitudes of the residents toward past, present and future coal development in Burke and Divde counties and in North Dakota. Attitude surveys, depth interviews, the compilation of baseline data, historical analysis of old newspapers, and a review of available secondary sources were combined in the project design.

080

Northern Great Plains Resources Program
Effects of Coal Development in the Northern Great Plains: A Review of Major Issues and Consequences at Different Rates of Development, Denver, Colorado, NGPRP, 1975.

Availability: Environmental Library

Purpose/Topic:
Impact Overview

Not Relevant
(perhaps to economic aspect)

Reviewer's Comments: (K.E.)
Part V of the report addresses the economic, social and cultural impacts of coal development. The critical nature of these impacts is considered as dependent on the timing and magnitude of development. Thirty-six counties in Montana, Nebraska, North Dakota and Wyoming were selected as "principal impact areas." Within these areas, a number of communities were designated as "principal impact communities." Indicators selected for measurements of change within the "impact areas" were employment and population (migration and spatial distribution) and within "impact communities" were labor supply, population, institutional and community services, housing and revenue. The kind and magnitude of changes expected were involved in this primarily economic and quantitative analysis. A look at coal development on six Indian reservations briefly describes current population, age of residents, labor force and employment, the Indian family and income, educational levels, and an anticipated reservation coal development. The potential impact on culture and lifestyle is not explored. A discussion of the present setting of agriculture is followed by an assessment of labor, water and land impacts that coal development may bring. Societal and cultural impacts are the subject of a three-page discourse that makes the following points (but fails to expand or support them by discussing specific studies): acceleration of urbanization process, loss of Indian cultural values, socio-psychological trauma at Coal Development Profiles 2 and 3 levels, large numbers of newcomers with different values, change in way of life as varying with level and pace of development, "boom town" syndrome, cessation of the rural family as a strong social unit, increase in variety of cultural and recreational opportunities, fragmentation of well-defined and long-term political and social relationships, and increased activity in planning and organizing for changes.

The report is useful to those interested in economic and demographic projections of impacts, evaluated at three levels. Its general treatise of social concerns "touches the bases," so to speak, but includes no mention of methodology and no validation of points made. The report of the Work Group, whose subject of study was the social, economic and cultural aspects, may prove more useful. Individual reports of the Work Group are in listed repositories and centers.

080 Cont.

Abstract:

The purpose of the report is to provide information useful in developing a perspective of the issues and consequences of expanded development of coal. Cooperative studies of several major impacts of increased production from coal deposits in the Northern Great Plains region at different theoretical rates of development during the next 25-year period are described. The reported studies are expected to be helpful in the decision-making processes of individuals; federal, state and local governments; industry; and other public and private groups. Seven work groups with the following specific subject areas were involved: regional geology; mineral resources; water; atmospheric aspects; surface resources; social, economic, and cultural aspects; and national energy considerations. Three pre-designated coal development profiles--low, intermediate and high levels of development--are considered in the analyses of the effects of different rates of coal development.

081

Northern Great Plains Resources Program
Socio-Economic and Cultural Aspects Work Group Report, Denver, Colorado, NGPRP, June 1974.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments:
None

Abstract:

The report represents a summary of the findings of Work Group F, which investigated the socio-economic and cultural aspects of coal development in the Northern Great Plains. The problem of population growth (its magnitude, rate of occurrence, uneven distribution, and short-term fluctuations during construction phases) is discussed. Also included in the assessment of potential problems are the following: 1) limited services and unpreparedness of most communities; 2) lack of appreciation of potential magnitude of coal development by private citizens and government officials; 3) lack of satisfaction of newcomers with community services; 4) lag of revenue collection behind public service requirements; 5) three service areas of particular concern--housing, health care and education; 6) loss of local autonomy; 7) social and demographic changes on Indian reservations. Recommendations for potential solutions to some of the major problems are presented. Chapters provide background information on the study area, examine potential population changes attributed to alternative levels of coal development, and discuss anticipated changes in lifestyles of local residents resulting from rapid population increases and accelerated urbanization.

082

Northrop, G.M., C.A. D'Ambra, and R.L. Scott
"A Workable Methodology for Evaluating Socioeconomic and Environmental Impacts of Energy Conversion Facilities at Potential Sites," in Energy Technology VI: Achievements in Perspective; Proceedings of the Sixth Energy Technology Conference, February 26-28, 1979, Washington, D.C., Washington, D.C., Government Institutes, Inc., pgs. 215-230, April 1979.

Availability: R. Gold.

Purpose/Topic:

Impact Overview	Not Relevant
Economic Aspects	Perhaps Relevant

Reviewer's Comments: (K.E.)
This methodology is not comprehensive, as is claimed in the paper's introduction, in that data which cannot be quantified are, of course, excluded in this check-list approach. Its aim to reduce research effort in EIS preparation in itself is questionable. Also, its concern with an orderly and logical manner of EIS preparation can be attacked: standardization of investigation fails to consider the "real" situation, which each study must address. The methodology's use is limited and should be applied only in situations where supportive research is also carried out (to validate, substantiate, check the methodology's conclusions).

Abstract:
A methodology for the evaluation of socioeconomic and environmental impacts expected to occur when an energy conversion facility is implemented at a given site is explained. This "Site Evaluation for Energy Conversion Systems" methodology (SELECS) at Level 1 is designed to be performed by hand by a non-specialist in one day and to be used by government planning agencies, industrial and academic parties. The Level 1 methodology can be expanded to a computerized Level 2, which would include a data bank of process data, and options for computing impacts for construction and shut down phases, in addition to the operational phase which is presented herein. A Level 3 methodology would include additional modules for air and water quality, community services, infrastructure, etc. An outline of the SELECS Level 1 Methodology is presented; results from nine hypothetical, illustrative applications involving nine energy conversion processes located at urban, suburban, and rural sites in eastern, central and western regions of the United States are presented.

083

Ohio River Basin Commission
Water Assessment for Monongahela Synfuel Plant, Cincinnati, Ohio, Ohio River Basin Commission, 47 pages, June 6, 1980.

Availability: Environmental Library

Purpose/Topic:
Water Quantity and Quality Barely Useful

Reviewer's Comments: (R.E.)
This is an assessment of both water needs and the effect of development on water quality for the SRC-II demonstration plant planned for a site near Morgantown, West Virginia.
The demonstration plant will require 8.7 cfs (2.4% of the low flow), while the commercial plant would require 23 cfs (6.4% of the low flow). There may be difficulties meeting the Pennsylvania TDS standards (West Virginia doesn't have any).
Recommendations from the report are all concerned with further study and the need for cooperation, planning and management.

084

Oil and Gas Journal
"New Zealand Methanol-to-Gasoline Process Can Be Based on Coal," Oil and Gas Journal, pgs. 95-96, January 14, 1980.

Availability: Environmental Library

Purpose/Topic:
Technology Description - Mobil M Significant

Reviewer's Comments: (R.E.)
Despite the title, the plan is to produce 1/3 of New Zealand's gasoline from methane using the Mobil M process (methanol to coal). A brief explanation of the technology is given.

085

Oil and Gas Journal
"Sasol Pushes Licensing of Coal Process," Oil and Gas Journal, pgs. 108-109, September 19, 1979.

Availability: Environmental Library

Purpose/Topic:
SASOL

Useful

Reviewer's Comments: (R.E.)
A "news" type story on Fluor's contract with Sasol to market their technology in the United States. They claim that a 62% thermal efficiency would be obtainable for a United States plant.
A brief description of Sasol II is given. For example, the plant will use 36 Lurgi Mark IV gasifiers, 6 oxygen plants, 6 boilers (540 tons/hour of steam), and, synthoil units, an oil workup section of about 50,000 b/day.
Fluor's study seems to be centered on using Wyoming, Colorado or New Mexico coal.

Old West Regional Commission
Construction Worker Profile, Summary Report, by Mountain West Research, Inc., Billings, Montana, Old West Regional Commission, 23 pages, December 1975.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (J.M.)

This profile was conducted to study the socio-economic consequences of construction of energy facilities and included a household survey (door-to-door interviews with 1,432 households in 9 western communities), a project survey (to construction workers at 14 construction sites), and a community survey (in-depth case studies with 3 households). The summary report capsulizes the principal findings of the study.

The study is helpful in that it could aid communities in anticipating and planning for construction worker impacts. The project survey is not entirely dependable, however, because surveys were self-administered. To determine local/non-local composition of most work forces, a second questionnaire was administered. The study does provide some demographic data about workers, however, that is pertinent when planning for impacts on community services.

The profile is not totally exhaustive and by the authors' own admission merely scratches the surface of available data on construction work forces.

Abstract:

This document presents a summary of an investigation undertaken to help concerned individuals and community representatives anticipate and plan for construction worker impacts. The body of experience with, and information about, the effects of large numbers of construction workers on communities and community members is described in part and analyzed for regularities and discernible cause/effect relationships. The study objectives included: 1) to develop a broad-based set of primary data on construction projects and related work forces that describe the experiences of communities and that document the sources of the impacts they have felt; 2) to analyze the data to determine both the stability and the quantitative magnitude of certain important relationships which are factors in determining the impact of a construction force on nearby communities. Several of the study's most important findings are described, followed by a summary of some of the analytical results. The report concludes with a brief discussion of the applicability of the results to the planning and impact assessment processes.

087

Palmer, A.
"Mortality Experience of 50 Workers with Occupational Exposures to the Products of Coal Hydrogenation Processes," Journal of Occupational Medicine, Vol. 21, No. 1, pgs. 41-44, January 1979.

Availability: Environmental Library

Purpose/Topic:
Air
Health

Not Relevant
Useful

Reviewer's Comments: (G.B.)
The results of this investigation are inconclusive but indicate that those workers exposed to carcinogenic substances did not show an increased death rate (18-20 years later) due to cancer. Additional research along these lines would be advised.

Abstract:

A STUDY WAS UNDERTAKEN TO DETERMINE THE MORTALITY EXPERIENCE OF 50 WORKERS DIAGNOSED WITH EITHER SKIN CANCER OR PRECANCEROUS LESIONS. THESE WORKERS WERE FIRST DIAGNOSED BETWEEN 1955 AND 1959 AS PART OF A SCREENING PROGRAM FOR WORKERS EMPLOYED IN A COAL HYDROGENATION PLANT. WORKERS WERE TRACED AND DEATH CERTIFICATES OBTAINED FOR THOSE WHO WERE DECEASED. FINDINGS REVEALED THAT FIVE OF THE WORKERS HAD DIED FROM NONCANCEROUS CAUSES. 16 HAD RETIRED. 28 WERE STILL WORKING. AND ONE SUBJECT WAS LOST TO FOLLOW-UP. BECAUSE OF THE LIMITED SCOPE OF THE STUDY (IT ONLY INCLUDED THOSE WORKERS WITH SKIN LESIONS) AND THE SMALL SAMPLE SIZE (50). NO FIRM CONCLUSIONS CAN BE MADE. ALTHOUGH IT WOULD APPEAR THAT THERE IS NO INCREASE OF DEATH DUE TO SYSTEMIC CANCERS.

088

Parfit, M.
"A Gathering Storm Over Synfuels on the Big Sky Range,"
Smithsonian Magazine, pgs. 71-78, January 1980.

Availability: R. Gold

Purpose/Topic:
History-Background Information Significant

Reviewer's Comments: (J.M.)
This magazine article presents a close-up view of some of the major participants in an organization which has formed in McCone County, Montana, to fight construction of synfuel plants in Eastern Montana. The article, although brief, offers some insight into the types of lifestyles that have evolved in the ranching country of Eastern Montana, and also talks about some of the impacts that have already begun to emerge as a result of the anticipation of synfuel development. Implications are that any further news of energy development in McCone Country will be met with staunch opposition by area residents.

Abstract:
Attitudes and activities of Montana's McCone County residents who are confronted with coal and possible synfuel development are described. A group of local farmers and townspeople who formed the McCone Agricultural Protection Organization in response to a Burlington Northern, Inc., proposed liquefaction facility is focused on. The area's agricultural way of life is described in this article which considers the controversy over whether land should be used for agriculture or mining.

089

Petrie, T.W., W.J. Rhodes, and G.C. Page
"Coal Processing Technology: Environmental Impact of Synthetic Fuels Development," Chemical Engineering Progress, Vol. 75, No. 6, pgs. 73-80, June 1979.

Availability: Environmental Library

Purpose/Topic:
Air Significant
Health Significant

Reviewer's Comments: (G.B.)
This article presents an excellent overview of the state-of-the-art on environmental research sponsored by EPA for 1979. It summarizes the principal goals and projects that EPA is promoting and contains an excellent EPA bibliography (for 1978-1979).

Probstein, R.F., and H. Gold
Water in Synthetic Fuel Production: The Technology and Alternatives, Cambridge, Massachusetts, MIT Press, 296 pages, 1978.

Availability: Environmental Library

Purpose/Topic:	
Water Quantities Required	Significant
Water Treatment Schemes	Significant
Technology Fundamentals	Significant
Cooling System Fundamentals	Significant

Reviewer's Comments: (N.Z.)

This book is by far the best overall reference on water use in the synthetic fuels industry. I recommend purchasing this book ($9.00) as prime reference material. After reading all other material, I conclude that at least 80% of the information could be obtained by reading this book alone. The material is a fairly objective account of the most probable technologies being proposed, water balances for each process are included and the most appropriate wastewater treatment schemes are discussed.

There is an extremely good chapter on cooling fundamentals and the role of water in cooling. All aspects of water use are considered including municipal use by a satellite town.

The authors indicate when assumptions are being made and explain limitations in current knowledge or research. The book is limited on details of chemical constituents entering the water system. Water pollution is generally treated by a zero-discharge regime and possible problems or upsets of this regime are not discussed. The authors present an optimistic (perhaps overly optimistic) view that all water-related problems are solvable.

The book appears to be the "bible" for information on water in the synthetic fuels industry; the authors are often quoted and they are associated with a number of reports on the subject. One should be aware that there may be other ways to approach the problem and that these people have dominated the information on this subject.

Quality Development Associates Incorporated
C-B Shale Oil Venture, Socio-economic Monitoring Report No. 1, January - June 1978, Denver, Colorado, Quality Development Associates, Inc., u.p., 1978.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (J.M.)
This monitoring report was designed to provide continuing information on project work force and socioeconomic impacts on community infrastructure for project management and involved communities. Information in the report was collected via questionnaires completed by every member of the work force (300) and by community agencies in two towns.
Information on work force is cursory, dealing primarily with their places of residence, marital status and family size, although report noted that at the time the survey was completed it was impossible to distinguish between employees with families along and those whose families are elsewhere--there is no explanation for that discrepancy. Also at the time, statistics on school-age children of employees were unavailable.
Socioeconomic data deal exclusively with housing, schools, hospitals and health care and law enforcement, and is limited to information tables. While not exhaustive, information presented here, when looked at in conjunction with later monitoring reports, could reveal significant trends in work force needs and makeup, as well as trends in impacts on community infrastructure.

Abstract:
This report is first in a series of reports which will provide selected information on the C-b project work force and socioeconomic conditions within nearby communities. The community data reflect a six-month period from January 1 to June 30, 1978, while the work force data reflects the month of July 1978. Information was collected through a survey form completed by each member of the C-b work force, and from individuals and agencies in the communities of Rifle and Meeker. Included are brief sections pertaining to: economic indicators; law enforcement and fire protection; water and sewer; hospitals and health care; schools; housing and land use; types of residence; marital status and family size; school age children; the work force.

Quality Development Associates
C-b Shale Oil Venture Socio-economic Monitoring Report No. 4 (Quarterly Report), Denver, Colorado, Quality Development Associates, Inc., 11 pages, April 1979.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (J.M.)

Report contains selected information on C-B project work force--the data were obtained through use of a questionnaire which surveyed 62% of the work force. Of 245 persons employed at the site, 90% of workers still held construction jobs and were considered temporary employees. The survey results deal mainly with housing preferences of workers, average rental costs in particular towns, as well as some demographic data on work force. Methodology used, survey instrument, etc., were not included as part of the report.

Apparently there is very little of significance in this report to distinguish it from earlier similar ones. Report is useful as general guide to characteristics of transient work force, although it should be read in conjunction with earlier reports for the tract.

Abstract:

This fourth monitoring report concerning the C-b Shale Oil Venture contains selected information on the C-b project work force. The data were collected through a questionnaire completed by persons employed on the C-b tract, and reflects the current work force as of April 6, 1979. Included are brief sections pertaining to: housing (location, length of residence, type, preference, cost); age, sex, marital status; family size and characteristics; and recreational activities.

093

Quality Development Associates Incorporated
Cathedral Bluffs Shale Oil Project Socioeconomic Monitoring Report No. 6, Year End Report 1979, Denver, Colorado, Quality Development Associates, Incorporated, 37 pages, 1979.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (J.M.)

This report is the sixth in a series monitoring changes in work force data and changes in community infrastructure due to continuing shale oil project. As with preceding reports, data was collected via questionnaires of labor force and from community agencies in two affected towns. The surveys were coded and analyzed through a computerized data base management system.

The report documents changes that have occurred over a two-year period: for example, the percentage of workers who are newcomers increased; the median age of workers decreased from 31 years to 29 years; population projections decreased from expected totals; types of residences changed as more workers began buying homes; crime increased, particularly crimes related to fraud, etc.

Reading this report along with preceding ones is helpful as far as revealing some of the more significant trends regarding makeup of work force, their housing needs, and their impacts on community services.

Abstract:

This sixth monitoring report provides local communities with selected information on the C-B project work force, as well as data on changing socioeconomic conditions. The information on the work force was collected through a questionnaire completed by employees when they started work at the Cathedral Bluffs site. The surveys were coded and analyzed through a computerized data base management system. The socioeconomic data are collected from various community agencies in Rifle and Meeker. Comparisons are made with data from previous years. Included are brief sections pertaining to the work force: housing (location, length of residence, type, preference, cost); age, sex, marital status and family size; recreational activities. Population growth of the two communities is discussed, along with the communities' housing, law enforcement and fire protection, hospitals and health care, school data, labor force, and economic indicators.

Quilici, F.J.
Characteristics and Uses of Montana Fly Ash, Bulletin 90, Butte, Montana, Montana College of Mineral Science and Technology, 27 pages, 1973.

Availability: Montana College of Mineral Science and Technology

Purpose/Topic:

Uses of Fly Ash	Significant
Dangers of Using Fly Ash	Not Relevant

Reviewer's Comments: (N.Z.)

Presently, fly-ash production in Montana comes from coal-fueled electric power plants. The fly ash produced in these plants is analogous to fly ash produced in synthetic fuel plants and, thus, this report is useful in evaluating the commercial value of fly ash from synfuel production.

The report details a number of possible and successful uses of fly ash. These uses include: cement manufacture; concrete construction; concrete products; filler material in tile, rubber, paint and putty; soil amender and plant-growth stimulant; soil stabilization; abrasive, mineral filler in asphalt; lightweight aggregate; water purification; oil-well cementing and grouting; filtering medium for water and other fluids.

No mention is made in this report of possible polluting from commercial use of fly ash (i.e., trace metals in fly ash, etc.).

Abstract:

The physical and chemical properties of Montana fly ash suggest several practical uses for the ash, which consists mainly of oxides of silica, aluminum, calcium, and magnesium. It can replace part of the cement or aggregate when added to concrete. Sintering to spherical particles useable as lightweight aggregate was successful in the laboratory. Fly ash imparts strength and stability to soils. As a mineral filler in asphalt, fly ash behaves like lime but to a lesser degree.

The ash reacts with water and exhibits reverse solubility with increased concentration. It is extremely basic as shown by the pH, and this feature along with its cementitious properties indicate a practical use in short- and long-period neutralization of acid mine water. Adsorptive and filtering capacity are lacking, however, because of carbon deficiency and the tendency of seepage water to form channels. Montana fly ash is inexpensive, but utilization and availability are affected by transportation costs.

095

Reilly, M.J.
Synthetic Fuels and Environmental Protection, paper delivered at 179th National Meeting of the American Chemical Society (Houston, Texas), Washington, D.C., Engineering Societies Commission Energy, Inc., 30 pages, April 1980.

Availability: Authors

Purpose/Topic:

Water Use in Synthetic Fuel Processes	Useful
Water Treatment for Synthetic Fuel Processes	Useful

Reviewer's Comments: (N.Z.)
This is a very general report and has little or no unique information on synthetic fuel production.

The Rho Corporation
The Northern Cheyenne Tribe and Energy Development in South-eastern Montana; Volume 2: Decision Information System Design and Analysis, Lame Deer, Montana, Northern Cheyenne Tribe, 392 pages, September 1977.

Availability: R. Gold

Purpose/Topic:

Impact Overview	Not Relevant
Economic Aspects	Perhaps Relevant

Reviewer's Comments: (K.E.)
Since the focus of this volume is economic, its significance to social inpact assessment involves the demographic changes projected with the three potential developments. Ball-park estimates only are provided in this analysis, due to its crude and preliminary nature. Baseline population projections for the Indian population have been completed along with several additional projections which reflect possible future variations in Indian fertility and survival rates. The report does emphasize that its focus on economic concerns does not disallow the existence of other, i.e., environmental and social, concerns. The analyses attempted in this volume utilized secondary sources only.
This volume would be useful to the economic aspect of socio-economic impacts, particularly due to its concern with the Northern Cheyenne (a reservation which could become part of synfuel development).

Abstract:
This volume (part two of two volumes) includes two parts: 1) a report on the design of a system with the purpose of providing information to tribal members making decisions about future economic developments and planning for the impacts of such developments; and 2) a preliminary analysis of three potential developments in terms of a) their feasibility, in a strictly economic-dollar revenues and dollar-costs sense, and b) the economic impacts these potential projects would have on the reservation if developed. The information system is considered to be a permanent part of the overall decision-making and planning process and provides not only an overall design but also "economic" elements. These "economic" elements involve impact projections concerning: population increases, employment increases, housing requirement increases, income increases, tribal revenue increases, etc. The second part of the volume addresses the feasibility (not to be mistaken with desirability) of the following potential developments: 1) small-scale development of the Midway Coal Mine, primarily for reservation use; 2) a large-scale coal mine located near the reservation for export markets; and 3) off-reservation grazing of cattle on U.S. Bureau of Land Management or Forest Service land. Also included was a preliminary

096 Cont.

Abstract: continued
analysis of economic impact of the potential developments. A population component and a more strictly economic component were involved in the analysis. The changes in the number of people in an area and in their age, sex, and racial breakdowns make up the population component. The economic component deals with changes in employment, wages and salaries earned, incomes to individuals and households, etc. Two types of projections of future conditions were determined: 1) a baseline projection, assuming no major new developments, which provides the context within which the impacts of potential economic developments are to be evaluated, and 2) the projections of the impacts of the potential developments themselves.

097

Roa, T.K., et al.
Analytical and Biological Analyses of Test Materials from the Synthetic Fuel Technologies. II. Extended Genetic and Biochemical Studies with Mutagenic Fractions, Oak Ridge, Tennessee, Oak Ridge National Laboratory, 18 pages, 1977.

Availability: Environmental Library

Purpose/Topic:
Health Useful

Reviewer's Comments: (G.B.)
This study showed significant mutagenic activity is associated with a synfuel crude product. The report is useful in that it indicates the types of on-going research in the Biological Division of Oak Ridge National Laboratories. More recent publications should be consulted.

The mutagenicity of environmental effluents from modern synthetic fuel technology has been described by Epler et al. [6]. This article reports an extensive genetic and biochemical analysis of a crude synthetic fuel, Synfuel A-3, to examine certain highly mutagenic fractions. The results indicate a frameshift mechanism for the mutagenicity of this test material which correlates with the organic constituents known or suspected to occur in it [10]. The test material requires metabolic activation in order to be mutagenic; various activating or deactivating mechanisms in the metabolic transformation are discussed.

098

Salvador, L.A., and J.D. Holmgren
Westinghouse Coal Gasification System, Madison, PA, Westinghouse Advance Coal Conversion Department, 7 pages, August 1978.

Availability: Environmental Library

Purpose/Topic:
Technology Description — Useful

Reviewer's Comments: (R.E.)

The Westinghouse fluidized bed gasifier (IJTPD, process development unit) was originally designed for low-BTU gas for use with gas turbine combined power cycle plants. The simplicity of the system and its capability of using any coal has lead to a change to testing in an oxygen-blown mode.

The system consists of two units--a devolatilizer which produces char and a gasifier which gasifies the char. The system achieves 90-99% carbon efficiency and produces no liquid products. No environmental problems have been noted at the plant.

It seems likely that the process will be tested first for power production in some other region of the country. We doubt that such a gasifier will be used in Montana in this decade.

099

Sauter, D.Y.
Synthetic Fuels and Cancer, New York, New York, Scientists' Institute for Public Information, 11 pages, November 1975.

Availability: Environmental Library

Purpose/Topic:
Air — Not Relevant
Health — Useful

Reviewer's Comments: (G.B.)

This short commentary briefly reviews many historical relationships between occupational exposures to coal processes (oil shale, liquefaction, gasification, coke ovens, gas works, etc.) and cancer rates in workers. According to the studies reviewed and the President's Interagency Task Force report (1975), adverse health hazards will be unavoidable if synthetic fuel plants are built even with modern pollution controls (1974). This is the only report I've reviewed which addresses potential synergism between organics (PAH) and trace elements which may both be adsorbed onto fine particulates and also between NO_x or SO_x with these organics, trace elements and particulates.

Schiller, J.E.
"Composition of Coal Liquefaction Products," Hydrocarbon Processing, 6 pages, January 1977.

Availability: Environmental Library

Purpose/Topic:
Solvent Refined Coals | Significant

Reviewer's Comments: (R.E.)
The author gives typical compositions of seven different SRC samples from four kinds of coal at five different facilities. Composition is strikingly different (e.g., average molecular weight ranges between 295 and 550, the percentage soluble in hexane ranges between 16 and 57%).

The point for Montana is that unless our coals have been tested under conditions which will be used commercially, we will not know the composition of the products.

101

Schultz, T.W., J.N. Dumont, L.M. Kyte
"Cytotoxicity of Untreated Coal-Conversion Gasifier Condensate," in Symposium on Energy and Environmental Stress in Aquatic Systems, Savannah, Georgia, Savannah River Ecology Laboratory, 27 pages, November 1977.

Availability: Environmental Library

Purpose/Topic:
Health | Not Relevant

Reviewer' Comments: (G.B.)
This study showed that greater than 2% water/product solutions (gasifier condensate from Synthane plant) adversely affected an aquatic cellular organism. The study is relevant to aquatic-related environmental impacts.

Abstract:

The untreated gasifier condensate used in this study is a filtered product water from the Synthane gasification process. To examine poxxible environmental effects of this product, populations of the ciliate Tetrahymena pyriformis were exposed to varying concentrations, and their behavior, respiration, cytology, and growth rates were investigated. Product water concentrations of 1% and less cause little if any behavioral (shape and motility) changes. Concentrations of 2% and greater decrease motility and increase cell lysis. The condensate causes a nonlinear, dose-dependent reduction in oxygen consumption. At concentrations of less than 2% no alteration in respiration is noted over 300 min. At all concentrations tested, the most striking cytological alterations are in the mitochondrial matrix, which becomes more electron-dense. Cell membranes are also disrupted, and mucocysts discharge. Population growth is reduced by concentrations of product water as low as 0.2% and is completely inhibited by 1%. The density of test populations plateaus at values inversely related to concentration. Pure phenolic compounds elicit similar responses.

102

Shafer, J.R., R.W. Grendel, and D.R. Pogue
"Sulphuric Acid Plants for Handling H_2S Gases," Chemical Engineering Progress, Vol. 74, pgs. 62-65, December 1978.

Availability: Environmental Library

Purpose/Topic:
Technology Description - H_2S Removal Useful

Reviewer's Comments: (R.E.)
This article makes the case for converting H_2S from coke ovens (and in the future from coal gasification plants) to H_2SO_4 (rather than to sulfur by the Claus process). Such an operation would remove only 97.2% of the sulfur and would require further treatment by an ammonia scrubber.

It seems unlikely that Western synfuel plants would select such a technology given the poor market for sulfuric acid. (In fact, extensive synfuel development would clearly gut the sulfur market, too.)

103

Smith, I.H., and G.J. Werner
Coal Conversion Technology: A Review, NP-20814, Park Ridge, New Jersey, Noyes Data Corporation, 107 pages + appendices, May 1975.

Availability: Environmental Library

Purpose/Topic:
Technology Descriptions Useful or Not Relevant

Reviewer's Comments: (R.E.)
Brief descriptions (and a glossary of terms) of all coal conversion processes. This would have been very useful five years ago when it was first published, but it is out of date. Its only possible use now is that it provides an initial lead for obscure or foreign technologies.

104

Stewart, J.T., and M.G. Klett
"Converting Coal to Liquid/Gaseous Fuels," Mechanical Engineering, Vol. 101, pgs. 34-41, June 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Review — Useful

Reviewer's Comments: (R.E.)
A concise review of the technologies being developed for synfuels. All of the information is available elsewhere but specific critiques include:

a) The EDS process has a problem liquefying Western coals (deposition of calcium carbonate in the reactor).
b) The H-coal process does not yet have an economical method of separating solids in the boiler feed mode.
c) Inspection of comparable data of syncrude composition vs. crude oil composition (see Appendix for table) shows how variable "crudes" can be.

105

Stewart, J.T., and T.D. Pay
Coal Gasification Processes and Equipment Availability for Small Industrial Applications. Reading, PA, Gilbert Associates, Inc., 21 pages, August 1978.

Availability: Environmental Library

Purpose/Topic:
Small Gasifiers — Useful

Reviewer's Comments: (R.E.)

1) Brief description of six small fixed-bed gasifiers, McDowell-Wellman, Wilputte, Riley-Morgan, Woodall-Duckham, Wellman-Incandescent, and Foster Wheeler-Stoic.
2) Discussion and data on costs of three modes of operation:
   a) hot, raw gas,
   b) dust, tar, and oil-free gas, and
   c) dust, tar, oil-free and desulfurized gas.
3) Case study of small gasifier for Caterpillar Tractor Company, which will use Holmes-Stretford desulfurization plant (the type proposed by Northern Resources Inc. for Billings).

106

Susskind, L.E., et al.
Resolving Environmental Disputes: Approaches to Intervention, Negotiation and Conflict Resolution, Cambridge, Massachusetts, Massachusetts Institute of Technology, 131 pages, 1978.

Availability: R. Gold

Purpose/Topic:
Impact Overview — Not Relevant

Reviewer's Comments:
None

Abstract:
This hand book, intended primarily for public agency personnel, summarizes the latest developments in the field of "environmental dispute resolution." Case studies are used to animate the discussion of the nine steps which are undertaken to resolve environmental disputes, e.g., confrontations between public agencies and private interests with competing objectives. Techniques for intervention, negotiation and conflict resolution are described, as well as the political realities of intervention and mediation.

107

Takach, H.J.
Assessment of the Water Balance on Coal Conversion Plant Design, paper delivered at 179th National Meeting of the American Chemical Society (Houston, Texas), El Toro, California, Mittelhauser Corp., March 26, 1980.

Availability: Authors

Purpose/Topic:
Wastewater Treatment in Synthetic Fuel Production — Useful

Reviewer's Comments: (N.Z.)
The information was obtained directly from the author and consists of his viewgraphs used in the presentation; the report has not been published. There is little new or unique information presented except for an analysis of the costs of zero-discharge designs. Zero-discharge is much more expensive and energy intensive than several alternative approaches presented (minimum organic discharge--utilizing carbon adsorption--and activated sludge design cases).

Tenneco Coal Gasification Company
Tenneco Coal Gasification Company Montana Long-Range Plan, April 1, 1980, Houston, Texas, Tenneco, Inc., 20 pages, April 1980.

Availability: DNRC and Environmental Library

Purpose/Topic:

Water Requirements	Not Relevant
Technology Used for Gasification	Useful

Reviewer's Comments: (N.Z.)
This report has no information relating to water requirements of the Tenneco gasification plant or water pollution resulting from the plant. A very brief report stating the general direction the company wishes to take regarding coal gasification. The chosen technology is the Lurgi process to produce a nominal supply of 250 million scf gas per day.

Tennessee Valley Authority
Ammonia from Coal, Symposium, Bulletin Y-143, Muscle Shoals, Alabama, Tennessee Valley Authority, 202 pages, July 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Descriptions and Update   Significant

Reviewer's Comments: (R.E.)
Twenty-five papers were presented at this symposium--many of significance for either technology assessment or environmental control. Some papers have been reviewed separately.

Topics (each with four or five papers) include Coal Gasification Processes, Auxiliary Systems, Acid Gas Removal, Sulfur Recovery Systems and Operating Experiences.

Particularly useful papers include:

1) The best description we've seen of the Winkler process, with some details on gas composition and efficiency for a unit used for ammonia production in India for over 15 years.
2) A second paper on Winkler that describes new developments (the high temperature Winkler). The paper describes a plan to use the gasifier for methanol production and notes that it can be used for wood or peat gasification.
3) A good description of the U-gas process.
4) Relatively short papers on Koppers-Totzek and Texaco are included. Note is made in the Texaco paper of the environmental advantages of that process (no phenols, tars or heavy materials). A second paper on Texaco describes their process for using coal fines in a demonstration plant in Oberhausen-Holten in Germany. Construction is to finish in 1981 on a commercial plant. The "demonstration plant," finished in 1978, handles 6 tons/hr, which would place it in the "pilot plant" category in this country. Two papers describing Koppers-Totzek plants in India and South Africa are also present.
5) There is a decent paper on water pollution control for gasifiers.
6) A paper describing a Danish ammonia plant that uses a special catalyst to hydrolyze COS to H_2S and shows that control of COS is achievable.
7) There are four papers on acid gas removal. None of them provides a critical comparison of processes but the papers on Claus and Holmes-Stretford give short summaries of the basic technology.

All in all, this set of papers is useful and should an ammonia plant again be considered for Montana, this collection should provide some significant leads.

U.S. Commission on Civil Rights
Energy Resource Development - Implications for Women and Minorities in the Intermountain West, Washington, D.C., GPO, 221 pages, November 1978.

Availability: R. Gold

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
A variety of viewpoints on the problems and possibilities in resource development for women and minorities are evident in the collection. One paper defines the "boom town" situation in an overview, briefly defining the problems of population growth, finance, human services, local residents and construction workers, social stress, and social integration. In examining Rock Springs, Wyoming, another paper lists, with little in-depth analysis, problems in the political and fiscal arenas, housing, services, and community life (i.e., recreation, quality of life, cultural differences, family differences). Loneliness, the conflict of values, and the rise in crimes such as rape and wife-beating are considered. A case study of Craig, Colorado, presents primary data derived from agencies' reports to the study of incidents and complaints in the following categories: substance abuse, emotional disorder, child abuse, family disturbance, child behavior problems, crimes against people and property. A theoretical framework is given for understanding crime in and disorder in boom towns: i.e., rapid change and stress. A discussion of the social costs to rural women represents the views of one woman rancher in Eastern Montana, who outlines the problems with: estrangement in what had been own community; breakdown in church, school, and family; marriage; quality of life; and the newcomers' limited opportunities, loneliness, and tension. The legal status and issue of coal sales are the concerns of the articles addressing coal development on the Northern Cheyenne reservation.

The papers represent a discourse only on part of the subject area of social impact and provides identification, more than analysis, of impacts with resource development. The information is the personal views of the conference participants and is derived in part from secondary sources, with the exception of the study from Craig, Colorado. The document's application to the investigation of synfuel development in Montana is limited; the viewpoints can be looked upon as being shared or contrasting. Its significance is due to its focus, consideration of women often lacking in discussions of resource development.

Abstract:
Selected papers presented at a consultation which considered the impact of resource development on women and minorities are contained in this report. Included are panels entitled: directions for the future in the region; boom town sociology; resource development--

110 Cont.

Abstract: continued
problems and opportunities; energy development, energy policies, and reservations; mitigation of problems for minorities and women; ways of participating in the opportunities; and policy initiatives for the future.

111

U.S. Congress, House, Committee on Science and Technology
Findings and Recommendations of the Advisory Panel on Synthetic Fuels, Washington, D.C., GPO, 34 pages, February 14, 1980.

Availability: Environmental Library

Purpose/Topic:
National Policy on Synfuels — Significant

Reviewer's Comments: (R.E.)
1) The panel is concerned that present policy would concentrate synfuel plants in the West. They argue for changes that would place more demonstration plants in the East.
2) They also argue for several changes in the law that would make synfuel production by 1990 more likely.
3) They state "Fast track legislation should not be used to speed synthetic fuels projects unless sought."
4) They make significant recommendations concerning environmental impact statements and social impacts (see appendix).

Abstract:

The successful execution of individual projects will depend on the successful resolution of the social and economic problems that will accompany the construction and operation of synthetic fuel plants.

Responsibility for resolving these problems lies with the state and federal governments, the industry participants in the project, and the local government and their citizens. The resolution of the problems will depend upon the coordination and collaboration of all these parties. In federal programs for both the demonstration and/or production of synthetic fuels the burden of expediting this collaboration rests with the federal government.

Studies of western energy development show that early planning and citizen involvement is key to successful resoltuion of these problems.

Early initation and preparation of environmental impact statements (FIS) required by law will serve two functions for the synthetic fuel production and demonstration programs: (1) at any given time they provide assurance that all known and likely environmental impacts of the synthetic fuel program have been considered as well as those of alternative energy options, and (2) to provide information to the public to permit early and intelligent participation in the planning for both the synthetic fuels production program and specific projects.

U.S. Congress, Senate, Committee on the Budget
Synthetic Fuels: Report by the Subcommittee on Synthetic Fuels, Washington, D.C., GPO, September 27, 1979.

Availability: Montana State University

Purpose/Topic:

Federal Policy Reviewed	Significant
Production Potential	Significant
Economic Incentives	Significant

Reveiwer's Comments: (T.S.)
Excellent summary of recent technical information and federal policy. Assesses the long and short term costs of various incentive proposals before the Senate. Very much a federal perspective and sympathetic to synfuels development. Includes three good appendices on: Economic incentives; overview of production potential to 1990; and an analysis of production and conservation alternatives to oil import reduction.

113

U.S. Department of Energy
An Analysis of Coal Hydrogasification Processes: Final Report, FE-2565-14 by M. Epstein, T. Chen, and M.A. Ghaly, Bechtel Corporation, Springfield, Virginia, NTIS, 125 pgs., August, 1978.

Availability: University of Montana Library

Purpose/Topic:
Third Generation Technologies   Useful

Reviewer's Comments: (R.E.)
Third generation gasifiers will have some distinct economic, technical and environmental advantages. This is a positive final report on several hydrogasification systems. It is unlikely that such technologies would come to Montana soon.

Abstract:

Bechtel Corporation has conducted a program for the Department of Energy (DOE) to investigate the operability potential and scaleup feasibility of the Cities Service, Rocketdyne, Pittsburgh Energy Research Center (PERC), and Brookhaven National Laboratory coal hydrogasification processes. As part of the program objective, a reactor model study has been performed for each of the processes, and a conceptual, full-scale hydrogasification reactor design has been generated. The entrained-downflow reactor systems operate at temperatures up to 2,000°F and pressures up to 3,000 psi. Reactor product is primarily methane, with smaller amounts of ethane, BTX, light oils, and carbon-oxides.

Bechtel has collected and analyzed bituminous, subbituminous, and lignite coal hydrogasification and hydropyrolysis data from Rocketdyne, Cities Service, PERC, and Brookhaven National Laboratory. The data have been entered into a computerized data base for ease of evaluation and tabulation. Semi-empirical correlations for predicting overall carbon conversion efficiency and carbon selectivity to gaseous products have been fitted to the data. The results show that the Cities Service bench-scale reactor and the Rocketdyne 1/4-ton/hr reactor achieve similar values of overall carbon conversion and carbon selectivity to gaseous products for subbituminous coal under comparable operating conditions; therefore, the test data at Rocketdyne and Cities Service should be scalable to a PDU or commercial-size reactor, within the region investigated. The results also show that overall carbon conversion (or reactivity) for bituminous coal is greater than the reactivity for subbituminous or lignite coals at reduced residence time and/or pressure.

A conceptual design of a full-scale hydrogasification reactor has been generated, on the basis of the subbituminous coal data gathered in the Cities Service and Rocketdyne reactors, together with the predictive reactor performance models fitted to the data. The hydrogasification stage has a configuration similar to the Rocketdyne reactor assembly, which incorporates an entrained-downflow reactor chamber and high-efficiency injector nozzles which produce coal heatup rates in excess of 100,000°F/sec. For the design conditions of 50 percent overall carbon conversion and 100 percent carbon selectivity to gas, predicted operating variable levels for reactor gas temperature, pressure, and residence time were 1,875°F, 1,500 psig, and 1,100 milliseconds, respectively.

U.S. Department of Energy
Assessment of Advanced Process Concepts for Liquefaction of Low H_2:CO Ratio Synthesis Gas Based on the Kölbel Slurry Reactor and the Mobil-Gasoline Process, ORNL-5635, by M.L. Poutsma, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 42 pages, February 1980.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - New System Useful

Reviewer's Comments: (R.E.)
This paper analyzes an intriguing technical idea--the direct conversion of low H_2:CO synthesis gas from second generation gasifiers to make gasoline. The Kölbel reactor is a specially designed Fischer-Tropsch reactor, invented in the 1950s. The original data from the reactor have never been verified completely, but Poutsma argues that one of two configurations (shown below) might be advantageous (in terms of economics and thermal efficiency) in producing gasoline.

Process 1:
$H_2:CO \xrightarrow{\text{Kölbel}}$ hydrocarbons, alcohols $\xrightarrow{\text{Mobil M}}$ gasoline

Process 2:
$H_2:CO \xrightarrow[\text{Kölbel and Mobil catalysts in same reactor}]{\text{Kölbel reactor with}}$ gasoline

The proposed process requires years of testing and development.

The paper refers to a report by Shinnar and Kuo (DOE Report FE-2766-13, 1978), which we have not reviewed. According to Poutsma, they show that lowest cost synthesis gas will come from processes (Slagging Lurgi, Texaco, K-T, Winkler) that use the minimum amount of steam and oxygen. All those processes yield gas with a H_2:CO ratio of about 0.6 - 0.7, which would normally have to be shifted if high Btu gas were the desired product.

U.S. Department of Energy
Assessment of Environmental Control Technologies for Koppers-Totzek, Winkler, and Texaco Coal Gasification Systems, PNL-3104, by L.K. Mudge and L.J. Sealock, Jr., Pacific Northwest Laboratory, Springfield, Virginia, NTIS, 79 pages, September 1979.

Availability: Environmental Library

Purpose/Topic:

Technology Assessment	Useful
Air	Fairly Useful
Health	Not That Useful

Reviewer's Comments: (R.E.)
This is one of the few documents we've seen that compares the gasification systems offered by Texaco and Winkler. Because K-T and Winkler have operating gasifiers overseas and Texaco publishes very little data on its proprietary system, many of the tables and much of the assessment comes--from necessity--from calculations and best guesses. Nonetheless, it's all we have, and several tables have been reproduced in the appendix.
Limitations of note:
1) Winkler ash contains a lot of carbon--thereby negatively affecting thermal efficiency unless the material is used.
2) Texaco's process seems to produce more COS than other gasifiers (89% H_2S, 11% COS).

Unit processes up and downstream are described. Other than the coal feed systems for Texaco (they use a water slurry, 40-60% coal), they are not greatly different than for any other gasification systems.
One of the tables in the appendix lists thermal efficiency for K-T and Winkler. The K-T data differ from that found elsewhere.

Reviewer's Comments: (G.B.)
Conclusions of the authors indicate that an insufficient amount of comprehensive emission data are available on these three technologies; especially on fates of trace elements and volatiles from cooling towers, ponds, and storage tanks. Overall, they feel modern control technologies are able to reduce hazardous air emissions (except little is known about trace elements), but that more monitoring and control technology improvements may be necessary. Includes a very useful bibliography.

U.S. Department of Energy
Biomedical Studies on Solvent Refined Coal (SRC-II) Liquefaction Materials: A Status Report by Battelle Pacific Northwest Laboratory, Springfield, Virginia, NTIS, 54 pages, October 1979.

Availability: Environmental Library

Purpose/Topic:
Health - Liquefaction — Significant

Reviewer's Comments: (G.B.)
This document is a very useful but also a fairly technical review of Battelle Northwest's on-going biomedical studies on SRC materials. Four appendices to this report (which can be ordered) provide details of methods and of results. The report describes Battelle's approach to evaluating health hazards as well as its preliminary results from studies of SRC I and II products from a pilot plant in Washington. The results definitely show carcinogenic, mutagenic and toxic properties of SRC by-products--particularly of the heavy distallates (SRC-II and particular identifial fractions) and of process solvents (SRC-I).

Abstract:

This technical report summarizes the results of the biomedical research effort at Pacific Northwest Laboratory on solvent refined coal (SRC) materials obtained from the pilot plant at Fort Lewis, WA. The process conditions under which the PNL samples were produced are discussed as is the relevance of these samples to demonstration/commercial-scale operations.

Samples of light, middle, and heavy distillates (LD, MD, and HD) were obtained from the Fort Lewis pilot plant during operation in the SRC-II mode. The samples were obtained from the raw product distillation section of the plant and contain components produced not only during stable operation, but also during plant startup and during upset conditions. Thus, the samples were representative of materials produced during a spectrum of operating conditions. As such, they bear a generic relationship to materials to be produced in a demonstration-scale facility.

The above-described samples as well as samples of raw shale oil, crude petroleums, and some SRC-I materials were evaluated for biological activity in several different systems: (1) microbial mutagenesis coupled to chemical characterization efforts, (2) in vitro mammalian cell toxicity and transformation, (3) epidermal carcinogenesis (skin painting) in mice, (4) acute and subchronic oral toxicity in rats, (5) developmental toxicity in rats, and (6) dosimetry and metabolism in rats.

Microbial mutagenesis (Ames assay) was used as the first step in a tier approach (sequential assays in progressively more complex biological systems). This system is commonly used as a rapid, inexpensive screening procedure for potential carcinogens. Heavy distillate (SRC-II) and process solvent (PS; SRC I), which are high boiling point materials, showed significant mutagenic activity while lower boiling fractions from both processes were inactive. Crude petroleum was also inactive while raw shale oil showed only a low level of activity. Chemical characterization studies suggested that 3- and 4-ring primary aromatic amines are responsible for a large fraction of the mutagenic activity of HD and PS.

Studies of transformation (altered morphologic and biochemical properties which permit unrestricted growth) were performed in cultured mammalian cells (2nd step in tier approach). These studies showed that materials exhibiting a positive effect in the Ames system also caused mammalian cell transformation. In addition, some materials which were negative in the Ames assay showed a low level of activity in the cell transformation assay. These included petroleum crudes and the polynuclear aromatic fraction from process solvent and shale oil.

The results of skin carcinogenesis studies in the mouse (third level of tier testing) were generally consistent with those of the cellular studies. Heavy distillate, shale oil and the known carcinogen, benzo(a)pyrene, produced high incidences of skin tumors. Wilmington petroleum crude had less tumorigenic activity while LD has shown little tumor induction after 456 days of study.

Light distillate, MD, and HD were found to be moderately toxic after oral administration to rats (acute LD_{50}'s ranged from 2.3 to 3.8 grams/kilogram body weight). When the materials were administered once daily for 5 consecutive days, there were indications of cumulative effects. The effects of LD, MD, and HD on development were determined after administration to pregnant rats from either 7-11 or 12-16 days of gestation (d.g.). Fetal growth and survival were decreased by LD, MD, or HD administration at either period. Administration of HD from 12-16 d.g. also increased the incidence of malformations (principally cleft palate, diaphragmatic hernia, and hypoplastic lungs). In most cases, doses of materials which produced prenatal toxicity also produced some indications of maternal toxicity.

Fuel upgrading, process modification, and appropriate occupational/ environmental controls may ameliorate some of the biological effects of SRC materials and other coal liquids of high boiling point. Low-boiling SRC liquids appear to have little biological effects in the assays employed.

117

U.S. Department of Energy
Coal Gasification Pilot Plant Support Studies: Project 9030 First Quarter Report, April 1-June 30, 1978, FE-2806-1 by D.Q. Tran, et al., Institute of Gas Technology, Springfield, Virginia, NTIS, 83 pgs., August, 1978.

Availability: University of Montana Library

Purpose/Topic:
Laboratory Studies on Gasification Useful

Reviewer's Comments: (R.E.)
This group is conducting laboratory studies on several problems with or improvements on gasification technology. Problems being investigated include:
1) Studies of reactions for improving the performance of Coal Gasification Reactors,
2) Studies of Fluidized-Bed Reactors,
3) Studies to improve Methods of Feed Preparation,
4) Studies to improve the Processing Techniques of Product and Waste Gases from Coal Gasification

The latter task would be significant for Montana. Research on in-plant hydrolysis of COS and HCN is being carried out, but this report gives no definitive data.

118

U.S. Department of Energy
Coal Gasification Quarterly Reports, DOE/ET-0024/1-4, DOE/ET-0067/1,2, DOE/ET-67, Washington, D.C., GPO, December 1977 - January 1980.

Availability: University of Montana Library; Environmental Library

Purpose/Topic:
Gasification - General Useful

Reviewer's Comments: (R.E.)
This was a useful series of reports for quick update on DOE-sponsored gasification research and development. We believe that the series is no longer being published.

U.S. Department of Energy
Coal Liquefaction Quarterly Reports, DOE/ET-0026/1-4 and DOE/ET-0068/1, Washington, D.C., GPO, December 1977-September 1978.

Availability: University of Montana Library

Purpose/Topic:
DOE-Funded Research on Liquefaction Significant

Reviewer's Comments: (R.E.)
The last quarterly report available to this reviewer was published in September 1978 for the period January-March 1978. These reports are valuable for two very different reasons, and if DOE is still publishing Coal Liquefaction Quarterly Reports, future issues will be of value to Montana. Their value lies in:

1) Up-to-date technical review of the major liquefaction processes being funded by DOE for commercialization; and
2) Summary of other DOE liquefaction research. By seeing what kind of research in being funded, some idea of crucial, unsolved problems can be obtained. For example, five of fifteen projects in the most recent report deal with attempts to upgrade the liquid products from major liquefaction processes. The basic problem is that most liquids derived from coal just aren't very good refinery stock and further treatment is necessary.

U.S. Department of Energy
Comparison of Coal Liquefaction Processes, Final Report, FE-2468-25, by K.A. Rogers, et al., Engineering Societies Commission on Energy, Inc., Springfield, Virginia, NTIS, 22 pages, 1978.

Availability: University of Montana Library

Purpose/Topic:
Liquefaction Technologies and Economics Significant

Reviewer's Comments: (R.E.)
A short but significant comparison. Tables II, III and IV of the report have been included in the appendix.
1) Their conclusion is that the five major technologies are ready for commercialization.
2) They state that H-Coal process (because of Reactor problems) is the greatest risk.
3) The time to build any plant would be about five years.
4) They doubt that any change in thermal efficiency will occur for any of the technologies in the next decade.

Abstract:

Five processes were studied to determine which could give best results for supplying hydrocarbon fuels to replace petroleum products. The processes were: Fischer-Tropsch; M-Gasoline; H-Coal; Exxon Donor Solvent; and Solvent Refined Coal.

The conlcusions of the study are that all of the processes are considered commercially feasible and, because the different products from the different processes will meet different market demands, any significant future liquids from coal market will probably use some of each of these processes.

The anticipated conversion efficiency values are given to indicate resource utilization.

Simplified capital costs are approximated for each process. These are used in combination with product amounts and relative values to achieve a cost ranking.

Because the study was concerned solely with liquid products, Fischer-Tropsch was at a disadvantage. The remaining four were relatively close and a final decision would depend upon the actual end use requirements. For a situation with residual fuels selling at severe discounts, M-Gasoline and H-Coal (Syncrude Mode) were the better choices.

121

U.S. Department of Energy
Conceptual Designs of Commercial Facilities Coal to Methanol Plant and Methanol to Gasoline Plant: Annual Report for August 1, 1977-July 28, 1978, No. FE-2416-33 by Badger Plants, Inc., Springfield, Virginia, NTIS, 32pgs., September 12, 1978.

Availability: University of Montana Library

Purpose/Topic:
Commercial Design - Mobil M   Significant

Reviewer's Comments: (R.E.)
This relatively short report (20 pages) outlines progress on the design of both coal-to-methanol and methanol-to-gasoline commerical facilities. The contract was to have expired in 1979 and the final report should be of particular interest to Montana, should a Mobil M plant be sited in the state. Even if such siting does not occur, the final report should be of interest for technology assessment becuase the authors are investigating the following gasifiers:
1) Babcock and Wilcox suspension-type gasifiers,
2) Shell-Koppers gasifiers,
3) Winkler gasifier.

Design for the system is based on siting in Southern Appalachia.

122

U.S. Department of Energy
Developmental Toxicology of Energy-Related Pollutants, Proceedings of the 17th Annual Hanford Biology Symposium, October 17-19, 1977, CONF-771017, D.D. Mahlum, et al., editors, Springfield, Virginia, NTIS, 646 pages, 1979.

Availability: Environmental Library

Purpose/Topic:
Health   Useful

Reviewer's Comments: (G.B.)
This symposium proceedings contains highly technical reports, covering nearly every aspect of toxicology--representative of the state-of-the-art in 1977. Reports describe cellular effects as well as organismal responses to a wide range of energy-related pollutants. Only two articles appear relevant to synfuels:
1) Developmental Toxicology of Organic Pollutants (p. 115);
2) Two reports on Benzo(a)pyrenne (p. 152 and 175).

123

U.S. Department of Energy
The Economic Impact of Synfuels Development in the Upper Colorado River Basin, LA-UR-2784, by G.E. Morris, Los Alamos Scientific Laboratory, 92 pages + append., 1979.

Availability: Environmental Library

Purpose/Topic:
Impact Overview

Not Relevant

Reviewer's Comments:
None

Abstract:
This report describes the methodology and results of research aimed at projecting the economic impact of emerging energy technology development (oil production from shale and gas production from coal) in the Upper Colorado River Basin. A computer model, termed the Upper Colorado River Basin Optimization Model, was run under economic conditions estimated to have prevailed in 1975 and conditions projected for the year 2000 without synfuel development. Once the pictures of how the Basin economy looks currently and how it might look in 2000 without synfuel development were established, "baseline" and "accelerated" scenarios for synfuel were considered for the year 2000. Personal income was the measure of economic activity used to assess aggregate economic impact; magnitude of the variable was seen as varying with the technology employed. Dramatic impact on the economic size and structure of the UCR Basin was predicted. A specific instance would be the shift from export market to local market orientation in the agriculture and electricity sectors of the Basin.

U.S. Department of Energy
"Economics of Gasoline Production from Underground Coal Gasification via Mobil-M Process," in AICE Meeting, CONF-79-0405-12, by M.S. Edwards, et al., Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 36 pages, 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Description - Mobil M Useful

Reviewer's Comments: (R.E.)
The plan calls for 6 "trains" of 30 wells (10 wells for production, 10 for injection and 10 for linking). Each producing well has a life of 73 days.

The above-ground processing is identical to what is required for any Mobil process (i.e., shift to CO to CO_2 to obtain correct H_2/CO ratio, acid gas removal, tail gas removal, methanol formation, Mobil M process). They have chosen the Selexol Solvent process for H_2S removal, and the proprietary ICI process for methanol synthesis.

The overall 22% efficiency assumes a 64% efficiency of underground gasification (80% of coal gasified and 80% of gas recovered). They then assume 60% more loss of gas by leakage (see appendix for a diagram of losses).

The overall economic analysis yields a price at the plant of \$.90/gallon for gasoline and suggests capital costs of only about a half billion dollars (1978 dollars). If correct, the costs for the process are considerably cheaper than technologies which use 20 million tons of coal above ground. The costs do not account for mitigation costs connected with subsidence or groundwater pollution.

If 10% of the gas produced underground does "leak" out, we're in trouble. For example, at least 2 tons/day of H_2S and 460 tons/day of CO would be emitted.

Abstract:

A CONCEPTUAL PROCESS DESIGN AND COST ESTIMATE IS PRESENTED FOR A FACILITY PRODUCING APPROXIMATELY 100
M$SUP 3$/H (15.000 BARRELS PER DAY) OF M-GASOLINE VIA METHANOL FROM SYNTHESIS GAS GENERATED BY
GASIFICATION OF COAL IN SITU. THE DESIGN WAS BASED ON EXPERIMENTAL DATA OBTAINED AT THE LARAMIE ENERGY
TECHNOLOGY CENTER ON THE LINKED VERTICAL WELL IN SITU COAL GASIFICATION PROCESS. IN-PLACE COAL
CONSUMPTION IS 756 MG/H (20.000 TONS/DAY). BASED ON A SUBBITUMINOUS WYOMING COAL. THE CAPITAL
INVESTMENT WAS ESTIMATED TO BE $535 MILLION IN FIRST QUARTER 1978 DOLLARS. M-GASOLINE PRODUCT PRICE WAS
CALCULATED AS A FUNCTION OF DEBT/EQUITY RATIO. ANNUAL EARNING RATES ON DEBT AND EQUITY. IN-PLACE COAL
COST. AND PLANT FACTOR (ONSTREAM EFFICIENCY). USING A DEBT/EQUITY RATIO OF 70/30. AN INTEREST RATE ON
DEBT OF 9%. AN AFTER-TAX EARNING RATE ON EQUITY OF 15%. AN IN-PLACE COAL COST OF $5.50/MG ($5/TON). AN
LPG (PROPANE) BY-PRODUCT CREDIT OF $3.80/GJ ($4/10$SUP 6$ BTU). AND A PLANT FACTOR OF [illegible]%. THE PRODUCT
PRICE OF M-GASOLINE (INCLUDING MIXED BUTANE LPG) IS ABOUT $240/M$SUP 3$ ($0.90/GAL) AT THE PLANT GATE.
CALCULATED OVERALL THERMAL EFFICIENCY FOR THE FACILITY WAS 22%. BASED ON IN-PLACE COAL.

U.S. Department of Energy
EDS Coal Liquefaction Process Development Phase III A: EDS Process Alternatives LP Model, Interim Report, FE-2353-19 by B.T. Fant, Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 88 pgs., January, 1978.

Availability:

Purpose/Topic:
Technology Assessment - Exxon D.S. (unit processes) Useful

Reviewer's Comments: (R.E.)
This report summarizes a rather complicated model that Exxon is using in making decisions on unit processes for an EDS commerical plant. Their economic analysis might be of some use for other processes, but most of the work appears to be technology specific.

Abstract:

This is an Interim Report on the development of the EDS Process Alternatives LP Model (PAM). PAM is a computerized linear programming (LP) Model of the EDS Coal Liquefaction process. The model was developed for use in process engineering and cost evaluation studies. PAM will be used to investigate the various process alternatives and their interactions to determine the economics of alternative configurations for the EDS process. A PAM case has been run to simulate the Illinois Base Case of the EDS Commercial Plant Study Design. The results were validated by comparing the PAM LP Model simulation with the Study Design.

The report covers the development of PAM to simulate the Illinois Base Case of the EDS Commercial Plant Study Design. Included within are a brief introduction to linear programming, an outline of the components in the PAM LP-matrix, the process and project bases for the initial formulation of PAM and the results of the validation case. Attached are several sections covering the details of the process and utility information from which the PAM LP-matrix was developed.

U.S. Department of Energy
EDS Coal Liquefaction Process Development, Phases IIIb/IV: Annual Technical Progress Report, July 1, 1977 - June 30, 1978, FE-2893-17, by W.R. Epperly, Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 371 pages + appendices, September 1978.

Availability: University of Montana Library

Purpose/Topic:
Process Development EDS Useful

Reviewer's Comments: (R.E.)
Contents include:

1) Description of Recycle Coal Liquefaction Units on Wyoming coal (the data are not all presented but it appears as if Illinois coal may be better in this unit; Pittsburgh coal is worse than Illinois coal).
2) Some data on the one-ton-per-day coal liquefaction pilot plant (includes data on Wyodak coal).
3) Evaluation of gas treatment and sulfur recovery schemes for low sulfur Wyoming coal showed that acceptable cleanup could be achieved through split flow DEA (diethanol-amine) and Claus plants. "Acceptable" means 94% cleanup with additional cleanup (unspecified) of the tail gas.

The document is rich in data and conclusions. However, much more useful material should be available soon (the Baytown pilot plant began operation in April 1980).

U.S. Department of Energy
EDS Coal Liquefaction Process Development: Phase IV. Summary of EDS Predevelopment (1966-1975), Interim Report, FE-2893-16 by W.R. Epperly, Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 50 pgs., July, 1978.

Availability: University of Montana Library

Purpose/Topic:
Technology Development | Useful

Reviewer's Comments: (R.E.)
This short (50 pages) report summarizes 10 years of work (1966-1975) on the Exxon donor solvent system.

Abstract:

The Exxon Donor Solvent (EDS) coal liquefaction process is currently being developed to a state of commercial readiness by Exxon Research & Engineering Company under a jointly funded research program. Prior to this jointly funded program, Exxon carried out privately funded research over the 10 year period 1966 through 1975 which led to the selection of the EDS Process as the preferred route to produce liquid fuels from coal. This report summarizes the research program which led to the development of the EDS Process. The significant research findings and alternative processing options which were evaluated are discussed.

U.S. Department of Energy
Environmental Analysis of Synthetic Liquid Fuels, DOE/EV-0044, Washington, D.C., GPO, 90 pages + appendices, July 12, 1979.

Availability: Environmental Library

Purpose/Topic:

Liquefaction Commercialization - Environmental Impact	Significant
Air	Useful
Health	Not Applicable
Water Quality in Coal Liquefaction	Not Very Useful
Water Quantity Demanded	Not Very Useful
Water Pollution Technologies	Not Very Useful
Potential Problems	Useful

Reviewer's Comments: (R.E.)

This document summarizes environmental constraints to the commercialization of liquid-fuel-producing technologies. Oil shale, ethanol from wastes and biomass, and coal liquefaction are covered.

This is a very significant document. We have chosen to reproduce several pages in the appendix, but all of it should be read.

1) Regulations and institutional impediments, probable future regulations and probable worst impacts (on commercialization, not the environment) of stringent regulation were investigated.

2) Each technology was appraised for probable environmental constraints.

3) A survey of sites was accomplished.

4) State permitting processes for facilities and mines were viewed.

The findings of this report are in the index. Highlights include:

1) There are no absolute environmental constraints.
2) Yet-to-be-defined regulations are perceived by developers as the major impediment to commercialization.
3) For up to one million BPD, siting will not be a problem; at two million BPD there may be problems.
4) Reducing institutional barriers such as water allocation needs to be addressed.
5) Simplifying public review and specifying the conditions of judicial review are recommended.

The specific assessments include:

1) The greatest environmental risks are hazardous wastes in high volume wastes, reclamation, toxics in products and in the work place, fugitive venting and in-situ technologies/water intrusion.
2) Montana has ten counties that could support 100,000 BPD facilities.

Reviewer's Comments: (G.B.)

The brief (150 pages) report only describes environmental aspects of synfuels in terms of the existing or proposed regulatory/siting hurdles that must be overcome. Some of the principal "problems" with siting synfuel plants are the PSD requirements. However, the consensus of the DOE authors of this document is that in terms of Class II air increments "it appears six to eight 50,000 BPD modules would be acceptable in western locales judged capable of accepting the synthetic liquids plants" (p. 58).

The report gives two hypothetical modeling results (EPA's PTMAX and PTMTP models) which show that Class II increments will not preclude "judiciously sited and efficiently controlled" liquefaction facilities. They admit they cannot site in Class I areas. This is an unrigorous report and can easily be questioned.

Reviewer's Comments: (N.Z.)

This report is a compile of general comments from a task force and, thus, has little detailed technological information. The report does identify general areas of potential problems such as: 1) Pollutant characterization has often been from small lab and pilot plant studies, so there is a possibility that unanticipated problems may arise. 2) Major potential sources of hydrocarbons and potentially hazardous emissions from fugitive sources such as wastewater drains and pumps, pump seals, valves, flanges and other leaks should be addressed. 3) Studies are also necessary to develop controls for the safe handling and use of synthetic fuel products.

The report includes a detailed section on existing laws and regulations affecting a liquefaction industry and the impact of these regulations on the progress of liquefaction plant development.

Abstract:

Assuming application of the most effective environmental control technologies and practices, deployment of synthetic liquids facilities on an accelerated schedule to 1990 appears feasible in terms of current environmental constraints. A set of first-generation technologies (surface oil shale retorting, indirect liquefaction, and biomass conversion) at the low (500,000 barrels per day (BPD)) and medium (1,000,000 BPD) levels of production have sufficient siting opportunities; the high level of production (2,000,000 BPD) brings rapidly increasing siting difficulties. Yet-to-be-defined regulations, in their stringent forms, could change this finding. These regulations include visibility, short-term nitrogen oxide ambient standard, extension of prevention of significant deterioration (PSD) regulations, hazardous waste standards, toxic product regulations, and occupational safety standards.

Any production level requires resolution of a number of institutional constraints, including permitting delays and the acceptability of the facility to the local population and state authorities. The greatest impediments for the first-generation technologies include long time delays, facility size limitations, and unwillingness to change the character of the community.

In reaching this general finding, the environmental analysis found that, within present and anticipated environmental regulations and standards, and for a selected set of first-generation facilities,

- There appears to be no absolute environmentally related constraint identified for any of the first-generation surface conversion technologies. Second-generation processes run greater risks of major environmental problems. For in situ processes, the major risk is leaching of hazardous materials into water; for direct liquefaction, concern is potential worker and public exposure to toxic substances.

- Yet-to-be-defined regulations are perceived by developers as major technology development impediments. These include air quality standards (visibility, short-term nitrogen oxide, and new PSD regulations), regulation of hazardous wastes and toxic products, underground injection guidelines, and worker safety regulations.

- Some risk exists that environmental R&D programs cannot fully satisfy all existing and expected regulatory demands, but these risks should be known by 1985 and it is expected that appropriate control adjustments can be made. Because of lack of data, one area of concern with indirect liquefaction is environmental emissions of processes following gas synthesis. However, as these and similar catalytic conversions are currently effected in the petrochemical industries, the primary impact of these adjustments is expected to have a minor effect on product cost.

- Reduction of these uncertainties requires refocusing of environmental research and assessment programs to aggressively address these areas and to promptly identify environmental issues that may become future impediments.

- There is a need for intermediate to long-term environmental health and safety monitoring of operations at all scales of development, especially with regard to anticipating the effect of equipment reliability and maintainability on fugitive emissions and the ultimate fate of solid wastes.

- From the present state-of-the-art and from mitigation controls developed as part of the research and assessment programs, stringent environmental controls and engineering practices need to be determined. Based on these, guidelines and standards must be set early, followed by responsive periodic updating based on new information.

- Sufficient siting opportunities exist within current regulatory and resource availability requirements, given that institutional impediments are reduced, to meet an accelerated deployment program. Practical maximum deployment levels, however, cannot be projected without much more detailed siting analyses than were carried out for this "siting opportunities" analysis.

Therefore, the primary environmentally related impediments that need to be addressed at the general program level are as follows:

- Reduce existing institutional barriers such as water allocations and transport rights-of-way to allow available existing physical resources to be tapped by these new demands without overly constraining prior claims for these resources;

- Improve the permitting processes and supporting technical information systems to significantly reduce the required permitting time schedules, including early conduct of broad locational surveys to determine the detailed siting opportunities; and

- Simplify existing and establish new points of public review and comment and, further, specify more exactly the conditions for judicial review of permitting procedures in order to reduce probable delaying impacts of litigation.

While technology risks are not fully resolved, analysis of the interaction of stringent environmental regulations, critical resource availability, and site availability show that siting areas are sufficient to allow deployment of a synthetic liquids supply industry within other projected energy and industrial growth patterns. Therefore, programmatic and management activities to facilitate technology siting and deployment, reduce complexity in permitting requirements, reduce institutional constraints on critical resource allocations, and improve procedures for providing public involvement in the program appear most critical.

Table 1 provides a summary of the findings of the analysis grouped as follows:

- Technology-specific results
- Siting opportunities
- Permitting process findings

Because many results of this environmental analysis and the potential courses of action are discrete and do not lend themselves to summarization, a more extensive list of concerns (Table 5) is presented at the end of this summary.

The Office of Environment is now initiating a broader, more comprehensive assessment of the siting-related development capacity for synthetic fuels, which will address in detail all areas considered by the present siting analysis, including state and local institutional considerations. This more detailed assessment should be completed by October 1979 and will be made available to the public at that time.

U.S. Department of Energy
Environmental Assessment of the Hygas Process, Quarterly Progress Report No. 6, October 1 through December 31, 1977, No. F.E. 2433-24 by Institute of Gas Technology, Springfield, Virginia, NTIS, 20 pgs., September, 1978.

Availability: University of Montana Library

Purpose/Topic:

Health	Useful
Air	Useful

Reviewer's Comments: (G.B.)
This progress report primarily describes the data from a series of sampling programs undertaken at the plant. Full analyses of results are not discussed in detail. Monitoring appears to be still in progress and later reports which have been completed should be consulted.

Abstract:

The data base for the HYGAS® environmental assessment program includes tests made with Montana subbituminous coal and Illinois bituminous coal from the Peabody No. 10 mine. The data base has also been expanded to include information from previous tests using Montana lignite and Illinois bituminous coal from the Sahara Mine. Correlation of these data for extrapolation to demonstration and commercial plants is continuing.

Editing and revision of the initial draft for the comprehensive test plan for the HYGAS environmental assessment program have been completed, and a second draft is being prepared.

Pollutant production rates are now being calculated by a computer program that was written to minimize possible calculation errors, to provide a check on past results, and to produce pollutant production rates for each HYGAS test on a consistent basis.

Development work continued for routine operation of three on-line analytical instruments: a high-level sulfur chromatograph for gaseous streams, a total organic carbon analyzer and a total oxygen meter for liquid streams.

Gas analyses were obtained with the Bendix 7000 sulfur chromatograph during Test 67 with bituminous coal. Six analyses were carried out on each of five process streams for 1 or 2 days of plant operation (total of 60 analyses), and mean compositions were calculated. The predominant species during pretreatment and gasification are sulfur dioxide and hydrogen sulfide, respectively. Carbonyl sulfide and ethyl plus methyl mercaptans were also detected in all the sampled streams. Gases off the toluene storage vent after pressure blowdown (1000 psig to ambient) show approximately the same relative ratios of carbonyl sulfide and mercaptans as vent gases from the light oil stripper; however, the stripper vent appears to be highly enriched in hydrogen sulfide.

Trace element analyses in selected solids samples from HYGAS Test 55 with Rosebud subbituminous coal have been completed and reported. Interim trace element results are updated for HYGAS Tests 56, 57, and 58 with this same coal. Additionally, preliminary trace element analyses are presented for HYGAS Tests 59 and 60 with Illinois No. 6 bituminous coal from the Peabody No. 10 mine. Some differences in trace element distribution for both coal types are evident from these preliminary data; for example, only 7% of the boron in the bituminous feed remained in the spent gasified char while 77% remained in the char during subbituminous gasification.

Trace element analysis of subbituminous coals and chars was investigated using proton-induced X-ray emission (PIXIE), because this method appeared promising from the standpoint of good accuracy and quick analytical turnaround. The PIXIE method was examined for precision and accuracy by comparing results obtained with atomic adsorption on "as-received" chars and low-temperature ashed samples. Good analytical agreement was observed for manganese, nickel, copper, barium, and lead but poor agreement was observed for iron, arsenic, and selenium. Additionally, the PIXIE method needs further development because it lacks sufficient sensitivity for chlorine, vanadium, chromium, cobalt, zinc, cadmium, tin, antimony, tellurium, mercury, and thallium.

In Test 64, the major oxide species found in high-temperature ash from both pretreated and spent chars consisted of SiO_2, Fe_2O_3, Al_2O_3; minor amounts of CaO, K_2O, MgO, Na_2O, and TiO_2 were present.

In Test 64 with Illinois No. 6 bituminous coal, the total gasification of sulfur from first feed through pretreatment and gasification was 95.6%. Pretreatment released 27% of the sulfur and the first stage of gasification, 42%. In the spent gasified char, organic sulfur species were predominant and accounted for 80% of the total sulfur remaining.

Leaching studies with spent HYGAS subbituminous char are nearing completion, and data are being tabulated in preparation for a final report. HYGAS wastewater treatability studies are still in progress and should be completed shortly to allow timely tabulation of the data and preparation of a final report.

130

U.S. Department of Energy
Environmental Assessment of the Hygas Process, Volume I. Interim Report on Hygas Environmental Characterization: Data Synthesis, Analysis, and Interpretation - Tests 36 Through 64, FE-2433-25, by R.J. Jonardi, et al., Institute of Gas Technology, Chicago, Illinois, Institute of Gas Technology, 195 pages, June 1979.

Availability: Environmental Library

Reviewer's Comments:
Received too late for comment.

Abstract:

THE INSTITUTE OF GAS TECHNOLOGY (IGT) HAS BEEN COMMISSIONED TO PERFORM AN ENVIRONMENTAL ASSESSMENT OF ITS HYGAS PROCESS. IN THIS INTERIM REPORT, THE AVAILABLE DATA ARE REVIEWED AND INTERPRETED. THIS DOCUMENT REPRESENTS THE ANALYSIS OF ALL PREVIOUSLY REPORTED DATA PUBLISHED BY IGT IN THE FORM OF MONTHLY AND QUARTERLY REPORTS COVERING HYGAS TESTS 37 THROUGH 64, ALONG WITH A PRESENTATION OF NEW DATA AND INTERPRETATIONS. THIS REPORT DESCRIBES THE CURRENT PROGRAM STATE-OF-THE-ART, OUTLINES FUTURE TASKS, AND SERVES AS THE PRIMARY REFERENCE DOCUMENT FOR PROGRAM STRATEGY, DATA, AND INTERPRETATION. THE ENVIRONMENTAL DATA BASE IS DIVIDED INTO TWO PARTS - ONE FOR THE COAL PRETREATMENT SECTION, AND THE OTHER FOR THE GASIFICATION SECTION AND RELATED DOWNSTREAM OPERATIONS. THE FORMAT EMPLOYED IS TO IDENTIFY THE FATE OF SELECTED COAL CONSTITUENTS (FOR EXAMPLE, COAL NITROGEN, SULFUR, AND TRACE ELEMENTS) ALONG WITH OTHER ENVIRONMENTALLY IMPORTANT SPECIES LIBERATED OR PRODUCED DURING THE GASIFICATION PROCESS (FOR EXAMPLE, PHENOLIC COMPOUNDS). THE FINAL SECTION OF THIS DOCUMENT REVIEWS CURRENT PROGRAM STATUS AND OUTLINES ISSUES TO BE ADDRESSED IN THE FUTURE.

131

U.S. Department of Energy
Environmental Development Plan Underground Coal Gasification, DOE/EDP-0047, Washington, D.C., GPO, u.p., September 1979.

Availability: Environmental Library

Purpose/Topic:
In situ Gasification — Significant

Reviewer's Comments: (R.E.)
After listing the major environmental concerns of underground gasification (groundwater contamination, subsidence, air quality degradation via emission through cracks and fissures, and hazardous substance effects on workers), the document develops a strategy to "resolve environmental concerns."

There is an excellent review (brief) of all current activity and a reference to the Russian work (An Overview of the Soviet Effort in Underground Gasification of Coal, Report No. UCRL-52004, Lawrence Livermore Lab, January 1976). Unfortunately, there is little data on environmental, health or safety issues from the Russian experience (which includes five power plants using UCG gas).

We have included a four-page summary of environmental concerns and research efforts to alleviate those concerns in the appendix.

U.S. Department of Energy
Environmental Readiness Document--Coal Liquefaction, Commercialization Phase III Planning, Springfield, Virginia, NTIS, 16 pages + appendices, September 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful

Reviewer's Comments: (G.B.)
The summary document briefly describes the research needed on environmental aspects of liquefaction (Appendix A). It gives the reader an idea of the state of the art in 1978. At that time, huge information gaps (though not insurmountable ones) existed. R&D programs have since been implemented.

Abstract:

Abstract: Coal liquefaction technologies under consideration for commercial applications appear to have a medium probability of achieving environmental acceptability. However, program delays or increased costs may be encountered in the event of adverse environmental R and D findings. Key environmental issues include worker protection; siting; potential public health risks from process products, by-products and emissions; and management of solid wastes. Direct coal liquefaction technologies treated in this document are Solvent Refined Coal I and II, Exxon Donor Solvent, and H-Coal. Indirect liquefaction gasification of coal followed by conversion of gaseous products to liquid fuels has definite environmental advantages because many carcinogenic compounds are broken down into noncarcinogenic materials by the process. There are no absolute environmental barriers to coal liquefaction conversion processes under existing Environmental Protection Agency, Occupational Safety and Health Administration, or other agency regulations. A series of proposed new regulations may require better emission control technologies. A plan of environmental research and development related to the current commercialization program is included in Appendix A. It is anticipated that this research will affect coal liquefaction development primarily by defining health issues more precisely, which may dictate further safeguards. (ERA citation 04:012060)

U.S. Department of Energy
Environmentally Based Siting Assessment for Synthetic Liquid Fuels Facilities, by SRI International, Springfield, Virginia, NTIS, u.p., December 1979.

Availability: Montana State University

Purpose/Topic:
Employment, Population Impacts
of Synthetic Liquid Fuels Useful

Reviewer's Comments: (T.S.)
This important, very recent assessment is an update and refinement of ERDA's 1976 Assessment of Critical Factors study. Seeks to determine whether sufficient siting opportunities remain to develop a large-scale synfuels industry over the next 10 to 15 years. Secondly, it assesses the ability to mitigate some of the constraining impacts through altering institutional arrangements. Analysis is regional-specific. Technical data is derived from early conceptual designs rather than operating experience, and thus should be used with caution. The study acknowledges two major biases: it does not consider cumulative effects of several plants built in the same area. Second, the impacts of the plant's associated coal mine are not considered. Thus, as the study states, site-specific analysis is needed to determine the full price of synfuels development. (Note: several pages have been copied for inclusion in the text of this report.)

134

U.S. Department of Energy
Evaluation of an In-Situ Coal Gasification Facility for Producing M-Gasoline Via Methanol, ORNL-5439, by W.C. Ulrich, M.S. Edwards, R. Salmon, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 250 pgs., December, 1979.

Availability: DNRC

Reviewer's Comments:
Not received for comment.

Abstract:
A CONCEPTUAL PROCESS DESIGN AND COST ESTIMATE IS PRESENTED FOR A FACILITY PRODUCING APPROX. 15,000 BARRELS OF M-GASOLINE PER DAY VIA METHANOL FROM SYNTHESIS GAS GENERATED BY GASIFICATION OF COAL IN SITU. THE DESIGN WAS BASED ON EXPERIMENTAL DATA AND MATHEMATICAL PREDICTIONS FROM THE LARAMIE ENERGY TECHNOLOGY CENTER ON THE LINKED VERTICAL WELL IN SITU COAL GASIFICATION PROCESS. IN-PLACE COAL CONSUMPTION IS 20,000 TONS/DAY. BASED ON A SUBBITUMINOUS WYOMING COAL. THE CAPITAL INVESTMENT WAS ESTIMATED TO BE $535 MILLION IN FIRST-QUARTER 1978 DOLLARS. M-GASOLINE PRODUCT PRICE WAS CALCULATED AS A FUNCTION OF THE DEBT/EQUITY RATIO. ANNUAL EARNING RATES ON DEBT AND EQUITY. INPLACE COAL COST. AND PLANT FACTOR (UNSTREAM EFFICIENCY). USING A DEBT/EQUITY RATIO OF 70/30. AN INTEREST RATE ON DEBT OF 9%. AN AFTER-TAX EARNING RATE ON EQUITY OF 15%. AN IN-PLACE COAL COST OF $5/TON. AN LPG (PROPANE) BY-PRODUCT CREDIT OF $4/10**6 BTU. AND A PLANT FACTOR OF 90%. THE PRODUCT PRICE OF M-GASOLINE (INCLUDING MIXED-BUTANE LPG) IS APPROX. $0.90/GAL AT THE PLANT GATE. CALCULATED OVERALL EFFICIENCY FOR THE FACILITY WAS 22%. BASED ON IN-PLACE COAL.

135

U.S. Department of Energy
Evaluation of the Texaco Synthesis Gas Generation Process for the Production of Hydrogen from SRC-II Residue, ORNL/Sub-7240/6, by T.Y. Chang, A.S. West, Scientific Design Co., Springfield, Virginia, NTIS, 87 pgs., December, 1979.

Availability: DNRC

Reviewer's Comments:
Not received for comment.

Abstract:
THE RESULTS ARE PRESENTED OF AN EVALUATION OF THE TEXACO SYNTHESIS GAS GENERATION PROCESS FOR THE PRODUCTION OF HYDROGEN FROM SRC-II VACUUM BOTTOMS RESIDUE. BASED ON GASIFICATION TESTS CARRIED OUT BY TEXACO. THE OPERABILITY AND EFFICIENCY OF THE GASIFIER HAVE BEEN COMMENTED UPON. PRELIMINARY PROCESS DESIGNS FOR A TEXACO GASIFICATION FACILITY FOR A COMMERCIAL SCALE COAL LIQUEFACTION PLANT WERE PREPARED. A NUMBER OF STUDIES WERE PERFORMED TO ESTABLISH A NEAR-OPTIMAL OPERATING PRESSURE AND METHOD OF ACID GAS REMOVAL. PLANT INVESTMENT AND OPERATING COST ESTIMATES ARE INCLUDED. THE REPORT CONCLUDES THAT THE TEXACO GASIFIER IS WELL SUITED FOR THE EFFICIENT PRODUCTION OF HYDROGEN FROM SRC-II RESIDUE AND ONLY MINIMAL DEVELOPMENTAL WORK IS NEEDED PRIOR TO COMMERCIALIZATION. BECAUSE OF THE SHORT DURATION OF THE TEST RUNS. REFRACTORY AND BURNER LIVES ARE A POINT OF CONCERN. BASED ON THE CURRENT STATE OF OXYGEN COMPRESSION TECHNOLOGY THE GASIFIER SHOULD BE DESIGNED TO OPERATE AT ABOUT 800 PSIG.

U.S. Department of Energy
Experimental Analysis of the Leaching Characteristics of Residual Hygas Coal Gasification Solids, FE-2496-28 by R.G. Luthy, P. Vassiliou, and M.J. Carter, Carnegie-Mellon University, Springfield, Virginia, NTIS, 106 pgs., November, 1978.

Availability: University of Montana Library

Purpose/Topic:
Solid Wastes — Significant

Reviewer's Comments: (C.K.)
Excellent, although preliminary analysis of trace elements found in char from Hygas gasification pilot plant. Several eluants were tested to determine which of these trace elements would leach from the char. Most of the eluants were water of varying types. With the water eluants, proposed EPA standards for discharges from coal residues were not exceeded, except for pH, but the authors explain how the results may differ under actual conditions, which will vary from site to site. The report points out that the fate of the trace elements leached from the char remain essentially unknown, and that environmental assessment is impossible without explicit site-by-site data.

137

U.S. Department of Energy
Exxon Catalytic Coal Gasification Process: Predevelopment Program. Annual Report, July 1976-June 1977, FE-2369-20 by T. Kalina, Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 96 pgs., January 26, 1978.

Availability: University of Montana Library

Purpose/Topic:
Third Generation Technology - Exxon Catalytic Coal Conversion Useful

Reviewer's Comments: (R.E.)
This technology receives funding from DOE and the American Gas Association. It's many years away from commercialization.
In the long run, the technology may offer several economics and thermal efficiency advantages. Use of an alkali metal catalyst during gasification leads to the following reaction:

$$\text{coal} + H_2O \rightarrow CH_4 + CO_2$$

The reaction is thermal neutral and requires many fewer processes to produce pipeline gas.

138

U.S. Department of Energy
Fuel Contaminants. Volume 3. Control of Coal-Related Pollutants. Final Report, July 1975-1976, PB-293328, by E.J. Mezey, et al., Battelle Columbus Labs., Springfield, Virginia, NTIS, 135 pgs., January, 1979.

Availability: DNRC

Reviewer's Comments:
Not received for comment.

Abstract:

THE REPORT GIVES RESULTS OF A STUDY TO IDENTIFY STRATEGIES FOR REMOVING POLLUTANTS FROM COAL AND COAL-DERIVED LIQUIDS. OF THE APPROACHES CONSIDERED, FIVE WERE SELECTED FOR PRELIMINARY ASSESSMENT BY EXPERIMENTATION (A SIXTH, IMPROVEMENTS IN PYRITE LIBERATION FROM COAL, WAS NOT STUDIED BECAUSE OF SIGNIFICANT ADVANCES BY OTHERS). STUDY FINDINGS INCLUDE: (1) BIOLOGICAL ACTION ON COAL-DERIVED LIQUIDS--PROSPECTS OF USING NONMUTATED BACTERIA FOR SULFUR AND/OR NITROGEN REMOVAL FROM COAL LIQUIDS APPEAR SMALL; (2) ENHANCEMENT OF PYRITE REMOVAL DURING IMMISCIBLE FLUID AGGLOMERATION--REMOVAL EQUIVALENT TO THAT OBTAINED FOR FLOAT-SINK ANALYSIS WAS OBTAINED BY PRETREATMENT AND OIL AGGLOMERATION. THE SAME TECHNIQUE FOUND TO BE EFFECTIVE FOR RECOVERING GREATER THAN 90% OF COAL FROM COAL CLEANING PLANT FINES; (3) EXTRACTION OF CLEAN FUELS FROM COAL LIQUIDS--LIGHT HYDROCARBONS CAN BE USED TO EXTRACT 83% OF COAL LIQUID AT SUPERCRITICAL CONDITIONS TO YIELD A LOW SULFUR AND NITROGEN FUEL; (4) CONCENTRATION OF ORGANIC SULFUR AND NITROGEN AND ASH FROM COAL LIQUIDS--UP TO 76% OF THE SULFUR AND ABOUT 10% OF THE NITROGEN CAN BE REMOVED BY PASSING COAL LIQUIDS OVER VARIOUS SPECIAL POROUS MEDIA; AND (5) CONVERSION OF COAL LIQUEFACTION RESIDUES TO ENVIRONMENTALLY ACCEPTABLE FUELS--TREATMENT OF COAL LIQUEFACTION RESIDUE WITH H2/CO MIXTURES REDUCES NITROGEN CONTENT BY AS MUCH AS 14%.

U.S. Department of Energy
Guidelines for Multimedia Environmental Monitoring of Department of Energy Fossil Energy RD & D Facilities, (2 Volumes), FE-2495-T13, Washington, D.C., GPO, 103 pages, November 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful

Reviewer's Comments: (G.B.)
This document broadly outlines DOE's proposed environmental monitoring program for all their own (or supported) fossil energy demonstration projects. Monitoring will include continuous studies (chemical, physical, biological) before, during and after plant construction of all media (air, water, wastes). Also included are useful brief descriptions of the various coal conversion technologies as their associated emission or effluent streams. This report is somewhat useful as an introduction to coal conversion processes and environmental effects, but more useful in understanding what DOE plans to undertake when constructing a facility (at least on paper).

Abstract:

These guidelines outline a procedure for the detailed design and specification of environmental monitoring projects relating to all fossil energy technology research, development and demonstration (RD & D) facilities funded by the Department of Energy (DOE), as well as a procedure for determining when and how much of such monitoring is appropriate. The guidelines cover effluent and ambient monitoring for the following:

- Coal gasification
- Coal liquefaction
- Magnetohydrodynamics
- Fluidized bed combustion
- Combined power cycles
- Coal-oil slurry combustion
- In-situ coal gasification
- Surface shale oil retorting
- In-situ shale oil retorting
- Recovery of oil from tar sands
- Enhanced oil recovery
- Enhanced gas recovery
- Advanced well drilling technologies

They are also applicable to other fossil energy technologies which are not currently funded by DOE.

The guidelines do not address OSHA monitoring, process monitoring, the monitoring of socio-economic effects, or the monitoring of raw material resource extraction, unless such extraction is an integral part of the technology under development.

U.S. Department of Energy, et al.
Health and Environmental Effects of Coal Gasification and Liquefaction Technologies: A Workshop Summary and Panel Reports, No. DOE/HEW/EPA-03 by R. Brown and A. Witter, MITRE Corporation, Springfield, Virginia, NTIS, 358 pages + append., May 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Significant
Solid Wastes	Significant

Reviewer's Comments: (G.B.)
These excellent reports assess the state-of-the-art on health, air quality, terrestrial effects, ambient measurement and monitoring and source characterization from both coal gasification and liquefaction technologies. Panels clearly identified specific data gaps and problem areas within their areas of expertise. In sum, the panels (composed of leading government/industrial researchers) identified these major areas of concern and/or in need of additional research:

a) Health - need more analyses on toxic and carcinogenic substances and their associated health effects; need to undertake planning for occupational health monitoring programs;
b) Terrestrial - study transport and transformations of chemicals emitted; work on modeling and baseline information from impacted areas, research more on pollutants exposures and effects;
c) Source Characterization - improve sampling and analytical techniques;
d) Air Quality - study losses of volatile species that are toxic or photochemically reactive in and near plants; study effects of carbonyl sulfide; study visibility and acid rain effects;
e) Ecological Effects - gain knowledge on toxicology of contaminants to use in prediction modeling of ecological effects;
f) Ambient Air - develop occupational and ambient monitoring strategies and programs, develop reliable analytical techniques particularly for nonchromatographic organics, and heterocyclic compounds, carbonyl sulfide and HCN; develop quality assurance programs for ambient data collected.

This document is an excellent source for understanding major health and environmental concerns.

Reviewer's Comments: (C.K.)
This document does not contain information on specific constituents found in various solid wastes generated during coal conversion, but has a very good approach to determining environmental impacts to aquatic and terrestrial systems. The authors' approach is much more concerned with bioaccumulation, synergism,

140 Cont.

Reviewer's Comments: (C.K.) continued
and chronic effects than the EPA "MEG/MATE" system. Both methodologies suffer from insufficient data and too little time to do adequate research, but this document's approach is much more realistic in terms of what potential impacts will be and is much superior to what the EPA has come up with on its own. The authors also give listings of what type of research needs to be done for each aspect of the solid waste problem.

Abstract:

The purposes of the workshop were:

- to assemble biomedical and environmental scientists, representative of a broad range of disciplines, to address current developments in coal gasification and liquefaction technologies
- to review and identify specific health and environmental issues and problems associated with the development and commercialization of these technologies
- to consider the research strategies required to address them and to identify the requisite research information needs, expressed via detailed task statements, for resolving the uncertainties of assessing the relevant impacts of coal gasification and liquefaction technologies.

141

U.S. Department of Energy
Hydrogen-Sulfide Removal Processes for Low-BTU Coal Gas, ORNL/TM-6077, by M.S. Edwards, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 216 pages, January 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - H_2S Removal Useful

Reviewer's Comments: (R.E.)
There are over 50 processes capable of removing hydrogen sulfide from coal gas. The author, after a technical evaluation, selects 14 processes of 6 basic types for detailed study (see Appendix).

The goal of the author was to describe the operation of feasible processes rather than to select optimal processes. A close reading of this lengthy document could be of use in determining relative impacts of different sulfur removal systems.

U.S. Department of Energy
Industrial Fuel Gas Demonstration Plant Program, Task III Report, Demonstration Plant Mechanical Design, Vol. I, Overall Plant Description, FE-2582-1 (Vol. 1), by Memphis Light, Gas and Water Division, Springfield, Virginia, NTIS, 86 pgs., December, 1979.

Availability: DNRC

Reviewer's Comments:
Not received for comment.

Abstract:

THE UNITED STATES DEPARTMENT OF ENERGY AWARDED A CONTRACT TO MEMPHIS LIGHT. GAS AND WATER DIVISION (MLGW) WHICH REQUIRES MLGW TO PERFORM PROCESS ANALYSIS. DESIGN. PROCUREMENT. CONSTRUCTION. TESTING. OPERATION. AND EVALUATION OF A PLANT WHICH WILL DEMONSTRATE THE FEASIBILITY OF CONVERTING HIGH SULFUR BITUMINOUS COAL TO INDUSTRIAL FUEL GAS WITH A HEATING VALUE OF 300 +- 30 BTU PER STANDARD CUBIC FOOT (SCF). THE DEMONSTRATION PLANT IS TO BE BASED ON THE U-GAS PROCESS. WITH ITS PRODUCT GAS TO BE USED IN COMMERCIAL APPLICATIONS IN MEMPHIS. TENNESSEE. IN ORDER TO PERFORM THIS WORK. MLGW HAS ESTABLISHED AN INDUSTRIAL TEAM. WHICH INCLUDES: MLGW - MEMPHIS LIGHT. GAS AND WATER DIVISION. MEMPHIS. TENN. (THE PRIME CONTRACTOR AND DISTRIBUTOR OF THE INDUSTRIAL FUEL GAS); FWEC - FOSTER WHEELER ENERGY CORPORATION. LIVINGSTON. NJ (THE ENGINEER-CONSTRUCTION MANAGER); IGT - INSTITUTE OF GAS TECHNOLOGY. CHICAGO. ILLINOIS (THE PROCESS DEVELOPER); AND DRC - DELTA REFINING COMPANY. MEMPHIS. TENN. (TO PROVIDE OPERATING EXPERIENCE). THE CONTRACT SPECIFIES THAT THE WORK IS TO BE CONDUCTED IN THREE PHASES. UNDER TASK III OF PHASE I A MECHANICAL DESIGN AND COST ESTIMATE FOR THE DEMONSTRATION PLANT WAS COMPLETED. THE OUTPUT OF THIS TASK. IN ADDITION TO THE COST ESTIMATE. IS COMPRISED OF THE FOLLOWING ITEMS: DRAWINGS/FLOWSHEETS. EQUIPMENT LIST. PROCUREMENT REQUISITIONS. INSTRUMENTATION DATA. PLOT PLANS. AND BUILDING SKETCHES. THIS REPORT IN 12 VOLUMES ENTITLED DEMONSTRATION PLANT MECHANICAL DESIGN IS INTENDED TO PROVIDE ALL ENGINEERING INFORMATION NECESSARY FOR THE PRELIMINARY DESIGN OF THE PLANT. THIS REPORT. WHICH SHOULD BE USED IN CONJUNCTION WITH THE TASK II REPORT DEMONSTRATION PLANT PROCESS DESIGN INCLUDES INFORMATION ON ALL PLANT UNITS SHOWN ON TABLE 1. THIS IS VOLUME 1. OVERALL PLANT DESCRIPTION.

U.S. Department of Energy
Inhalation Toxicology Research Institute Annual Report, 1978-1979, LF-69, by R.F. Henderson, J.H. Diel, and B.S. Martinez, editors, Inhalation Toxicology Research Institute, Springfield, Virginia, NTIS, 639 pages, December 1979.

Availability: Environmental Library

Purpose/Topic:

Health Siginifcant

Reviewer's Comments: (G.B.)

A significant portion of this document (pages 275-279) contains biologically technical articles on Lovelace's coal technology toxicology research programs, which are divided into three emphases:

1) Field collection and characterization of effluents from coal utilization,
2) Lab studies on airborne pollutants associated with coal utilization,
3) Toxicology of airborne pollutants associated with coal utilization.

Their present research appears to be limited to fluidized bed combustion and low BTU gasification processes (associated with research ongoing in Morgantown Energy Technology Center, West Virginia). These annual reports with cited references and materials printed in open literature by Lovelace personnel probably represent the state-of-the-art on health effects from gasification technologies.

Abstract:

Development of a well-reasoned strategy for expanded use of coal to meet national energy needs requires knowledge of the potential human health effects associated with various technologies. This program is directed to developing such health effects information with major emphasis on studies relevant to advanced coal utiliziation technologies such as the fluidized bed combustion (FBC) of coal and low Btu gasification of coal. This reflects the role of the Department of Energy (DOE) in developing these technologies in an environmentally acceptable fashion. Because many of the potential effluents from these developing technologies are similar to those from the conventional combustion of coal, the studies address problems common to most coal utilization technologies. This orientation to developing comparative health risk data on the airborne effluents from various technologies can provide the basis for intelligent risk versus benefit judgements between various coal technologies and environmental control strategies.

143 (Continued)

The entire program has benefited from a series of collaborative studies that have been initiated over the past 3 years with the Morgantown Energy Technology Center (METC). The METC is located in Morgantown, WV and operated by the DOE. Among METC objectives are the development of FBC of coal and of low Btu gasification of coal. Thus, with full cooperation of METC, it has been possible for ITRI to initiate field sampling studies on the experimental FBC and low Btu gasifier units located at METC. The strategy has been to obtain information on the physical and chemical characteristics of airborne material at various locations in the process stream as an indicator of potential fugitive emissions to which workers may be exposed or potential environmental emissions that may result in exposure of the general population. Further, the information gained has unique value in understanding the dynamics of the process stream and how the airborne constituents may be modified by implementing various control technologies. The field studies also provide samples for use in laboratory-based inhalation toxicity studies.

This program also includes a series of laboratory-based studies concerned with developing instruments and methodology for the characterization of aerosols, studies on the basic properties of aerosol formation and behavior and the development of equipment and techniques for exposing experimental animals to atmospheres of real or simulated airborne effluents associated with coal utilization. Instruments and approaches developed are then applied to field sampling studies. These studies also provide a better understanding of aerosol formation and the subsequent biological behavior of aerosols following inhalation by man.

A major emphasis of the program is determining the potential toxicological effects of emissions from coal utilization. When applicable, a multi-tiered approach is being used. This consists of a series of relatively rapid *in vitro* and *in vivo* screening tests for cytotoxicity or mutagenicity. These are then followed by inhalation studies to determine the retention and distribution of the inhaled materials. A more limited number of materials are then selected for chronic inhalation studies which may extend for the life span of the animal to establish dose-response relationships for late-occurring diseases. With this approach it is anticipated that the number of compounds on which extensive toxicological testing is done can be reduced.

144

U.S. Department of Energy
Pacific Northwest Laboratory Annual Report for 1979 to the DOE Assistant Secretary for Environment, Part 5. Environmental Assessment, Control, Health and Safety, PNL-3300, Part 5, by W.J. Bair, et al., Pacific Northwest Laboratories, Springfield, Virginia, NTIS, 113 pages, February 1980.

Availability: Environmental Library

Purpose/Topic:
Air
Health

Useful
Not Relevant

Reviewer's Comments: (G.B.)
The annual report gives short synopses of current research ongoing at Battelle Northwest. Part of their research includes analyzing control technologies for gasification systems, particularly for Koppers-Totzek, Texaco and Winkler.

145

U.S. Department of Energy
Phase I: The Pipeline Gas Demonstration Plant. Annual Technical Progress Report, July 1, 1977 - June 30, 1978, FE-2542-12, by G.A. Sweany, Continental Oil Company, Springfield, Virginia, NTIS, 222 pages, 1979.

Availability: University of Montana Library

Purpose/Topic:

Air	Not Very Useful
Health	Not Very Useful

Reviewer's Comments: (G.B.)
This preliminary technical report gives very little information on associated environmental and health hazards for a commercial-scale slagging Lurgi gasification plant (one or two tables). Later reports (Phase II and III) should give more information as would the environmental impact statements required for siting this plant. Since the plant will be located in Illinois, the coal used and predicted emissions may be significantly different than a similar plant for Montana.

146

U.S. Department of Energy
Phase I, The Pipeline-Gas Demonstration Plant Design and Evaluation of Commercial Plant (4 Volumes) by Continental Oil Company, Springfield, VA., NTIS, 1979.

Availability: Montana State University

Purpose/Topic:

Employment Estimates, by Skill	Significant

Reviewer's Comments: (T.S.)
A 1977 contract between Continental and DOE requires the company to construct and operate a demonstration 242 mmscfd high-Btu Lurgi gasification plant, using high-sulfur bituminous coal. A major task, the preparation of a preliminary design of a commercial-scale plant, was completed in 1978.

V1. Executive Summary
V2. Process and Project Engineering Design
V3. Economic Analysis and Technical Assessment
V4. Environmental Assessment and Site Requirements.

V3. was used in this preliminary assessment.
As the Lurgi process is perhaps the most advanced gasification process, the study's design and estimates are generally reliable. However, the data is not specifically relevant to Montana because of the types of coal to be used. Such factors as different heating values and sulfur contents would lead to changes for a similar kind of plant for Montana.

U.S. Department of Energy
Phase I: The Pipeline Gas Demonstration Plant Design and Evaluation of Commercial Plant, Volume Three. Part One: Economic Analysis. Part Two: Technical Assessment, FE-2542-10, (Vol. 3), by Continental Oil Company, Springfield, Virginia, NTIS, 173 pages, 1979.

Availability: University of Montana Library

Purpose/Topic:
Demonstration Plant Design Significant

Reviewer's Comments: (R.E.)
See previous abstract, which is in same series.
An economic analysis of the Slagging Lurgi is presented (capital costs approximately $\$1.3 \times 10^9$, first quarter 1978 dollar price for gas estimated at \$4.85 to \$6.60 per million BTU).
The technical assessment is given in slightly more detail than in the previous document. A risk analysis of each of the unit processes concludes that the Gasification, Shift Conversion and Methanation units are riskier than all other units because each unit involves some scale-up problems.
The "zero discharge" solids disposal area has been assigned a moderate to high risk factor. The authors state "This area would be best proven by operating the Demonstration Plant with a conventional waste water treatment system and having vendors resolve the chemical fixation characteristics of the dissolved solids in the waste water using actual plant streams."

U.S. Department of Energy
Phase I: The Pipeline Gas Demonstration Plant. Annual Technical Progress Report, July 1, 1977 - June 30, 1978, FE-2542-12, by G.A. Sweany, Continental Oil Co., Springfield, Virginia, NTIS, 222 pages, 1979.

Availability: University of Montana Library

Purpose/Topic:
Demonstration Plant Design | Significant

Reviewer's Comments: (R.E.)
This progress report for the Slagging Lurgi Gasification Demonstration is particularly useful because it should represent the state-of-the-art for most of the unit processes (other than the gasifier itself, which is unlikely to be used here) for any Lurgi unit placed in Montana.

Significant decisions include:

1) Although the demonstration plant will purchase electric power, the commercial design calls for generation of electricity on site.
2) Sulfur will be recovered by a Claus plant but the tail gas will be incinerated in power boilers.
3) Power boilers will use the Wellman-Lord process to remove SO_2 (in the Wellman-Lord process, SO_2 is recovered; the SO_2 will be recycled to the Claus unit).
4) Most of the other unit processes are those used by Lurgi plants elsewhere (e.g., Phenosolvon for phenols, Rectisol for acid gases).

The next progress report should be more complete.
Several tables have been included in the appendix.

Abstract:

Contract No. EF-77-C-01-2542 between Continental Oil Company and the U.S. Department of Energy requires Continental Oil, as Contractor to design, construct, and operate a Demonstration Plant capable of converting bituminous coal into pipeline quality gas. Work under this contract started on July 1, 1977.

On January 6, 1978, DOE requested that work on Task II be deferred for the present, and work on Tasks III, IV, and V be continued at a reduced rate. Work on Task VI which was stopped in September, 1977, was not restarted. Work on the remaining tasks, particularly Task I and Task IX, continued as planned. Plans are being made to reprogram and restart the project on October 1, 1978.

During the reporting period, the design and evaluation of a Commercial Coal Gasification Plant, using the British Gas/Lurgi slagging gasifier technology, was completed. The Commercial Plant is designed to produce 241.7 million standard cubic feet of pipeline gas per day from Illinois No. 6 coal. The gas has a heating value of 960 Btu/SCF. The capital cost of the Commercial Plant is estimated to be $1.3 billion (first quarter, 1978 dollars) and the cost of gas ranges from $6.60 to $4.85 per thousand standard cubic feet depending upon the assumptions about financing, taxes, etc.

Thirteen slagging gasifier pilot plant runs were completed at the Westfield Development Centre in Cardenden, Scotland, under a technical support program. This program produced extensive experience with the operation of the gasifier on eastern coals. Ohio No. 9 coal and Pittsburgh No. 8 coal were successfully gasified. It is concluded that Pittsburgh No. 8 coal is somewhat easier to gasify than Ohio No. 9 coal, but both coals could be handled in a Demonstration Plant gasifier designed on the basis of the data from the Westfield technical support program.

A Demonstration Plant site of approximately 1,200 acres has been evaluated, selected, and proposed to DOE for approval. Environmental data collection has been proceeding over the entire year.

A plan to obtain permits and licenses was submitted to DOE. A coal fines marketing study and a coal briquetting study were prepared under Task XII as trade-off studies.

U.S. Department of Energy
Proceedings of the 5th Underground Coal Conversion Symposium, Conference No. 790630, Washington, D.C., GPO, 449 pages, May 1979.

Availability: University of Montana Library

Purpose/Topic:
Undergound Coal Gasification　　　　Significant

Reviewer's Comments: (R.E.)

This 449-page volume is on the "must" reading list if underground gasification comes to Montana. Forty-one papers are published, including four on "environmental studies." Two other very significant titles ("Environmental Studies of LLL's Hoe Creek II Underground Gasification Experiments" and "Department of Energy Environmental Activities Related to Undergound Coal Conversion") were not printed in the pre-print to the symposium, but must be available. In all probability, there will be sixth, seventh, etc., symposia in the future.

We have included four abstracts from this volume.

Abstract:

Sashihara, T.F., et al., "Low and Medium BTU Gasification - A Chemical Industry Perspective"

A chemical industry perspective of the uses and value of the gaseous products obtainable from underground conversion of coal is presented. Discussed briefly is its use as a syngas source for conversion to chemical products. Also, its value as a boiler fuel opposite alternate fuel is analyzed. It is concluded that the medium Btu gas (MBG) derived when converting coal by oxygen injection can be attractive for both feedstocks and fuel use by the chemical processing industries. The usefulness of the low Btu gas derived when injecting air is much more limited. Underground conversion of coal to MBG merits increased emphasis.

Hagen, A. A., et al., "Implications of RCRA, SMCRA, And TSCA on Underground Coal Gasification"

This paper presents an assessment of the implications of current legislative and regulatory actions associated with the Resource Conservation and Recovery Act (RCRA), Surface Mining Control and Reclamation Act (SMCRA), and Toxic Substances Control Act (TSCA) upon underground coal gasification. RCRA and TSCA regulations are not final; however, under the regulations as currently proposed, liquids and tars condensed from UCG product gas stream will be classified hazardous wastes, requiring application of prescribed waste disposal techniques. Options will include use of incinerators meeting specific design and performance criteria, or storage and disposal that must be documented through a manifest system for up to 20 years. TSCA premanufacture notice of chemical substances may apply unless provisions for exclusion are pursued by DOE.

SMCRA regulations are now final, and coal in situ processing is to be regulated under the underground mining provisions which will include submission of detailed mining and operation permit applications, and reclamation plans, with fees based on coal production rates.

Mattox, C.F. and Humenick, M.J., "Organic Groundwater Contaminants from UCG"

The purpose of this research is to identify and quantify the organic compounds that could contaminate groundwaters in the vicinity of in-situ gasification of Texas lignite. Field samples of groundwater and above groud condensate and tar from two sites in Texas were analyzed by gas chromatography-mass spectrometry (GC-MS). The extent of groundwater contamination was found to be a strong function of the water solubility of the organics. Phenolic compounds such as phenol, indanol, naphthol, and other alkyl derivatives comprised most of the organics in the burn cavity waters. Polynuclear aromatic hydrocarbons (PNA) were present in very low concentrations consistent with their solubilities. PNA's of up to five condensed rings, including benzo[a]pyrene, were found in the ppb levels. Based on limited sampling, water quality has appeared to improve over a one year period after gasification operations were completed at a field test site.

Edwards, M.S., et al., "Economics of Producing Gasoline from Underground Coal Gasification Synthesis Gas"

A conceptual process design and cost estimate is presented for a facility producing approximately 15,000 barrels per day of M-gasoline via methanol from synthesis gas generated by underground gasification of coal. The design was based on experimental data and mathematical predictions from the Laramie Energy Technology Center on the linked vertical well UCG process. In-place subbituminous coal consumption is 23,000 tons/day. The capital investment was estimated to be $535 million (first quarter 1978). M-gasoline product price was calculated as a function of financing approach, in-place coal cost, and plant factor. At a 70/30 debt/equity ratio, 9% debt interest rate, after-tax 15% return on equity, $5/ton in-place coal cost, $4/$10^6$ Btu propane by-product credit, and 90% plant factor, the product price of M-gasoline (including butane LPG) is about $0.90/gal (plant gate). The sensitivity analyses provided permit the interpretation of study results for widely different technical and economic assumptions.

U.S. Department of Energy
U.S. Department of Energy Environmental Control Symposium Proceedings: Volume 1 of 3. Plenary Session and Fossil Fuels, DOE/EV-0046, Springfield, Virginia, NTIS, 642 pages. September 1979.

Availability: University of Montana Library and Environmental Library

Purpose/Topic:

Environmental Controls	Significant
Slagging Lurgi	Significant

Reviewer's Comments: (R.E.)

This volume contains papers on Precombustion, Control of Fossil Fuel Power Generation, Conventional and Fossil Fuel Power Generation-Advanced Methods, which are of little interest to synfuels. However, two sections on liquids and gasification (14 titles with 9 published papers) contains pertinent papers. Four of the five missing papers (on environmental control of liquefaction processes, hazardous compounds from liquefaction, polycyclic aromatic hydrocarbons, control technology for in-state work) should be obtained and read.

We have presented four abstracts of particularly pertinent papers and note that the work at Grand Forks on the Slagging Lurgi (contact R.C. Ellman) should prove useful to Montana if a Lurgi plant is to be sited in this state. One table from the Grand Forks work is included in the table. It indicates the large differences in organic by-products obtained from two different lignites.

Abstract:

Parsons, et al., "Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides"

Quench water is a principal wastewater from coal conversion processes that employ wet cleaning of gasses. The origin of the water is moisture in the coal and steam injected into the coal conversion reactor. Depending upon coal composition the quench water contains chlorides, flourides, ammonia, hydrogen sulfide and sulfur oxides. With tar producing coal conversion technology the quench water also contains cyanides, thiocyanates, phenols and various organics.

A two stage gas quenching process was proposed to absorb strong electrolytes in a small flow first-stage quench so as to improve the feasibility of reuse of the larger volume second-stage quench. A study was made to compare the technical and economic feasibility of two-stage quenching with conventional single-stage quenching.

The study evaluated methodology for estimation of quench water characteristics and engineered a concept for accomplishment of the two-stage quench. The results indicated that strong electrolytes could be absorbed from the gasses to a high degree in a first-stage quench with a blowdown of from 5 to 10 percent of the total condensate. The blowdown would be purged to waste disposal. The second-stage quench would collect 90-95 percent of the condensate containing a low content of strong electrolytes. The condensate containing weak electrolytes and organics would be treated by steam stripping and bioxidation prior to reuse as process water. Alternative disposal concepts were evaluated for two sites using representative Eastern and Western coals.

150 (Continued)

Klein, et al., "Abstracts of Papers in Session 12 Wastewater Treatment for Coal Conversion Plants"

Data on the treatment of aqueous coal conversion waste are needed to ensure that water supply and quality are not adversely affected by the developing coal conversion industry. This work is not intended to develop new wastewater treatment processes, but to provide useful and timely information on the application of known control technologies to coal conversion wastewaters.

Samples of lignitic coal and steam-plant fly ash have been tested for their ability to remove polyaromatic hydrocarbons (PAHs) and refractory phenolics from aqueous streams. Removal of up to 99% of the organics was obtained with solid loadings as high as 15 mg/g. In experiments with a tapered fluidized-bed bioreactor, phenol reductions of $\sim$ 99.9% were achieved at phenol degradation rates of 7 to 10 kg per day per m^3 of reactor volume. Ozonation tests have shown that, with biologically treated wastewater, 99% of the residual phenol and 22 to 97% of the refractory PAHs, along with most of the associated colors and odors, can be degraded using ozone dosages of 0.01 to 0.14 kg per thousand liters. Experiments using wet oxidation for the destruction of both soluble and absorbed organics have been initiated. (Research sponsored by the Division of Environmental Control Technology, U.S. Department of Energy under contract W-7405-eng-26 with the Union Carbide Corporation.)

151

U.S. Department of Energy
Regional Issue Identification and Assessment (RIIA), An Environmental Evaluation of the EIA, Mid-Mid Scenario for Federal Region 8, LA-8098-MS, by D.W. Morris, Los Alamos Scientific Laboratory, Washington, D.C., GPO, 103 pages, 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful

Reviewer's Comments: (G.B.)
This report addresses general air, socio-economic, health, water and solid waste problems associated with synthetic fuels on regional and state levels. The information is useful for comparing general site-specific impacts between different areas within the region and for identifying institutional and regulatory barriers. It is not all that useful for identifying specific technology-oriented impacts of synfuels.

U.S. Department of Energy
Regional Profile Energy Impacted Communities, Region VIII,
DOE/TIC-10001, Springfield, Virginia, NTIS, 426 pages,
March 1979.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments: (K.E.)

This report addresses a wide array of data critical in an analysis of current and potential socio-economic impacts on the states (Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming) and local communities identified in the report. This 1979 publication (an earlier 1977 version has been reviewed/abstracted) has data on 325 communities, 73 of which are in Montana. The information was made available to the study by state and local governments. Data are set forth under the categories of: population; administration; finance; housing; health and safety; human services; education; and water and sewer. An executive summary and state summaries are included, as well as the tabulated data.

The study operated under similar assumptions and with same limitations of the 1977 study. So, please refer to review of that document.

U.S. Department of Energy
A Review of C-MU Contributions to DOE-FE's Coal Gasification Environmental Assessment Program, Seventh Quarterly Report, FE-2496-38 by M.H. Massey, Carnegie-Mellon University, Springfield, Virginia, NTIS, 45 pgs., July, 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Marginally Useful
Health	Marginally Useful

Reviewer's Comments: (G.B.)
(See also later and more comprehensive report on C-MU contributions, December 1978 Annual Report.)
This report briefly summarizes activities of C-MU's environmental assessment program on many gasifiers. No data are presented.

Abstract:
In its role of providing assistance, coordination, and evaluation, C-MU has performed four basic tasks since the formal initiation of the DOE Coal Gasification Environmental Assessment Program in July 1976:

(1) Strategic development of an effluent data base

(2) Analysis of process-related environmental engineering problems

(3) Coordination of industrial hygiene sampling and analysis efforts at the DOE pilot plants

(4) Environmental assessment support activities.

To date, activities on these tasks have encompassed work with five high-BTU pilot plants (Bi-Gas in Homer City, Pa.; CO_2-Acceptor in Rapid City, S.D.; the fixed-bed slagging gasifier in Grand Forks, N.D.; Hygas in Chicago, Il.; Synthane in Bruceton, Pa.), two low-BTU plants (Glen Gery Brick Co. in York, Pa.; the Combustion Engineering gasifier in Windsor, Ct.), and two national laboratories (Argonne National Labs in Chicago, Il.; Oak Ridge National Labs in Oak Ridge, Tn.). What follows is a brief but comprehensive review of C-MU activities and accomplishments within and across these organizations with respect to each of these four tasks. Included are references to all reports and publications generated during the course of the work. A complete listing of these references is presented in Section V of this report.

154

U.S. Department of Energy
"Site Selection and Characterization for an Underground Coal Gasification Process" in 49th Annual International SEG Meeting, SAND-79-1022C, by L.C. Bartel, Sandia Labs., Springfield, Virginia, NTIS, 12 pgs., 1979.

Availability: DNRC

Reviewer's Comments:
Not received for comment.

Abstract:
GEOLOGIC AND HYDROGEOLOGIC FEATURES INFLUENCE THE SUCCESS OF THE UNDERGROUND COAL GASIFICATION (UCG) PROCESS. IT IS DESIRABLE TO PERFORM THE UCG PROCESS AT SITES HAVING OPTIMAL CONDITIONS, OR AT LEAST THE SITE DETAILED TO TAKE ADVANTAGE OF GEOLOGIC AND HYDROGEOLOGIC FEATURES. A SITE SELECTION AND CHARACTERIZATION PROGRAM IS TAKING PLACE IN THE STATE OF WASHINGTON AND ELEMENTS OF THIS PROGRAM ARE OUTLINED IN THIS PAPER. THE SELECTION AND CHARACTERIZATION STUDIES FOR A COMMERCIAL UCG PROCESS NEED TO BE ECONOMICAL WHICH PRECLUDES THE EXTENSIVE USE OF BOREHOLE SURVEYS. THE PROGRAM OUTLINED HELPS TO ESTABLISH CRITERIA FOR THE USE OF LESS EXPENSIVE SURFACE TECHNIQUES IN THE INITIAL SITE SELECTION AND CHARACTERIZATION PHASES FOR A COMMERCIAL PROCESS AND TO ESTABLISH ADEQUATE CHARACTERIZATION PROCEDURES WHICH REQUIRE A MINIMUM NUMBER OF BOREHOLES. EXAMPLES WILL BE GIVEN OF INFORMATION OBTAINED FROM SURFACE GEOPHYSICAL TECHNIQUES EMPLOYED AT THE HANNA IV SITE AND THE GULF SITE WEST OF RAWLINS, WY, AND EXAMPLES WILL ALSO BE GIVEN OF INFORMATION THAT CAN BE OBTAINED FROM WELL LOGS.

155

U.S. Department of Energy
Socioeconomic Impact Assessment: A Methodology Applied to Synthetic Fuels by Murphy & Williams Consultants, Springfield, VA., NTIS, 79 pgs., April 1978.

Availability: Montana State University

Purpose/Topic:

Employment Estimates	Useful
Population Impacts	Useful

Reviewer's Comments: (T.S.)
This is a major supporting document for ERDA's 1977 environmental impact statement of a synfuel commercialization program (cited here as ERDA, 1977). It describes the detailed methodology used in the ERDA study, and highlights the findings. It uses illustrative sites for various geographic locations and community types (including gasification in Custer Co., and liquefaction in Powder River Co.).

Generally more applicable to the operations phase. It is also important to note that the projections are of gross impacts, with no consideration given to local conditions (for eg., it is assumed that all project jobs will go to non-locals). Thus, it tends to overstate the scale of economic impacts.

U.S. Department of Energy
Solvent Refined Coal--II Demonstration Project, Fort Martin, Monongalia County, West Virginia, Draft Environmental Impact Statement, DOE/EIS-0069-D, Washington, D.C., DOE, u.p., May 1980.

Availability: Environmental Library

Purpose/Topic:

Technology Demonstration - EIS	Useful
Air	Useful
Health	Useful

Reviewer's Comments: (R.E.)

We have reviewed only small sections of this EIS, looking particularly for the degree of sulfur control planned for the process and for the kinds of mitigation of environmental impacts. We have also looked briefly at the section on "Economic, Social, and Cultural Impacts."

1) The SRC-II Process has been declared to be a petroleum refinery by EPA and must meet new source performance standards for such a refinery.
2) Sulfur control will be through a double Claus unit, followed by a Shell SUPER-SCOT Unit. Emissions under normal operating conditions will be 790 tons/year of SO_2.
3) There are clearly better systems available. The EIS notes that the Beavon-Stretford system would emit 126-253 tons/yr and that other systems could emit less than 126 tons/yr. 790 tons/yr will meet the NSPS of 250 ppmv and is a decrease from that planned in the phase 0 conceptual design where 500 ppmv was anticipated. Note that this is a 6000 tons/day plant and that a commercial plant will be five times as big. Presumably sulfur dioxide emissions will increase five fold, too.
4) SO_2 emissions during upsets and emergencies could reach 16 tons for a two-hour period.
5) They will apparently produce their needed hydrogen by gasifying the carbon containing mineral residue slurry from the process.
6) The demonstration plant is designed to produce no liquid waste discharge.
7) This is a rather peculiar EIS. Because the proposed design is still under evaluation by DOE, almost every process description is "hedged." All language is conditional. Any comment feels like a shot at the proverbial moving target. Clearly, the EIS was written to meet a legal obligation.
8) Some of the plant is built on a flood plain.
9) The social impact section is brief (8 pages) and quantitative. All impacts are seen as either favorable or manageable.

156 (Continued)

Reviewer's Comments: (G.B.)

This EIS contains some fairly useful and specific information on air quality and health concerns. However, because final engineering designs are not available, many predictions may be inaccurate or simply unavailable.

The most significant health hazards are those associated with exposure of workers (maintenance workers, especially) to toxic SRC products and/or by-products either from accidental explosions, spills, etc., or from constant fugitive leaks. Worst cases for worker (and public) exposures would be during emergency upset conditions where huge quantities of gases or oils may be leaked or incompletely combusted in the emergency care system. Approximately 90 tons (max) of fugitive gas emission and 200 tons of TSP are expected per year under normal operating conditions. Emissions during emergencies may be one or two orders of magnitude greater if based on those predicted SO_2 emissions during upset conditions.

I do not think the EIS addresses the emergency situation well at all.

Abstract:

The organization of this Draft Environmental Impact Statement is suggested by the CEQ regulations. Section 1 documents the purpose of the proposed demonstration plant, the need for it, and its current status. Section 2 describes the proposed action and alternatives to it, focusing on possible plant designs, sites, and timing for the project. It also summarizes the impacts of the project on the environment and compares these impacts at each of the alternative sites. Section 3 details the critical features of the potentially affected environment at each of the alternative sites. Section 4 analyzes the environmental consequences of the proposed action and alternatives to it during both the construction and operations phases of the project and identifies potentially significant issues that could arise during decommissioning or expansion to commercial scale. Section 5 presents the names and professional qualifications of the persons responsible for preparing the Draft Environmental Impact Statement.

157

U.S. Department of Energy
SRC-I Coal Refinery. Task 7. Environmental Analysis, ORO-3054-T7, by Southern Co. Services, Inc., Springfield, Virginia, NTIS, 353 pgs., July 31, 1979.

Availability: DNRC

Reviewer's Comments:

Not received for comment.

Abstract:

TASK SEVEN - ENVIRONMENTAL ANALYSIS CONTAINS A DISCUSSION OF ALL THE ENVIRONMENTAL ISSUES RELATED TO THE CONSTRUCTION AND OPERATION OF THE 6,000 TPD SRC-I DEMONSTRATION PLANT. THE SRC-I PROCESS WILL GENERATE A NUMBER OF AIR EMISSIONS INCLUDING SULFUR DIOXIDE, PARTICULATE, HYDROCARBONS AND REDUCED SULFUR COMPOUNDS. THE MAJOR IMPACT ON THE ENVIRONMENT IS EXPECTED TO BE CAUSED BY SULFUR DIOXIDE AND HYDROCARBON EMISSIONS. SULFUR DIOXIDE EMISSIONS HAVE BEEN GREATLY REDUCED BY UTILIZING THE CLEAN FUEL GAS GENERATED BY THE SRC-I PLANT AS A FUEL SOURCE. HYDROCARBON EMISSIONS HAVE BEEN GREATLY REDUCED BY EMPLOYING CONTROL TECHNIQUES. WASTEWATER GENERATED IN SEVERAL AREAS OF THE SRC-I PLANT WILL BE COLLECTED AND TREATED BY A TREATMENT FACILITY LOCATED ON THE PLANT SITE. SOLID WASTE GENERATED BY THE SRC-I PROCESS WILL BE HANDLED AS FOLLOWS: INERT MINERAL ASH RESIDUE WILL BE STORED ON-SITE IN ACCORDANCE WITH BEST ENGINEERING PRACTICE; HAZARDOUS WASTES WILL BE DISPOSED OF IN A PERMITTED SECURE LANDFILL LOCATED ON-SITE; AND NON-HAZARDOUS WASTE WILL BE RECYCLED TO THE PROCESS FOR ULTIMATE DEGRADATION. COMPLIANCE WITH APPLICABLE ENVIRONMENTAL REGULATIONS INFLUENCES THE DESIGN OF THE PLANT. TO INSURE THAT THE PLANT WILL BE IN COMPLIANCE, ALL DIRECTLY APPLICABLE REGULATIONS WERE COMBINED WITH THE MOST STRINGENT REGULATIONS WHICH COULD BE DETERMINED FOR SIMILAR FACILITIES AND COMPILED TO PROVIDE A SET OF EFFLUENT GUIDELINES. SPECIFIC COMPLIANCE TECHNIQUES ARE DISCUSSED IN THIS VOLUME. AN ENVIRONMENTAL ANALYSIS IS BEING CARRIED,OUT TO PROVIDE THE BASIS FOR PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT.

U.S. Department of Energy
Synopsis of C-MU Technical Contributions to the DOE Coal Gasification Environmental Assessment Program. Second Annual Report for July 1977 - July 1978, FE-2496-39, by M.J. Massey, et al., Carnegie-Mellon University, Springfield, Virginia, NTIS, 240 pages, December 1978.

Availability: University of Montana Library

Purpose/Topic:

Air	Useful
Health	Useful

Reviewer's Comments: (G.B.)
This synopsis describes C-MU's comprehensive environmental monitoring program on many gasification plants (Bi-gas, Hygas, CO_2-Acceptor, Slagging Fixed bed gasifier, Wellman-Galusha). Some results are presented--primarily on those technologies other than Hygas. Bibliography is useful for Hygas although slightly outdated. (Most Hygas information was published 1977-1978.)

Abstract:

Carnegie-Mellon University, in its role as assistance, coordination and evaluation contractor for the DOE-FE environmental assessment program has performed four basic tasks:

(1) Strategic development of an effluent data base

(2) Analysis of process-related environmental engineering problems

(3) Coordination of industrial hygiene sampling and analysis efforts

(4) Environmental assessment support activities

To date, task activities have encompassed work with five high-BTU and two low-BTU pilot plants. High BTU plants efforts include: Hygas in Chicago, Illinois, Bi-Gas in Homer City, PA., CO_2-Acceptor in Rapid City, SD., the slagging fixed bed gasifier in Grand Forks, ND., and Synthane in Bruceton, PA. Low-BTU plant efforts are the Glen Gery Brick Company in York, PA. and the Combustion Engineering gasifier in Windsor, CT. Activities have also involved relationships with two national laboratories – Argonne National Labs in Chicago, Illinois and Oak Ridge National Labs in Oak Ridge, TN.

158 (Continued)

The following section is an executive summary of the comprehensive technical review of activities. The comprehensive technical review examines individual task activities and presents significant findings and conclusions. Detailed reports of individual work efforts are referenced specifically to allow in depth examination of the work involved. The final section is a complete reference of C-MU contract reports and publications and a reference of other publications pertaining to the assessment program.

159

U.S. Department of Energy, Office of Technology Impacts
Synthetic Fuels and the Environment: An Environmental and Regulatory Impacts Analysis, Review Draft, Washington, D.C., DOE, u.p., January 7, 1980.

Availability: Environmental Library

Purpose/Topic:
Air
Health

Useful
Not Relevant

Reviewer's Comments: (G.B.)
This long policy document emphasizes the major current regulatory and environmental constraints which can and must be overcome before "development" of our synfuel development program. Most of the environmental information is general. However, a fairly detailed attempt is made to justify synfuels complexes in spite of potential air quality degradation. Several air modeling analyses (using CRSTER and VALLEY models) on liquefaction technologies (Exxon Donor and Fischer-Tropsch) generally showed little or no siting constraints in flat-terrained Class II attainment areas; however, potentially greater constraints appeared for Class I areas, rough terrain sites in Class II, and in nonattainment areas. The appendices to this report contain some relevant input and output data on ambient air modeling.

U.S. Department of Energy
The Utilization of Coal Conversion Process By-Products, Final Report, June 28, 1974 - September 27, 1977, by I.J. Solomon, et al., FE-1724-33, Springfield, Virginia, NTIS, 144 pages + appendices, January 1978.

Availability: Environmental Library

Purpose/Topic:	
By-Products	Not Relevant
Solid Waste	Useful
Useful By-Products from Coal Conversion Processes	Significant

Reviewer's Comments: (R.E.)
See abstract. The only things to add are that the by-products investigated came from HYGAS, SRC, Synthane and COED (none of which is particularly relevant to Montana) and that it seems unlikely that such by-products will ever be used for anything but fuel or feedstock for gasifiers.

Reviewer's Comments: (C.K.)
In order to increase the efficiency of coal conversion processes (CCP), a number of methods are discussed to render useful products from the char and heavy tar residues associated with CCP. The authors suggest that the synthesis of thermosetting polyester resins is a feasible outlet for such wastes.

Reviewer's Comments: (N.Z.)
Chemical products that could be derived from coal conversion by-products were identified as follows: 1) benzene carboxylic acids, 2) terephthalic acid, 3) detergent ingredients, 4) hydrogen, 5) benzenes, toluenes and xylenes. The report concludes with an economic analysis showing the combined production of terephthalic acid and detergent builders is probably most economical. In addition, five alternate process flowsheets were developed for conversion of the by-products to these chemicals. The detail of this report would be useful to anyone incorporating by-product recovery in a plant design.

Abstract:

The work described in this report was aimed at determining the feasibility of converting coal conversion process (CCP) by-products, i.e., chars and heavy tars, to one or more commercially useful materials. Initially the oxidation of the by-products was studied. It yielded a complex mixture of organic acids. In the case of the chars the acid mixture obtained in the aqueous alkaline oxygen oxidation was composed mainly of benzene carboxylic acids (80%) and smaller amounts of aliphatic carboxylic acids. The utilization of the acid mixture was subsequently studied, and a flow sheet of the processes envisioned is presented in Figure 1. One chemical process investigated was designed to convert the oxidation mixture to terephthalic acid by means of a modified Henkel

reaction. Terephthalic acid is a valuable large tonnage chemical feedstock used in many industrial processes. The product yields for the process were low, the maximum yield of terephthalic acid being 10% by weight. A preliminary economic analysis showed that the process could be economically feasible if the yields were increased.

The higher benzene carboxylic acids (BCA's), benzene tetracarboxylic, benzene pentacarboxylic and benzene hexacarboxylic acids have been shown to be prime candidates to replace phosphates in detergent formulations. A separation scheme was developed for isolating the higher BCA's from the lower acids using a pH fractionation. The possibility of using this mixture of higher BCA's as builders in detergent formulations was examined.

During the final phase of the program, the feasibility of synthesizing low cost, thermosetting polymers from the carboxylic acid mixture obtained in the oxidation of the coal conversion process chars was investigated. The synthesis of polyester resins was found to offer considerable promise. This application allows the utilization of the carboxylic acid mixture as a whole with no need for separation of specific components or fractions. Several polyester compositions were prepared by condensation of the carboxylic acid mixture with various glycols and subsequently evaluated as molding materials. Among the various glycols investigated, tetraethylene glycol "bottoms", a by-product of the synthesis of ethylene glycol, was found to be a useful, low cost co-reactant for polyesterification. Polymerization reactions were conducted under conditions leading to the formation of fusible, partially polymerized resins, which were subsequently cross-linked with epoxide-functional curing agents in the presence of amine catalysts. Plastic sheets and glass reinforced composite structures were fabricated and tested. Encouraging results have been obtained which demonstrate the feasibility of manufacturing commercially useful polymers by using CCP by-products as raw materials.

U.S. Department of Energy
"Wastewater Treatment Technology for Coal Conversion Plants," by J.A. Klein, et al., in Environmental Control Symposium (Washington, D.C.), DOE/EV-0046 (Volume 1), Springfield, Virginia, NTIS, pgs. 376-392, November 28, 1978.

Availability: Abstract only

Purpose/Topic:

Wastewater Treatment	Useful
Fly Ash Reuse	Useful

Reviewer's Comments: (N.Z.)
The report describes an interesting use of fly ash in its ability to remove polyaromatic hydrocarbons (PAHs) and refractory phenolics from aqueous streams.

Abstracts:
Data on the treatment of aqueous coal conversion waste are needed to ensure that water supply and quality are not adversely affected by the developing coal conversion industry. This work is not intended to develop new wastewater treatment processes, but to provide useful and timely information on the application of known control technologies to coal conversion wastewaters. Samples of lignitic coal and steam-plant fly ash have been tested for their ability to remove polyaromatic hydrocarbons (PAHS) and refractory phenolics from aqueous streams; removal of up to 99% of the organics was obtained with solid loadings as high as 15 mg/g. Ozonation tests have shown that, with biologically treated wastewater, 99% of the residual phenol and 22 to 79% of the refractory PAHs, along with most of the associated colors and odors, can be degraded using ozone dosages of 0.01 to 9.14 Kg per thousand liters.

Experiments using wet oxidation for the destruction of both soluble and adsorbed organics have been initiated.

U.S. Department of Energy
Water Related Environmental Effects in Fuel Conversion, Vol. I, FE-2445-1, by H. Gold and D.J. Goldstein, Washington, D.C., GPO, 231 pages, 1979.

Availability: Environmental Library

Purpose/Topic:

Site-specific Water Requirements	Significant
Site-specific Water Availability	Significant
Water Pollution	Useful
Water Treatment	Useful

Reviewer's Comments: (N.Z.)

Volume I is particularly useful, especially for its projections of water requirements and availability and methods of wastewater treatment. Volume II is of little use to anyone unless they are developing a detailed design for a synthetic fuel plant's water system.

This report details water requirements and availability for a number of sites in Montana; included are projections of total water requirements during the next 20 years for a variety of scenarios. Much of the general information in this report is included in Water in Synthetic Fuel Production: The Technology and Alternatives by Probstein and Gold.

Abstracts:

The report gives results of an examination of water-related effects that can be expected from siting conversion plants in the major U.S. coal and oil shale bearing regions. Ninety plant-site combinations were studied: 48 in the Central and Eastern U.S. and 42 in the Western. Synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low sulfur fuel oil; coal refining to produce a de-ashed, low-sulfur solvent refined (clean) coal; and oil shale retorting to produce synthetic crude. Results presented include the range of water requirements, conditions for narrowing the range and optimizing the use of water, ranges of residual solid wastes, and cost and energy requirements for wastewater treatment. A comparison of water requirements with those of two recently published studies shows widely varying estimates and emphasizes the need for both site- and design-specific calculations. A review of various combinations of cooling requirements indicates a factor of 4 difference in water consumption across all processes studied. Where water costs <25¢/1000 gal., a high degree of wet cooling appears best. If >$1.50/1000 gal., a minimum of wet cooling should be considered. Between these, a more balanced mix needs to be reviewed. All water requirements of this study are based on complete water re-use; i.e., no direct water discharge to streams or rivers.

162 (Continued)

U.S. Department of Energy
Water Related Environmental Effects in Fuel Conversion, Vol. II, Appendix, FE-2445-1, by H. Gold and D.J. Goldstein, Washington, D.C., GPO, 652 pages, 1979.

Availability: Environmental Library

Purpose/Topic:
Water

Not Very Useful

Reviewer's Comments: (N.Z.)
Volume II is of little use to anyone unless they are developing a detailed design for a synthetic fuel plant's water system. See Volume I commentary for additional information.

U.S. Department of Energy, et al., Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies
Background Material for the Workshop on Health and Environmental Effects of Coal Gasification and Liquefaction Technologies, M78-58, by J. Antizzo, MITRE Corporation, McLean, Virginia, MITRE Corporation, 265 pages, 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Not That Useful

Reviewer's Comments: (G.B.)
This is an excellent resource document for understanding general air pollution problems and potential health effects related to both gasification and liquefaction (also in situ). Although problem areas are identified in a general matter, they are often illustrated with examples from specific technologies.

Abstracts:

The purpose of this document is to provide background material for participants in the Interagency Workshop on the Health and Environmental Effects of Coal Gasification and Liquefaction technologies. The workshop is jointly sponsored by the Department of Energy, the Department of Health, Education and Welfare and the Environmental Protection Agency. The document is an edited compilation of information designed to provide a broad view of three major coal conversion technologies: coal liquefaction, coal gasification, and in situ gasification.

The document is organized to provide several different cuts of information, depending upon the needs of individual users. It consists of five major sections and four Appendices containing supporting material.

The introduction provides a brief overview of the need for coal conversion technology, and a short description of coal resources available for conversion. The primary purpose of the discussion of coal resources is to make the reader aware of the great variations in chemical and physical properties of coal and subsequent variations in environmental implications.

Section 2 provides brief, generic descriptions of the three technologies, including technology classifications and status, process chemistry, and process sequences. Specific process options which are considered likely candidates for emphasis and commercialization are indicated.

Section 3, Source Characterization, provides an overview of potential sources of pollutant streams, and the general classes of pollutants which may be present in those streams. The section also discusses the various perspectives from which source characterization may be accomplished, and the general problems associated with comparability of results. Finally, section 3 presents the state of knowledge of source characterization for the three technologies. More detailed descriptions of process steps which may be used in the three technologies are presented in Appendix A. The Appendix also identifies potential waste streams associated with each process step, possible constituents of the streams, and a brief discussion of the most salient environmental aspects. Appendix B provides more detailed process descriptions, flow diagrams and development schedules for specific process options, e.g., Solvent Refined Coal, Hygas, Bi-gas.

Section 4, Potential Pollutants, is a discussion of the pollutants which may be associated with coal conversion technologies. The pollutants are discussed in seven categories: air, water, solids, organics, trace elements, products and by-products, and transients.

Qualitative and quantitative data are presented in Section 4 and in Appendix C to provide an indication of the species and concentrations which have been found in various studies. But again the reader is cautioned that the data may not be truly representative or scalable to commercial facilities; considerable source characterization work remains to be done.

Appendix D is a cursory description of legislation which may affect efforts to develop and commercialize coal conversion technologies.

Section 5 presents a discussion of potential health and environmental problems of the technologies. The purpose of this section is to provide a "strawman" set of potential problems for each of the five panels of the workshop. A significant activity for each panel at the workshop will be the identification and prioritization of potential health and environmental problems, for the entire energy cycle, of each technology. The "strawman" problems presented here are to be considered only a starting point and are offered to panelists for augmentation and modification.

U.S. Department of Energy, et al., Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies
Health and Environmental Effects of Coal Gasification and Liquefaction Technologies, A Workshop Summary and Panel Reports, DOE/HEW/EPA-03, by R. Brown and A. Witter, editors, MITRE Corporation, McLean, Virginia, MITRE Corporation, 358 pages + append., May 1979.

Availability: Environmental Library

Purpose/Topic:

Health	Significant
Air	Significant
Solid Wastes	Significant

Reviewer's Comments: (G.B.)
This excellent document reviews both the major environmental and health problems associated with synthetic fuels and the research needs to solve or mitigate these problems. The report is organized around six panel reports, which detail each specific environmental/health problem area and associated research needs.
Names of panel members are given and would be useful contacts. The information in this document is an excellent jumping-off point for understanding the basic environmental/health problems of synthetic fuels development.

Reviewer's Comments: (C.K.)
Discusses what factors are important in determining what the environmental impact of solid waste disposal will be and what type of research is needed to aid in such determinations.
Disposal techniques are discussed with comments on their potential impacts. Leaching from land or mine fill sites identified as major problem. Authors point out that almost nothing is known about biological effects of low levels of exotic organics found in process wastes.

Abstracts:

16. Abstract (Limit: 200 words)

This report responds to President Carter's directive to identify health and environmental problems associated with advanced energy technologies. The report contains a presentation of the highlights of the issues and the detailed information requirements identified by panels of a workshop held in Leesburg, Virginia in August 1978 to address the health and environmental effects of coal gasification and liquefaction technologies.

The purposes of the workshop were to; 1) assemble multidisciplines of biomedical and environmental scientists to address current developments in these technologies, 2) review and identify specific health and environmental issues and problems associated with their development and commercialization, and 3) consider research strategies required to address them and to identify requisite information needs for resolving uncertainties of assessing the relevant impacts of coal gasification and liquefaction technologies.

The six panels of the workshop were: occupational and public health and safety; air quality; water quality, water quantity, and aquatic ecology; terrestrial effects; ambient measurement and monitoring; and source characterization. Panel reports containing specific information on environmental and health effects, information requirements, and detailed research statements are included in this report.

165

U.S. Department of Energy, et al., Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies Health and Environmental Effects of Coal Technologies: Background Information on Processes and Pollutants, DOE/HEW/EPA-04, by R. Brown, editor, MITRE Corporation, McLean, Virginia, MITRE Corporation, 509 pages, August 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful

Reviewer's Comments: (G.B.)

This document describes environmental problems (air emissions, water effluents and physical disturbances) associated with several coal-related activities. These include: a) chemical coal cleaning, b) fluidized bed combustion, c) coal-oil mixtures and d) in situ gasification. It is one of only a few reports that looks at coal cleaning or coal-oil mixtures.

Abstracts:

This report provides technology descriptions and characterization of air emissions, water effluents, and physical disturbances associated with coal-based technologies. The material was prepared as background information for use by the working groups for conventional and advanced coal technologies.

The coal-based technologies addressed in this document are conventional coal, chemical coal cleaning, fluidized bed combustion, magnetohydrodynamics, coal-oil mixtures, cocombustion with municipal solid waste, and in situ coal gasification. Because the subject of underground coal conversion is being reevaluated, it has been included within this compilation of background information. Background information on other technologies associated with coal gasification and liquefaction, as well as related information on health and environmental problems and research needs, may be found in documents previously released by the Committee and listed within the appendix. Although every effort has been made to provide up-to-date information on technology descriptions and source characterization in these documents, including an extensive review by scientists involved in technology development, the reader is cautioned that such information rapidly becomes dated as these technologies are refined.

U.S. Department of Energy, Nuclear Regulatory Commission
Socioeconomic Impacts of Nuclear Power Plants: A Paired Comparison of Operating Facilities, by M.A. Shields, J.T. Cowan, D.J. Bjornstad, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 176 pages, July 1979.

Availability: R. Gold

Purpose/Topic:
Impact Overview Significant

Reviewer's Comments: (K.E.)

The study examines a comprehensive, although not exhaustive, range of socioeconomic impacts. A section details its analytical framework of social impact assessment, and the case study of the two plants follows the framework in its comparative, empirical analysis of impacts. The framework outlines an approach that involves a systematic element (host community interacting with project-related inputs causing social impact) and a comparative element (its application to the analysis of several types of impact situations). Four sets of variables are defined: 1) project-related inputs (human resources, revenues, facility characteristics); 2) community system (sociodemographic structure, services, economy, normative system, political system); 3) impacts (structural and functional); and 4) exogenous impacts.

The role of the case study as a general methodology for SIA is evaluated, along with problems encountered with the research design of reconstruction of impacts. In reconstructing relationships between the nuclear plants and changes in host areas, internal and external validity* problems are noted. Some "post-licensing" study, and studies of rural industries and western "boom towns" are included--to address the problem of external validity. That is, the use of a comparative framework connects findings to empirical research and broadens considerations of community and regional change.

Data gathered in the case study were both qualitative and quantitative. Statistics obtained were concerning population estimates, marriages and divorces, housing, health care, crime, and employment. Unstructured interviews were conducted; newspapers perused.

The report is significant in its complete definition of the theoretical components of SIA, as well as in its attention to

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* Internal Validity: making valid causal inferences about a relationship between the plant and observed changes in a host area, i.e., whether or not alternative explanations for the observed effects can be ruled out.

External Validity: extent the results may be generalized to a large class of studies.

166 (Continued)

Reviewer's Comments: (K.E.) continued
needed research. Care in field work, i.e., obtaining the "crucial" data of open-ended interviewing is called for. Also considered as necessary is a socioeconomic impact monitoring program (i.e., data base for large number of projects), "quasi-experimental" research designs, and subject-limited case studies (i.e., monographs focused on health, housing, attitudes, crime). Consideration of "distributional impact assessment" (how different types of impacts affect people at different times) and the integration of theory and empirical research is also viewed as necessary. Although the case study concerns power plants in a dissimilar geographical area, the comparative approach could prove of interest to Montana-area planners.

Abstract:
This study compares the social, economic, and political effects of constructing and operating two nuclear power plants in the rural Southeast: Brunswick 1 & 2 in Brunswick County, North Carolina, and Hatch 1 & 2 in Appling County, Georgia. It is a comparative, "post-licensing" case study designed to analyze variations in the range and magnitude of impacts experienced by the areas in which the plants were constructed. The study is intended to assist the Nuclear Regulatory Commission in the preparation of socioeconomic impact sections of environmental impact statements for proposed nuclear power stations.

U.S. Department of Health, Education and Welfare, National Institute of Mental Health
Building a Power Plant: Newcomers and Social Impact, by G. Massey, Rockville, Maryland, National Institute of Mental Health, 105 pages, 1978.

Availability: R. Gold

Purpose/Topic:
Impact Overview

Useful

Reviewer's Comments: (K.E.)
The study is exploratory and descriptive, serving best to supplement the understanding of one part of an impacted community, i.e., the newcomer. Although it defines a few features of the work situation and describes the mobility of the workers, a more complete picture of their values, lifestyle, relationships to the community, and needs not provided by their job and company is required. Weaknesses in the methods employed are not due to the types chosen (i.e., primary methods of field observation and informal interviewing and supplementary methods of formal interviews and secondary data sources) but due to application of the methods. The researcher admits to problems of conducting field research while fully employed and of the type of interviewing done. The timing of the study also is a factor in the incompleteness of the data; it occurred at one point in time--after the project's start and before its completion. Since the focus is upon the construction worker, the profile would be useful in understanding mobile workers who would be involved in coal development projects in Montana.

Abstract:
This report focuses on social impact of the construction of a power plant from the perspective of the newcomer, the construction workers. From data obtained mainly by field observation and informal interviewing methods, a profile of these people is presented. Although the report considers problems the workers face concerning recreation and special concerns of single workers, it emphasizes the housing problems, the mobility of the workers, and two features of "the job," i.e., commuting versus living in the community and the role of unions in maintaining labor at the plant.

U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health
Coal Gasification Plants Occupational Exposures: Criteria for a Recommended Standard, Report No. 78-191, Washington, D.C., GPO, 195 pages, September 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Not Relevant
Health	Significant

Reviewer's Comments: (G.B.)
This report is essentially NIOSH's current assessment of the hazards associated with gasification that must be mitigated. They recommend many unit process precautionary measures to minimize worker exposures, such as emergency deluge systems in areas where particulate can be high, designs of lockhoppers and gasifiers so that fugitive emissions are minimal or vented to combustion units, appropriate designs and maintenance of valves, flanges, etc., fail safe emergency procedures and many others. No new in-plant ambient air standards are recommended other than those which currently exist. Instead they recommend compliance with existing standards and permissible exposure limits. They believe worker protection through engineering controls and work practices and medical surveillance can be achieved.

U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health
Coal Liquefaction: Recent Findings in Occupational Safety and Health, Draft, by L.R. Harris, et al., Rockville, Maryland, National Institute for Occupational Safety and Health, 14 pages, January 1980.

Availability: Environmental Library

Purpose/Topic:
Health Significant

Reviewer's Comments: (G.B.)
Although extremely brief, the report is the latest "statement" available from NIOSH. It describes results of their pilot plant monitoring program for PNAs, benzene, teulene, xylene, aromatic amines, particulates (also noise and heat) completed at two direct liquefaction pilot plants. Results show ambient levels of some of these chemicals can be detected but, where standards exist, do not exceed standards. NIOSH believes commercial plants will still pose substantial hazards to workers and recommends where process and technological change should be made to prevent worker exposure to these materials.

Abstracts:

Coal liquefaction materials contain potentially hazardous and biologically active substances, many of which have not been characterized as to their composition and/or health effects. Animal studies have shown that certain fractions of coal liquefaction process streams may cause tumors at the site of application. Recent industrial hygiene data show worker exposure at low concentrations of suspected carcinogens. Current control technology assessments of coal liquefaction processes indicate potential exposure of plant maintenance and repair personnel to hazardous materials. This report presents the results of recent NIOSH industrial hygiene studies at two coal liquefaction pilot plants and reviews recent health and process aspects of this technology.

U.S. Department of Health, Education and Welfare, National Institute of Occupational Safety and Health
Control Technology for Worker Exposure to Coke Oven Emissions, Technical Report, NIOSH #80-114, by J.W. Sheehy, 29 pages, March 1980.

Availability: Environmental Library

Purpose/Topic:

Health	Slightly Relevant
Air	Not Very Relevant

Reviewer's Comments: (G.B.)
This report is only relevant to synthetic fuel development as it points out how coke oven emissions (which are theoretically similar to gasification off-gases) are extremely hazardous to coke oven workers. The skin and lung cancer rates of coke oven workers historically have been and are astonishingly greater than other steel workers as well as national averages.

Abstracts:

Numerous studies have shown "coal tar" products increase the risk of skin and lung cancer. One study showed top side coke oven workers had a lung mortality rate 10 times that of all steel workers. Another study showed that men employed at coke ovens for more than five years showed a mortality rate 3.5 times the expected rate. In view of this significant health hazard to thousands of coke oven workers a NIOSH in-house study to assess coke oven control technology was performed.

Control technology for coke ovens was assessed through visits to seven United States coke oven plants with state-of-the-art control technology and by a review of current coke oven control technology literature. Each control method is briefly described and the effectiveness of important engineering and work practice controls is presented. The report discusses, separately, controls for charging emissions, pushing emissions, door emissions, and top side leaks.

Charging emission controls include larry car stage charging, fixed duct secondary collectors, and pipeline charging. More than a dozen pushing emission control methods are discussed in the report. Door emissions control technology such as new door sealing techniques, guillotine doors and exhaust hoods are described and evaluated, and enclosed filtered air systems are discussed.

Significant conclusions are: Greater effort should be devoted to the development of control technology for door emissions, and pipeline charging appears to have advantages over larry car stage charging in reducing worker exposure. Important recommendations include: Develop controls for 6-meter metal-to-metal doors, evaluate well ventilated sheds, and evaluate pipeline charging in terms of worker exposure.

171

U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health
Potential Health Hazards Involved with Coal Gasification, NIOSH Technical Report No. 79-113, by R.J. Young, Washington, D.C., GPO, 181 pages, November 1978.

Availability: Environmental Library

Purpose/Topic:
Health | Useful

Reviewer's Comments: (G.B.)
Unfortunately, much of this report is devoted to description of the unit processes of gasification instead of health hazards. However, the report is useful in identifying where in the gasification processes occupational hazards exist. Since this initial report was published, NIOSH and other agencies have gathered more specific information.

Abstracts:

The objective of the research effort described in this report was to develop an inventory of specifically identified, potentially hazardous contaminants which may be generated in synthetic fuel plants, which are likely to become commercially viable within the next decade. An additional objective was to prepare a review of the toxicological and epidemiological information on the more important substances.

U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health, and U.S. Environmental Protection Agency
Recommended Health and Safety Guidelines for Coal Gasification Pilot Plants, EPA-600/7-78-007, by Enviro Control, Inc., Springfield, Virginia, NTIS, 239 pages, January 1979.

Availability: Environmental Library

Purpose/Topic:
Health - General Hazards Useful

Reviewer's Comments: (G.B.)
This report is useful for obtaining a general feeling for the types of health hazards (toxic substances, noise, fire), which may or will exist at commercial-scale gasification plants. The document's data is based on pilot plant observations.
Much background information on health effects and OSHA standards is given for various in-plant pollutants expected to be emitted. However, this document does not cover Lurgi gasification (and it doesn't cover Texaco or Koppers-Totsek). It is useful for understanding some potential health hazards unique to HYGAS. The report does include recommended employee-health programs, but points out much more health and toxicity information is needed before standards could be developed.

Abstracts:

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. The National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived.

This document has been developed as part of the Interagency Energy and Environment Research and Development Program. It's purpose is to identify potential hazards to workers in coal gasification pilot plants, and to develop hazard control strategies. The guidelines emphasize worker protection measures such as safe work practices, personal protective equipment and clothing, industrial and personal hygiene, workplace and medical monitoring, labeling and posting, hazard information and awareness, and recordkeeping.

Although this document is specific for pilot scale coal gasification plants, many of the potential hazards and research and development needs are similar to those in bench or demonstration scale coal gasification or coal liquefaction facilities. The recommended health and safety guidelines are in many ways applicable to these facilities as well. This document should also be a valuable reference for researchers and administrators responsible for the development and operation of these related coal conversion implementation of these guidelines in experimental coal conversion facilities will not only help protect the health and safety of today's workers, but will also make occupational health and safety research an integral part of the development of coal conversion technology. In this way, hazards can be identified and effective control technology can be developed prior to the design and construction of commercial coal gasification plants.

173

U.S. Department of Housing and Urban Development
Rapid Growth from Energy Projects, Ideas for State and Local Action: A Program Guide, Washington, D.C., GPO, 59 pgs., April 1976.

Availability: Environmental Library

Purpose/Topic:
General Impacts — Useful

Reviewer's Comments: (T.S.)
A practical program on impact assessment methodology for communities undergoing rapid growth. Not specifically addressed to synfuels. El Paso's 1974 coal gasification proposal serves as one of the source documents. Includes many names and references for further information.

174

U.S. Department of the Interior, Bureau of Land Management
Public Involvement in Coal Leasing Activities, Billings, Montana, Bureau of Land Management, 77 pages, August 1977.

Availability: R. Gold

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments:
None

Abstract:
The brochure describes the results of public meetings in Southeastern Montana that focused on federal coal leasing proposals. Meeting objectives were to bring involved persons and groups up-to-date on BLM activities and, through small group workshops, document the factors that the participants themselves would use in deciding between a number of different possible leasing tracts. The following areas of concern were addressed: coal resource; mining economics; water resources; need; environmental concerns; social, economic and cultural; surface owner's consent; reclamation; geographic location; end use; administrative concerns; net energy return; and competition between federal coal and private coal. Ideas addressing each of these concerns are included in a summary analysis, which tallies the ideas on a point system. Ideas involving social, economic and cultural concerns were: impacts on local population; public opinion in areas to be mined; human concerns; leasing scheduled to minimize impacts to local communities; local economic impacts; impacts on existing agricultural operations; long-term impacts; regional impacts; status quo. Processes that BLM has undergone regarding the leasing of federal coal are summarized, along with the proposed federal leasing action.

175

U.S. Department of the Interior, Bureau of Land Management Sociological Research in Three North Dakota Counties: A Work Plan, Billings, Montana, Bureau of Land Management, 5 pages, July 1975.

Availability: R. Gold

Purpose/Topic:
Preparing for and Handling Impacts Useful

Reviewer's Comments: (J.C.)
This paper should be noted, as it was a forerunner to much of the more recently conducted field studies. It identified inadequacies in available research at the time, and pinpointed specific data areas that were considered necessary to obtain.

Abstract:
The work plan expresses the Montana State Office's concern for possible coal exploitation in the West, and the need for research and impact assessments. They outline existing social and economic research related to coal development in Montana and North Dakota, as well as data they feel is lacking. MSO has determined that the sociological sphere has the greatest research needs and goes on to anticipate an approach for fulfilling this need.

Included in the outline are: research methods, timing considerations, research coordination, proposed topics for study, and an anticipated contract position. The document is a brief suppositional statement that ultimately states the need for research in the area of coal development.

U.S. Department of the Interior, Bureau of Reclamation
ANG Coal Gasification Company, North Dakota Project, Final Environmental Impact Statement, FES 78-1, Washington, D.C., Bureau of Reclamation, u.p., January 20, 1978.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Not Relevant

Reviewer's Comments: (J.M.)
Description of socioeconomic impacts is brief and predictable, dealing only with quantifiable impacts. The socioeconomic characterization was mentioned as being done specifically to identify community facilities affected by population growth and the change from an agricultural to an industrial economy. The EIS does mention the fact that most technical labor for the coal gasification plant and support facilities will have to come from outside the area. The use of a construction camp to handle peak work forces is also planned for this project.

The statement's attitude toward social impacts is evident in the remark that whether or not permanent changes in the existing social environment are adverse will depend on "the ability and desire of local citizenry and institutions to adapt to changes of these magnitudes." No mention is made of the company's or the state's obligations to the community. No mention at all of impacts on qualitative aspects of the communities.

Abstract:
A brief description of socioeconomic impacts is presented in this report, which focuses upon community facilities affected by population growth and the change from an agricultural to an industrial economy. The technical labor for the coal gasification plant is considered to require workers outside the area. The use of a construction camp to handle the peak work force is planned. The document's treatment of social impacts is evident in the remark that whether or not permanent changes in the existing social environment are adverse depends on "the ability and desire of local citizenry and institutions to adapt to changes of these magnitudes.

177

U.S. Department of the Interior, Bureau of Reclamation
Assessment of Cumulative Sociocultural Impacts of Proposed Plans for Development of Coal and Water Resources in the Northern New Mexico Region, by J.R. Leonard Associates, Inc., Salt Lake City, Utah, Bureau of Reclamation, 260 pages, September 1975.

Availability: R. Gold

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)

Baseline information pertaining to the socioeconomic (demographic and economic statistics) and the sociocultural (Navajo, non-Navajo, and the social issues of alcoholism, the interface of Navajo/non-Navajo) is provided prior to the analysis of impacts. Impact projections were made at three levels of development: no development, seven projects developed, some projects developed. Statistics of socioeconomic impacts are presented concerning population, labor force and employment, income, and infrastructure (transportation, sewer, housing, education, health services, utilities, social services, government services). Sociocultural impact projections involved political impacts, social trends, ethnic interface, and changes for traditional Navajos (social organization, family conflict, the abandonment of traditional economic activities). The section on projected impacts concludes with a discussion of perceived social impacts by Navajo and non-Navajo. County-wide planning for housing, education, and transportation is mentioned to address ways of dealing with the impacts.

Quantitative and qualitative methods were employed. In making the projections the impacts were quantified wherever possible, and tables used to present statistical information. Projections in the sociocultural area, however, involved comparisons of the projects with developments elsewhere, analysis of local values and attitudes and projections of sociocultural trends which are already discernible in the area. Open and closed questions were included in the questionnaire used for the formal interviews.

The assessment is pertinent to Montana and synfuel development in its consideration of impacts for two coal gasification complexes and its concern with a native population, as well as with non-Indians. Although quantitative analysis is emphasized in the projections of impact, qualitative analysis is utilized. A wide range of concerns is included in the projections: attitudes, values, economic and demographic, infrastructure, cultural, etc.

Abstract:

The objectives of this study are to make projections of the cumulated socioeconomic impacts that current and proposed coal

177 (Continued)

Abstract: continued
and water resource development projects will have on the San Juan County area; and to analyze the impacts these socio-economic changes will have on the current social structures in the major Navajo and Angle communities of the county. The study seeks to provide a definitive analysis of probable sociocultural impacts of seven specific resource development projects: 1) El Paso Coal Gasification Complex; 2) El Paso Coal Mine Development; 3) WESCO Coal Gasification Complex; 4) Utah International Coal Mine Expansion; 5) Four Corners Generating Plant; 6) San Juan Generating Plant and Coal Mine Expansion; and 7) Navajo Indian Irrigation Project. The current social structures and processes of the major Navajo and non-Navajo communities in San Juan County and their interface with each other are assessed. These analyses taken together with current socioeconomic trends (migration patterns, land use patterns, industrial and agricultural development, employment, etc.) form a baseline from which predictions of socioeconomic and then sociocultural changes are made. Attitudes, opinions and activities of various groups in the affected communities were obtained with formal questionnaires, direct community observation and informal interviewing.

U.S. Department of the Interior, Bureau of Reclamation
Construction Worker Survey, by J.A. Chalmers, Mountain West Research, Inc., Springfield, Virginia, NTIS, 70 pages, October 1977.

Availability:

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
Limited sociological information, i.e., background information, was collected. The study sought to categorize construction workers as local or non-local, by occupation, by marital status and household size, by type of housing, and if workers had been unemployed previous to their employment on a project. Methodology involved self-administered questionnaires distributed by the contractors, or their representatives, at 15 project sites. Closed-type questions were included in the questionnaire. No opportunities for respondents to comment aside from the 10 given questions was possible with the survey design (i.e., lacking interviews and open-ended questions). The data were analyzed quantitatively through the "Statistical Package for the Social Sciences" computer program. Also included in data analysis were a number of computer models: 1) a Resident Choice Model, based on the assumption that a number of non-locals choosing to reside in one community relative to another reflects the relative attractiveness of the two communities; 2) a source of supply model used to determine the factors in the ability of community to supply workers; and 3) a model to estimate the number of local workers unemployed prior to employment on a project. No qualitative analysis of the characteristics of construction workers was possible with the research design. Of the quantitative analyses undertaken, 650 observations from the survey data allowed for some conclusions about the demographic characteristics of the workers. However, meaningful analysis involving quantitative relationships that could be used to predict the supply of local workers, the residential choice of non-local workers, or the number of local workers previously unemployed was not supported by the too-thin data.

The survey data represents information obtained at one point in time and, thus, cannot be related directly to construction projects in Montana. Only four projects in the Dakota-Wyoming area and no projects in Montana were included in the survey. The report's use is that it exemplifies quantitative methodology.

Abstract:
The problems associated with estimating the economic and demographic impacts arising out of project construction activities are the focus of this report. A survey was conducted to determine the following: the characteristics of construction workers and

178 (Continued)

Abstract: continued
their families; the distribution of the construction force between local and non-local workers; the extent to which non-local workers were accompanied by their families; the way in which the local residences of the non-local workers were distributed; and to investigate the previous employment status of local workers.

179

U.S. Department of the Interior, Bureau of Reclamation
El Paso Coal Gasification Project, New Mexico, Final Environmental Statement (two volumes), FES-77-03, Washington, D.C., Bureau of Reclamation, u.p., February 8, 1977.

Availability: Environmental Library

Purpose/Topic:

Commercialization of Lurgi	Useful
Solid Wastes	Significant
Water Quantity Required for Gasification	Not Very Useful
Water Quality of Effluent	Somewhat Useful
Water Treatment Scheme	Useful

Reviewer's Comments: (R.E.)
As one of the original projects scheduled in the United States, El Paso's EIS is worth reading. Newer documents on Lurgi technology are more valuable, however.
We chose to look more closely at the WESCO and the ANG North Dakota Project EISs, but data from El Paso are included in the commentary.
Technically, the most striking feature of El Paso was their decision to produce power and steam from low-BTU gasifiers on site.

Reviewer's Comments: (C.K.)
This EIS documents how solid wastes would be disposed of in arid regions, which obviously includes Montana. Estimates of the amounts of solid wates to be generated by a 288 MMCFD Lurgi gasifier are given, as well as some guesses about certain trace elements expected in the ash. The EIS assumes no leachates from the solid wastes will reach ground or surface waters, so almost nothing is said about what the leachate may contain and what potential impact it would have on aquatic or terrestrial biota.

Reviewer's Comments: (N.Z.)
An obviously very site-specific report. Has a very short but interesting section on marketability of by-products. The report also discusses some water technology schemes including methods of by-product recovery. In general, the report does not have a substantial amount of information pertaining to water and synthetic fuel production.

U.S. Department of the Interior, Bureau of Reclamation
A Guide to the Preparation of the Social Well-Being Account: Social Assessment Manual, by S.J. Fitzsimmons, L.I. Stuart, P.C. Wolff, Washington, D.C., Water Resources Scientific Information Center, 279 pages, July 1975.

Availability: R. Gold

Purpose/Topic:
Impact Overview Significant

Reviewer's Comments: (K.E.)

The manual provides an orientation to conducting social assessment and instructions for completing a formal Social Well-Being Account on behalf of the water resources planning officer. It represents a comprehensive, systematic and representative basis for social assessment in agency planning. Much of the manual is devoted to materials and procedures necessary to prepare a SWB account. Two fields, i.e., social and social-psychology field and water resources planning and development field, of literature were reviewed, analyzed and related. The manual was developed from program experience; federal requirements and the theory and research found in the two fields.

The representativeness of social concerns in the account is insured. Impacts are defined carefully, i.e, as changes which are given the social meaning of beneficial or adverse effects. Lists of the variety of impacts are provided; each is defined and scope of concern within each category is explained. Then, too, impacts are considered as indirect/direct and long/short term.

Methodology in SWB is also extensively described. Theoretical orientations or approaches, i.e., social sciences and a dynamic systems model, are examined. The broad perspective versus a selected, detailed assessment in designing one's research is discussed. Ways to rate impacts as beneficial/adverse, i.e., uniformity and monetary values, are evaluated. The methods to describe the community and to acquire data, both part of the SWB account process, are explained. Hard data versus soft data is a topic of discussion, along with the types of primary data and secondary sources.

The manual is important to government personnel who must operate with agency requirements. Since it is concerned with water resource management, it can be utilized by agencies involved in synfuel development, of which water is a key element.

Abstract:

The manual establishes procedures for conducting research and analyzing data to forecast probable future impacts of implementing alternative water development plans and assessing their beneficial and adverse social effects upon people and their communities.

180 (Continued)

Abstract: continued
The procedures produces a Social Well-Being Account, which is organized into five components, each containing various evaluation categories with specified data; 1) individual, personal effects; 2) community, institutional effects; 3) area, socioeconomic effects; 4) national, emergency preparedness effects; and 5) aggregate, social effects. Five steps are required for the completion of the SWB Account: 1) description of the history of water resources of the area; 2) description of the planning area to be affected in terms of its history, current social profile, and lifestyle; 3) identification of the future social impacts attributable to each alternative plan for each of the components; 4) comparison of the future beneficial and adverse social effects of the alternative plans; and 5) recommendations of the plan with optimal future social well-being effects on the plan area.

181

U.S. Department of the Interior, Bureau of Reclamation
Water for Energy, Missouri River Reservoirs, Draft Environmental Impact Statement Pick-Sloan Missouri Basin Program, DES 76-38, Billings, Montana, Bureau of Reclamation, u.p., October 12, 1976.

Availability: Environmental Library

Purpose/Topic:

Water Use and Quality Associated with Synthetic Fuel Plants	Not Relevant
Effects of Dewatering a Stream	Useful

Reviewer's Comments: (N.Z.)
This report is relatively old (1976) and has little information on synthetic fuel plants. There is some useful information on the effects of dewatering on a stream habitat but for the most part this report is of little use.

U.S. Department of the Interior, Bureau of Reclamation
Western Gasification Company (WESCO) Coal Gasification Project and Expansion of Navajo Mine by Utah International Inc., New Mexico, Final Environmental Statement (two volumes), Salt Lake City, Utah, Bureau of Reclamation, u.p., illus., diagr., January 14, 1976.

Availability: Environmental Library

Purpose/Topic:

Solid Wastes	Significant
Water Re-Use and Conservation	Significant
Water Quality of Effluent	Not Very Useful
Water Treatment Schemes	Useful
Water Quantity Required for Gasification	Somewhat Useful

Reviewer's Comments: (C.K.)
Pages E-1 to E-14 contain information on the fate of Hg, Sb, Se, Te, Cd, Pb, and F in a Lurgi gasifier. A computer program was used to simulate gasifier equilibrium conditions and derive the conclusions as to the disposition of the trace elements. These hypothetical results should be compared to leaching studies that have since been conducted.

Reviewer's Comments: (N.Z.)
An obviously very site-specific report, but it has some worthwhile information. The report has a particularly good section on re-use and conservation practices for water. The basic needs for water are discussed along with methods for minimizing use of water and reusing water. The report also has a section on monitoring water after construction to determine the effects of synfuel production on water quality; this section gives insight to setting up a monitoring program for a synthetic fuel plant site.

U.S. Department of the Interior, Geological Survey
The Impact of Coal Development on the Cultural Resources in Southeastern Montana, by Anthro Research, Inc., Livingston, Montana, 318 pages, 1978.

Availability: Environmental Library

Purpose/Topic:
Impact Overview | Not Relevant

Reviewer's Comments: (J.M.)
This report, done for inclusion in an USGS EIS, deals exclusively with evaluating impacts on cultural resources in Southeastern Montana and defining impacts of coal mining and development on those resources. (Cultural is defined as relating to sites, structures, objects, districts, etc., having significance in historical and/or archealogical perspectives.) Research methodology included literature searches and interview of local area residents.

Historical overview of the area (Southeastern Montana) might be significant as far as understanding tribal use of the land--for example, study mentions that, to the Crow Tribe, the area holds keys to cultural development and migration patterns. Some impacts could be expected in the way of loss of parts of their heritage if certain lands are developed. There is, however, no section in the study devoted to interviewing affected tribes for their feelings about possible development.

184

U.S. Department of the Interior, Geological Survey
Western Coal Planning Assistance Project Reference System (4 Volumes) by Mountain West Research Inc., Omaha, Nebraska, Missouri River Basin Commission, January 1979.

Availability: Montana State University

Purpose/Topic:

Employment Estimates and Scheduling	Significant

Reviewer's Comments: (T.S.)

V1. The Fact Book for Western Coal/Energy Development
V2. A Guide to Methods for Impact Assessment of Western Coal/Energy Development
V3. Forecasts for Western Coal/Energy Development
V4. Source Book for Western Coal/Energy Development

Probably the best source of recent estimates of employment requirements and scheduling (in V1). Based on two recent industry proposals: 137 mmscfd plant, ANG (1977); and 139 mmscfd plant, Panhandle Eastern (1978). A very comprehensive reference system for all coal-based energy developments. V4 includes names of many officials who may be useful sources.

185

U.S. Energy Research and Development Administration
Alternative Fuels Demonstration Program, Final Environmental Impact Statement (2 Volumes), Washington, D.C., ERDA, September 1977.

Availability: Montana State University

Purpose/Topics:

Employment Estimates and Scheduling, Including by Skill/by Year	Useful

Reviewer's Comments: (T.S.)

Relies heavily on the less-than-reliable 1974 Project Independence Blueprint report. Another weakness is its broad, national perspective. Still, it has some useful updates on employment estimates.

U.S. Energy Research and Development Administration
Assessment, Selection and Development of Procedures for Determining the Environmental Acceptability of Synthetic Fuel Plants Based on Coal, Basic Report and Appendix I, FE-1795-3 (Part 1), by R.G. Oldham and R.G. Wetherold, Austin, Texas, Radian Corp., 124 pages, May 1977.

Availability: Environmental Library

Purpose/Topic:
Air — Very Useful
Health — Not Very Useful

Reviewer's Comments: (G.B.)
Waste streams from Koppers-Totzek, Lurgi and SRC (also Synthane, Synthoil) processes were determined based on engineering analyses. Data are given primarily for stack emissions from all unit processes and auxiliary units. The major pollutants analyzed were particulates, NO_x, SO_2, CO, various carbon-sulfur species, ammonia, HC and trace organics, tars, oils, elements. How these data compare with later studies has not been determined.

Abstract: This document summarizes Radian Corporation's results from an investigation conducted for the Energy Research and Development Administration (ERDA). This program was designed to develop approaches for determining the environmental acceptability of synthetic fuel plants based on coal.

Process engineering analyses were conducted on five processes which were considered representative of the emerging technologies. The processes were Koppers-Totzek, Lurgi, Solvent Refined Coal, Synthane, and Synthoil. In addition, a detailed analysis was performed on a generalized coal handling facility which is common to all of the above processes.

The process engineering analyses were conducted from a mass and energy balance orientation. In this manner, all process streams, including effluent streams, were fully characterized as to temperature, pressure, phase, bulk composition and flow rate. By starting with raw material inputs and performing mass balances around each unit operation, the possible path of pollutants was followed through the five selected processes. All gaseous, liquid and solid effluents were identified for each process, with special emphasis being placed on the EPA criteria pollutants and trace organics and inorganics contained in these streams.

A sampling approach was developed that is generally applicable to all coal conversion processes. Emphasis was placed on the selection of sampling procedures that would yield representative samples from process streams under unusual conditions of temperature and pressure.

187

U.S. Energy Research and Development Administration
Development of the Co-Steam Process for Liquefaction of Lignite and Western Subbituminous Coals, by E.A. Sondreal, et al., Grand Forks Energy Research Center, Grand Forks, North Dakota, Grand Forks Energy Research Center, 31 pages, 1977.

Availability: Environmental Library

Purpose/Topic:	
Technology Description	Not Very Useful

Reviewer's Comments: (R.E.)
This three-year-old paper describes a very small bench scale unit (3-5 lbs coal/hr) for liquefying coal via carbon monoxide and steam. The technology does not sound particularly promising from this paper (too much pyrolysis in the mechanism) but later papers may show some advantages.
The process is, in any event, many years away from commercialization.

188

U.S. Energy Research and Development Administration
Environmental, Health and Control Aspects of Coal Conversion: An Information Overview, by H.M. Braunstein, E.D. Copenhaver, and H.A. Pfuderer, editors, Oak Ridge, Tennessee, Oak Ridge National Laboratory, Information Center Complex, u.p. (2 volumes), April 1977.

Availability: Environmental Library

Purpose/Topic:	
Solid Wastes	Significant
Air	Useful
Health	Significant

Reviewer's Comments: (C.K.)
Excellent review of information available at publishing date. Contains data on types of solid wastes from gasification and liquefaction processes, as well as indicating where further research is needed.

Reviewer's Comments: (G.B.)
This highly technical and comprehensive document provides an excellent resource for information on specific environmental (particularly ecological) or health effects of particular substances (i.e., trace elements, PAH, SO_2). It is organized by major environmental compartment (plant, animal, health, environment) and then by individual substances (PAH, SO_2, trace elements). The Health Section provides excellent background and specific information on effects. However, the information on air effects is scattered throughout.

U.S. Energy Research and Development Administration
Factors Influencing an Area's Ability to Absorb a Large-Scale Commercial Coal-Processing Complex, A Case Study of the Fort Union Lignite Region, Final Report, September 1973 - June 1975, FE-1526-2, by University of Denver Research Institute, Springfield, Virginia, NTIS, 280 pages, August 1975.

Availability: Environmental Library

Purpose/Topic:
Not Applicable

Reviewer's Comments:
Not received in time for review.

Abstract:
The introduction of a hypothetical large-scale, multiple product coal processing complex promises to have a major impact on a rural Western community, if located in a representative area in the Fort Union coal region. Each complex is seen as employing 3,000 workers and requiring a capital investment of $2.5 billion. Likely scenarios for development show a doubling or tripling of population in affected areas by 1990, and major increases in personal income.

In analogous instances where large-scale developments have been superimposed on rural communities the impacts have included housing shortages, inadequate retail and professional services, and an inability on the part of local governments to finance needed capital outlays and operating expenditures. This has led to resident dissatisfaction and alienation, unsatisfactory living conditions, high employee turnover rates, and low labor productivity.

With careful growth management, most of these negative impacts appear to be avoidable. This will mean strengthening existing institutions for balancing basic and nonbasic investment, affecting resource use and conservation, developing the local labor force, and accommodating and retaining the local population. External financial assistance will be necessary during the early years of the development period.

U.S. Energy Research and Development Administration
Fischer-Tropsch Complex Conceptual Design/Economic Analysis, Oil and SNG Production, R&D Report No. 114, Interim Report No. 3, FE-1775-7, by Ralph M. Parsons Company, Washington, D.C., ERDA, u.p., January 1977.

Availability: Environmental Library

Purpose/Topic:	
Unit Descriptions	Significant
Energy Balance	Significant
Environmental Factors	Significant
Air	Useful
Health	Not Very Useful
Solid Wastes	Useful

Reviewer's Comments: (R.E.)
Conceptual design for a large F-T plant, hypothetical siting Illinois-Kentucky (size 250×10^6 scf gas and 50,000 bbl/day). Features of the design include:
1) Use of the Bi-Gas Coal Gasification system,
2) Production of diesel fuel rather than gasoline from the F-T process,
3) A sulfur removal process using first a Claus unit (95% S removal), then a tail gas treating unit (Beavon), which yields a gas with 1 ppm H_2S.
4) The plant would produce its own power and yield up to 140 MW of marketable power.

It is very unlikely that this particular design would be used in Montana. However, there is enough good data in this document that it should be used to compare any planned F-T plant for relative impacts.

Reviewer's Comments: (G.B.)
Most of this document addresses and describes the Fischer-Tropsch process and not the environmental considerations. However, the few pages on environmental factors indicate significant levels of CO_2 may be emitted. No criteria pollutant emissions will exceed existing state or federal standards (CO, particulates, CO, NO_x, H_2S, HCN, etc.) according to one useful emissions table.

Reviewer's Comments: (C.K.)
Contains small amount of information on types of solid wastes generated by the Fischer-Tropsch process and possible environmental problems associated with their disposal. Generally a superficial treatment of the problem.

190 (Continued)

Abstract:

A conceptual design and economic evaluation has been completed for a project to design, engineer, procure, construct, start up, and operate an industrial complex which will mine high-sulfur coal and convert it to a nil sulfur product mix using Fischer-Tropsch technology. The objective was that the complex should be responsive to future U.S. energy requirements and be competitive with alternate energy sources. The results are summarized in this report.

The design basis was developed in cooperation with representatives of ERDA and the work was done with their guidance and support.

As conceived, the complex is located in the Eastern Region of the U.S. Interior Coal Province, which includes portions of Illinois, Indiana and Kentucky. It will mine approximately 40,000 TPD of run-of-mine (ROM) coal from which it will produce about 30,000 TPD of clean, sized coal as feed to the Fischer-Tropsch plant.' Here the coal will be gasified, the gases purified, and then reacted to produce liquid products plus substitute natural gas (SNG). The products will be separated and refined ready for sale. Plant products will have an energy value of approximately 525 billion Btu/day, which is about twice the energy value of commercial coal gasification plants planned for construction in the U.S. The plant will consist of two production lines. The plant is designed to meet environmental standards. It should be noted that the design is one of many that can be developed using Fischer-Tropsch technology.

Products from the plant include about 260 MMSCFD of SNG and approximately 50,000 BPD of liquid products. The liquids consist of LPGs, light and heavy naphthas, diesel fuel, fuel oil, and oxygenates (consisting primarily of alcohols). All petroleum liquids produced contain nil sulfur, nitrogen and particulate matter and can be referred to as premium fuels.

Estimated time needed to design, procure, construct and start up the facility is 37 months. The estimated fixed capital investment is approximately $1.5 billion; all economics have been based on fourth quarter 1975 dollars. The total capital investment required is estimated to be about $1.75 billion. In addition to fixed capital requirements, this total includes the cost of initial raw materials, catalysts and chemicals, working capital, allowance for startup costs, and allowance for land acquisition. The cost of financing during design and construction depends on the method of financing, and was added to the $1.75 billion for the separate project cases reported.

The fixed capital investment estimate was independently evaluated by the U.S. Army Engineer Division, Huntsville, Alabama (USAEDH). This work was done under contract to ERDA, Contract No. EX-76-C-01-1759. The USAEDH estimate was approximately 10% lower than Parsons, and they report an indicated overall estimate confidence factor of ±10%.

Annual operating costs for the complex are predicted to be about $190 million. Plant population is approximately 2100 people.

Predicted required product selling prices, expressed as dollars per million Btu, for a 12% DCF rate of return and a twenty-year project operating life are:

FINANCING METHOD		
100% Equity	$\frac{\text{Debt}}{\text{Equity}}$ Ratio = 65/35	Break-Even
3.25	2.50	1.45

These values correspond to about $14.80 and $19.40 per barrel equivalent for the 65/35 Debt/Equity (D/E) ratio and 100% equity cases, respectively, based on a heating value of 6 million Btu per barrel. Full details of the economic analysis, including complete sensitivity analyses, are presented.

PROCESS AND PLANT FACTORS

Key characteristics of the complex include:

- Large captive coal mine.
- Use of high capacity gasifiers - each gasifier vessel projected to produce 250+ million Btu/day of energy products.
- Fischer-Tropsch converter design that permits high throughput and recovery of reaction heat at 1,200 pound per square inch steam.
- Design for high thermal efficiency. Predicted thermal efficiency is approximately 70%, expressed as Btu's in salable products divided by Btu's in feed coal, times 100. Predicted efficiency is the result of considerable technical and economic analysis of alternates. Results of these analyses are reported.

The Fischer-Tropsch converter design is based on application of flame-sprayed catalyst (FSC) techniques which have been demonstrated experimentally by what is now the Pittsburgh Energy Research Center (PERC) of ERDA. Similar reactor designs were used for the shift and methanation reaction sections. This type of reactor is projected to provide efficient recovery of reaction heat as steam at a pressure of 1,200 pounds per square inch. As a result, all steam required to operate the plant, produce the necessary captive power requirements, and also produce excess power for sale is generated in the process sections;

a fuel-fired utility plant is not required for normal operation. All utilities are internally generated, i.e., feeds to the process plant consist of coal, air, and water.

This design is intended to aid in defining the potential for large, second-generation coal conversion plants. It incorporates a number of concepts and equipment items that careful analyses indicate have potential advantages and good probability for high performance. A number of these items is based on commercialization of expected favorable results of an in-progress development program. Key developments required and recommendations for continued development are presented. Comments regarding projected plant performance are presented.

The products, having nil sulfur, nitrogen, and particulate matter, represent premium grade fuels from an environmental standpoint. They also have characteristics which make them attractive as potential feedstocks for high value petrochemical and chemical manufacture.

Details of the design, operating efficiencies, and economic projections are presented in this report.

191

U.S. Energy Research and Development Administration
Fossil Energy Research and Development Program of the U.S. Department of Energy, DOE/ET-0013(78), Washington, D.C., GPO, 475 pages, February 1979.

Availability: R. Gold

Purpose/Topic:
Impact Overview

Not Relevant

Reviewer's Comments: (J.M.)
Report outlines the basic goals and objectives of the National Energy Plan and how it relates to various fossil energy technologies. Three pages of the 470-page document deal with environmental and socioeconomic implications of fossil energy development. That section outlines NEPA requirements for each Environmental Development Plan (EDP) and reiterates fossil energy's commitment to deal with socioeconomic impacts of development in pre- and post-planning phases.

Abstract:
Major research activities investigating national fossil fuel resources and reserves and the technologies involved in their use are reported. Individual sections in the document address coal, oil and gas. Included in the sections are the following: an overview of the resource; the research, development and demonstration of mines; enhanced oil and gas recovery; coal liquefaction; coal gasification; heat engines and heat recovery; combustion systems; fuel cells; advanced environmental control technology; advanced research and supporting technology; magnetohydrodynamics; oil and gas from oil shale--drilling and off shore technology; and capital acquisition. The support of energy research centers and national laboratories in research is discussed, along with university research activities and international programs. A four-page discussion of environmental and socioeconomic implications notes the government's goal of insuring the environmental acceptability of fossil energy technologies.

U.S. Energy Research and Development Administration
A Framework for Detailed Site-Specific Studies of Local Socio-economic Impacts from Energy Development, Draft, by T.E. Baldwin, et al., Argonne, Illinois, Argonne National Laboratory, 20 pages, December 1976.

Availability: R. Gold

Purpose/Topic:

Impact Overview	Useful
Preparing for and Handling Impacts	Useful

Reviewer's Comments: (K.E.)

Although the report considers itself as representing "detailed assessment," its framework is based on theoretical and research approaches limited in the treatment of social phenomenon. Integrated studies of local socioeconomic impact and interdisciplinary research combining analysis of fiscal; sociocultural and institutional changes represent the approach developed at the ANL. The approach builds on Gilmore's theory "that the interdependencies between labor supply, public capital, and the availability of goods and services circumscribe the most important spheres of socioeconomic impact: 1) industrial productivity, 2) the delivery of local services, and 3) quality of life." (p. 2) This social meaning of quality of life is not treated; the concept is viewed in its relationship to the ability of public services to cope with growth.

The seven major analyses that the report regards as contributing to a "detailed assessment" of socioeconomic impact reflect the incomplete approach of the framework to social concerns (and methodology): 1) employment-based projections of population growth; 2) demographic analysis of anticipated population composition; 3) attitudinal analysis of population-specific preferences for housing, public services, and residence-to-work commuting patterns; 4) application of a simulation model that allocates population growth to local communities based on preferences for and availability of housing, public services, and access to employment opportunities; 5) analysis of net revenue/expenditure balance associated with anticipated levels of population growth; 6) analysis of administrative capacities and governmental response; and 7) comparative studies of impacted communities. The limited input of residents in the case study of the coal gasification project in Mercer County, North Dakota, exemplifies the weakness in the framework. A survey requesting respondents to rate 13 given quality-of-life indicators (by noting their satisfaction with the delivery of public services, with the personal situation, with existing local business conditions, and with social change) represented the attempt to obtain attitudes.

The strength of the framework, which could be significant to persons involved in synfuel development is the advantage of a site-specific case study approach in suggesting policies that could be implemented to mitigate impacts. It should be remembered,

192 (Continued)

Reviewer's Comments: (K.E.) continued
however, that the impacts which are considered and which could be mitigated do not include all the possibilities of socio-economic impacts.

Abstract:
This report describes an analytical approach which can be used to assess the impacts of energy development in site-specific situations and prepare recommendations for the mitigation of these impacts. The framework presented enables the user to forecast annual changes in the magnitude and composition of employment and population of the impact area and then evaluate the effects of these changes on the provision of needed services and local quality of life. The framework has been applied to the case of a single coal gasification facility in Mercer County, North Dakota. Study results are summarized to illustrate the nature of the analysis, the types of conclusions, and the variety of mitigating strategies obtainable from use of this framework.

U.S. Energy Research and Development Administration
Framework for Projecting Employment and Population Changes Accompanying Energy Development: Phase I Draft, by E.J. Stenehjem, and J.E. Metzger, Argonne, Illinois, Argonne National Laboratory, 206 pages, August 1976.

Availability: R. Gold

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)

A full range of socioeconomic impacts is not assessed in this report, which focuses upon changes in employment and population. The report considers that the rate and magnitude of these changes represents determinants of future local social and economic impacts. It stresses the interrelationship among employment requirements of energy industry, population growth, and changes in local quality of life. Quality of life, however, is defined in terms of public service infrastructures, i.e., the failure of these infrastructures to keep up with the expansion of demands leads to the decline of quality of life. Social concerns in assessing quality of life, employment and population changes are not considered: demographic figures and an economic analysis of employment are the components of this study.

Methodology is concerned with quantitative analyses to forecast the rate and magnitude of expected growth. Included are a set of quantitative estimates and estimating procedures used to project changes in employment and population. From data obtained from institutional studies, estimates of industry, and environmental statements, the number of employees required in a development's construction and operation is determined. With these numbers and using employment multipliers, the number of secondary positions is forecast. A lag model is also included in the analyses to assist in the determination of time required for the projected increases in secondary employment to become manifest. These changes are examined by county, although groups of counties which are relatively the same size and within geographically similar areas are also used as observation units in a multiple regression analysis. A final set of planning factors assists in making population impact projections by a simple demographic model, from the base period (1970) and using census data and other secondary sources. By estimating the number of jobs unfilled by local workers, which can be filled by in-migrants, and using household factors for each county population changes are projected.

The report is useful to government officials and energy planners who need to project changes in employment and population statistically. Its breakdown of estimates by the type of energy development, i.e., coal liquefaction and gasification, and use of individual counties as observational units (while allowing

Reviewer's Comments: (K.E.) continued
for analysis on a multi-county basis) is helpful to the planner with a focused area of concern. A problem with county projections, however, is that a site for a development may occur in one county while the population center for the workers is in another. Since synfuel development could encompass a wide area in Eastern Montana, the multi-county assessment would prove useful. However, the limited treatment of impacts due to the report's focus should be emphasized: the social meaning of the projected changes is lacking.

Abstract:
This report provides a framework to estimate the size and timing of population and employment changes associated with energy development. The direct employment requirements for eight different technologies (oil shale conversion, coal gasification, coal liquefaction, coal-fired electric generating plants, nuclear power plants, geothermal facilities, strip-mining and underground mining development, off shore oil and gas development, with on shore support) are listed. This direct employment requirement can be combined with the set of employment multipliers and other information provided therein to obtain practical estimates of the employment and population impacts consequent to new energy development. Some explanation is given for the variation of the multipliers between counties in the same region. A demographic model is described to derive the annual population changes that can be expected as a result of in-migrating workers and their families. Several hypothetical examples of the procedure for making the calculations are discussed as practical exercises in using the multiplier. The necessary data are provided for obtaining estimates of population and employment changes in any county in the United States.

U.S. Energy Research and Development Administration
"Ground-water Quality Effects of an Underground Coal Gasification Experiment," by S.W. Mean, et al., in Annual Underground Coal Conversion Symposium (Fallen Leaf Lake, California), ERDA/520200, CONF-770652-8, Springfield, Virginia, NTIS, 15 pages, June 6, 1977.

Availability: Abstract only

Purpose/Topic:
Groundwater Contamination from In-Situ Coal Gasification — Useful

Reviewer's Comments: (N.Z.)
The report indicates groundwater in the vicinity of an in-situ coal gasification project is contaminated within a limited area surrounding the site. More work is required to determine the long term effects of in-situ gasification in contaminating groundwaters.

Abstract:
Abstract: Ground-water sampling and analysis have been carried out at the site of an in situ coal gasification experiment conducted by the Lawrence Livermore Laboratory (LLL) near Gillette, Wyoming. An important environmental question associated with the in situ gasification of coal concerns the possibility that reaction products (ash and tars) left underground following the gasification process may lead to the contamination of local ground waters. In an effort to clarify the significance of this problem, the water from more than 12 wells in the vicinity of an underground gasification experiment before, during, and up to 6 months following gasification was sampled. Water samples were analyzed in the field and at LLL, U.S. Geological Survey, and Research Triangle Institute for a variety of characteristics, including the presence of 70 inorganic elements and compounds, phenolic materials, dissolved organic carbon, and volatile organics. A greatly increased concentration of phenolic materials (450 mg/l) just outside the burn boundary, and a variety of inorganic species issuing from within the residual ash bed were found. All contaminants decrease rapidly with distance, although above-background levels of some species were detected 100 ft from the burn zone. Several important contaminants showed a large decrease in concentration with time, possibly a result of adsorption. (ERA citation 03:009028)

U.S. Energy Research and Development Administration
The Management of Social and Economic Impacts Associated with the Construction of Large-Scale Projects: Experiences from the Western Coal Development Communities, by M.R. Greene and M.G. Curry, Battelle Pacific Northwest Laboratories, BNWL-RAP-16, UC-11, Springfield, Virginina, NTIS, 45 pages, June 1977.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
Specific impact assessments or techniques used are not discussed. The report is a summary of potential management tools and is organized as follows. Sections corresponding to "major" social and economic impacts experienced by rural communities surrounding an energy development are presented. Each section contains a brief introductory description of the types of problems "typically" associated with the impact sector, and a discussion of management strategies either proposed or implemented for the impact. The management strategies are presented in tabular form, indicating the level of government responsible for implementation. The treatment of impacts considers: community cohesion and social structure; the education system; housing; police and fire services; social and health services; recreation; transportation; utilities; planning and growth management; and funding problems and needs. The report serves only to introduce the general issues in impact management. A more comprehensive analysis of management, in which a conceptual framework is proposed, is required.

The paper includes local and state strategies and, thereby, could be useful to city/county and state planners. Its brief treatment of impacts and assumptions that those impacts presented are "major" or "typically associated" should be evaluated prior to the attempt to apply a planner's problem to the outline of impacts and strategies. Then, too, the approach singling out an impact fails to take into account the inter-relatedness of impacts.

Abstract:
This paper addresses the question of impact management and discusses management strategies proposed or used for social and economic impacts associated with coal development communities in the West. A list, based on a literature review and analysis, of the strategies most commonly recommended or implemented in this area was compiled. An introductory analysis to the following issues raised by social and economic impact management is provided: planning and management capabilities; community acceptance of planning; and adequate funding.

U.S. Energy Research and Development Administration
Manual of Methods: Preservation and Analysis of Coal Gasification Wastewaters, ERDA/010404, by R.G. Luthy, Carnegie-Mellon University, Springfield, Virginia, NTIS, 53 pages, July 1977.

Availability: Abstract only

Purpose/Topic:
Methods for Analyzing Coal Conversion Wastewaters — Significant

Reviewer's Comments: (N.Z.)
An important aspect of controlling potential water pollution from coal conversion plants is the establishment of an efficient and accurate method for monitoring waters around the site. This report would probably be useful only to someone designing a monitoring program.

Abstract:
Abstract: One facet of a program for environmental assessment in the ERDA high BTU coal gasification program has been the development of a cost effective strategy for characterizing the composition of coal gasification wastewaters. Three factors have been identified as influencing the development of acceptable sampling and analytical methods: (1) The presence of temporal variations in stream constitution and composition. (2) The effect of sample handling and preservation techniques prior to analysis, particularly the influence of sample degradation before analysis. (3) The choice of analytical methods for wastewater analysis. Studies on the nature and extent of fluctuations in wastewater streams with time and their effect on specification of an optimal stream sampling strategy are reported elsewhere. Preliminary screening studies on the adequacy of conventional wastewater preservation and analytical techniques are also reported elsewhere; however, results clearly indicate a need for validation of a set of modified procedures which are responsive to the particular complexities of coal gasification wastewaters. With the cooperation and assistance of the other environmental assessment contractors in the program, C-MU has developed and tested a modified set of preservation and analysis procedures for 23 priority coal gasification wastewater parameters. (ERA citation 04:028740)

U.S. Energy Research and Development Administration
"Preliminary Laboratory and Modeling Studies on the Environmental Impact of In-Situ Coal Gasification," by J.H. Campbell and H. Washington, in Underground Coal Gasification Symposium (Morgantown, West Virginia), ERDA/010900, CONF-7608 17-2, Springfield, Virginia, NTIS, 23 pages, July 22, 1976.

Availability: Abstract only

Purpose/Topic:
Contamination of Groundwater by In-Situ Gasification — Useful

Reviewer's Comments: (N.Z.)
Leaching of contaminants into the groundwater occurs from in-situ gasification. The report indicates which components are most likely to be leached from the coal and concludes that un-gasified coal actually retards dispersion of pollutants.

Abstract:
Abstract: A preliminary laboratory and modeling study on the environmental impact of ''in-situ'' coal gasification field testing is reported. Experiments were conducted on the aspects of ground water pollution; water leaching, transport, and dispersion of pollutants. The major inorganic contaminants leached from the coal ash were determined to be Al exp +3 , Ca exp +2 , and OH exp - , while the principal organic pollutants were found to be phenols. A simple calculational model is used to predict the movement of the polluted ground-water. This model inputs information from laboratory experiments for the rate at which the above pollutants are removed from the gasification zone and the degree with which they are sorbed by the surrounding coal. It was discovered that ungasified coal has a strong beneficial effect on retarding the dispersion of the pollutants. The problem of air pollution resulting from the flaring of the production gas was also examined. The extent of the air pollution plume that develops from this flaring is predicted using a simple computer model. These predictions have been carried out for a set of atmospheric and flare operating conditions that may be encountered during field tests. It was determined that the LLL field experiments will adequately meet air quality standards, even under adverse conditions. (ERA citation 02:000070)

U.S. Energy Research and Development Administration
Safety Assurance Study of High BTU Coal Gasification Pilot Plants, Interim Report, FE-2240-8, by A.L. Wilson, C.F. Braun and Co., Springfield, Virginia, NTIS, 209 pages, August 1976.

Availability: Environmental Library

Purpose/Topic:

Air	Not Useful
Health	Marginally Useful

Reviewer's Comments: (G.B.)
The safety study was oriented towards discovering safety hazards associated with the technology processes of pilot plants as opposed to hazards associated with waste streams directly. Hazard discoveries and recommended corrections at two Hygas pilot plants consisted of a) preventing corrosion of a coal dryer shell, b) controlling temperatures of gasifiers, c) preventing possible explosions, and d) properly venting waste gases to avoid health/fire hazards. The document is not that relevant to currently identified environmental or health problems or commercial-scale operations. Other pilot plants investigated included CO_2-Acceptor, Synthane and a Bi-gas plant.

Abstract:

Plants that convert coal into pipeline gas contain new large size equipment and processes which are unproven commercially. Concern about operating safety has led to this study.

The purpose of this study was to investigate the pilot plant gasifiers to uncover operating conditions or equipment deficiencies that might lead to potential hazards.

A hazard was defined as any process-related event or condition having a significant potential for causing serious injury or major damage.

A systems analysis technique employing fault tree logic revealed certain potentially hazardous events existing in the plants.

These events were brought to the attention of the pilot plant operating contractors. Suitable actions were then taken by the operating contractors to eliminate, minimize, or mitigate these events.

This report gives details of the investigation leading to discovery of these events, and the actions taken - or planned - which will satisfactorily mitigate these potential hazards.

U.S. Energy Research and Development Administration
Synthetic Liquid Fuels Development: Assessment of Critical Factors, Summary, ERDA 76-129/1, Washington, D.C., GPO, 110 pages, May 1977.

Availability: Environmental Library

Purpose/Topic:

Impact Overview	Significant
Water Quantities Required	Very General
Water Effluent Quality	Very General
Water Treatment Technologies	Very General

Reviewer's Comments: (K.E.)
The social consequences of two scenarios, i.e., maximum credible implementation and constrained growth, are summarized. The occurrence of boom town situation is assessed; rapid and sustained population growth in currently rural communities is projected, along with deficiencies in public services and losses of social amenities and sense of community. These deficiencies are considered as resulting in social problems of high divorce rates, alcoholism, high worker absenteeism and reduced worker productivity. Lifestyle alterations from rural to urban-industrial are forecast, as well as value conflicts between longtime residents and newcomers. Terming the social consequences as beneficial or adverse is viewed as a matter of opinion. Mitigation of this critical factor of boom towns is treated briefly. The aversion of tax lag phenomenon (responsible for adverse quality of life) can be accomplished with federal provision of "front" money.

Since this volume deals only with content of the research, its methodology cannot be reviewed here. Considerations aside from the more quantitative socioeconomic impacts of population and employment are evident (i.e., note mention of sense of community, value conflicts, rural way of life). However, too much emphasis may be placed on quantitative measures, i.e., by relating quality of life to taxes.

This summary document would be helpful to those individuals interested in an overview of critical factors, i.e., social consequences, of synfuel development. Montana is considered in the report as an area potential for synfuel development.

Reviewer's Comments: (N.Z.)
There is very little detailed information regarding water quantities required for water quality and this information can be obtained from more recent reports. This report is not worth reading for information pertaining to water and synthetic fuel production.

Abstract:
This study assesses the impacts of the development of synthetic liquid fuels from coal and oil shale; the fuels considered are

199 (Continued)

Abstract: continued
synthetic crude oils from coal and oil shale and methanol from coal. Key issues examined in detail are the technology and all of its resource requirements, net energy analyses of the technological options, a maximum credible implementation schedule, legal mechanisms for access to coal and oil shale resources, financing of a synthetic liquid fuels industry, decision-making in the petroleum industry, government incentive policies, local and national economic impacts, environmental effects of stripmining, urbanization of rural areas, air pollution control, water resources and their availability and population growth and boom town effects in previously rural areas. The report encompasses four volumes; this volume consists of an executive summary and a synopsis. Intervolume reference is provided.

199 (Continued)

U.S. Energy Research and Development Administration
Synthetic Liquid Fuels Development: Assessment of Critical Factors, Summary. (Continued)

Purpose/Topic:
General Economic Impacts Not Relevant

Reviewer's Comments: (T.S.)
One of the first major technology assessments of synthetic liquid fuels, this study takes a broad national perspective. Critical factors to the growth of a large U.S. synfuel industry are identified as: industrial decisions to deploy the technology; resource depletion; water availability; strip mine reclamation; air pollution control; and boom towns.

The technical data on coal liquefaction is based on state-of-the-art as of 1974. This fact, plus its lack of discussion of regional and local impacts, make it of limited use for the present assessment in Montana.

U.S. Energy Research and Development Administration
Synthetic Liquid Fuels Development: Assessment of Critical Factors, Analysis, ERDA 76-129/2, Washington, D.C., GPO, 840 pages, May 1977.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Not Useful
Impact Overview	Significant

Reviewer's Comments: (G.B.)

Other volumes in this series do not pertain directly to Air Quality or Health Considerations. Within Volume II, the section on Air Pollution (Chapter 16, approximately 80 pages) is quite useful for obtaining emission and ambient air data based on modeling for H-Coal (also oil shale, methanol). (It is possible these data are now outdated.) Included are comparable data from SRC and SASOL plants. The information is treated fairly generally and only the criteria air pollutants are emphasized. Results of modeling show that syncrude plants which use the best available control technologies for SO_2, NO_x and particulates will essentially comply with all currently existing federal air regulations. (State regulations are not really addressed.)

The chapter on Health is so general that it is not very useful. The authors indicate that much more information is needed to assess health considerations. Since the report was completed in 1976, much more health data are now available.

Reviewer's Comments: (K.E.)

Chapters relevant to social critical factors of synfuel development are: 21, "The Impact of Industrial Growth on Rural Society"; 22, "Population Growth Constrained Synthetic Liquid Implementation Scenarios"; and 23, "Comparative Impacts of Controlled and Uncontrolled Urbanization." Miller's treatment of impacts in Chapter 21 involves local impacts and an analysis of the dynamics and economics of growth that would result from rapid energy development compatible with a "maximum credible" level of development. Also included is a look at controlled growth consistent with considerations of the interests of the various concerned parties. Interests of each group affected by decisions regarding energy development are examined, and the impact of development on each is assessed. Such an approach is considered a way of indicating the problems created for a region. (Groups included are: local government, state government, federal government, ranchers and farmers, workers and other residents, businessmen, new employees, and other newcomers, energy industrialists, environmentalists, and energy consumers.) Impacts assessed for these groups concern institutional capacity of local governments (housing, schools, roads, utilities, tax revenues), prices of ranchers' land, ranching way of life, employment for workers, retail sales of business people, housing and public services for newcomers, etc. The chapter concludes with sections relating the question of growth to economics

Reviewer's Comments: (K.E.) continued
and policy options (which sees policy options as means to address the boom-bust cycle of development but presents two options--1) EPA evaluation of land use on the basis of impact factors, i.e., institutional capacity of localities to absorb population growth, and 2) fiscal options). Secondary sources were used as bases for the chapter.

Walton's chapter describes the preparation of scenarios on this theme: limiting the impacts of synthetic fuels production by constraining population growth rate of a community. Several alternative scenarios are presented. Secondary sources were employed to explain the methodology and to provide data for the scenarios presented.

Chapter 23, authored by Miller, analyzes the effects on the urban growth process of varying plant sizes, construction schedules, and rates of population growth, and considers the implications of this analysis for increased energy development in Appalachia and Southern Illinois. Comparative impacts of two levels of growth on two specific areas, the Powder River Basin of Wyoming and the Piceance Basin of Colorado, are focused upon in the analysis. Population, housing, age distribution and schools, and public expenditures are the impacts considered for the maximum credible level of synthetic fuel production. A 5% annual growth rate represents the second level of growth. Secondary sources were again utilized.

The three chapters emphasize quantitative measures of socioeconomic impacts, often demographic and economic concerns. Brief mention, with little expansion, is made of the impact of a way of life for ranchers. The document has limited application, serving those planners interested in population projections and rates of growth. The consideration of levels of development, however, represent a strength in the analyses.

Abstract:
The feasibility of alternative automobile fuels production is determined in a context which includes environmental, societal, and institutional ramifications of synthetic fuels development. Two futures were considered: a future of stepped-up domestic oil production and imports, and a future of major deployment of synfuel technology. A scenario of the maximum possible rate of deployment was prepared. Critical impacts that might decide the question of deployment, prove intolerable unless mitigated, or prove not to be amenable to mitigation, are identified, along with the government policies that might lessen or avoid adverse impacts or enhance deployment prospects of synthetic fuels capability. Criteria on which to base comparison of alternative synthetic fuels options are developed. This volume represents the complete analyses of the study and is comprised of 23 chapters addressing the technology, requirements, potential production, and the legal, financial, economic, political, environmental, and social ramifications of synthetic fuel development.

201

U.S. Energy Research and Development Administration
Synthetic Liquid Fuels Development: Assessment of Critical Factors, Regionalized Industry, Social Impact and Coal Resource Depletion, ERDA 76-129/3, Washington, D.C., GPO, 250 pages, May 1977.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Significant

Reviewer's Comments: (K.E.)
The chapter on the boom-bust cycle discusses: boom-inducing industries (resource dependence, intense construction period); the boom-town process; Gillette (Campbell County), Wyoming, as exemplifying a boom town; growth impacts of the minemouth scenario for the synthetic fuels industry; and redistributing industry to reduce impacts. Demographic, economic, land use, social service, political-administrative, and attitudinal characteristics of a community are considered factors critical to determining the local impacts of a large-scale development. These impacts are discussed in terms of their implications for site suitability. The presentations concerning Gillette, Wyoming, describes in a general manner the following impacts, prevalent in the county: tight housing market; need for new waste water treatment facilities; increases in public agency responsibilities; health care shortages; shortages in retail goods and services; changes in the social and cultural character of the community; aesthetic blight and uncontrolled sprawl; and an inequitably high burden on portions of the pre-boom population which do not participate in economic benefits of growth.
Socio-economic impact, although part of the analysis of this report to understand the regional and resource base implications of high coal use, is not dealt with in depth. Problems of the boom towns are not considered per se, but, together with the issue of depletion of coal resource, are included in the analysis of policy questions (such as conversion plant location).

Abstract:
The depletion rate of coal resources in a coal-based energy future and the problem of regional boom-bust cycles associated with intensified coal production and conversion are the issues examined in this report. A computerized coal depletion model and three plant location scenarios are used. The Coal Resource Depletion Model inventories the coal resource on a regional basis (eight regions, including Montana) and derives the quantities of coal extractable at different costs by three technologies--strip and underground mining, and in-situ combustion. The coal demand scenario (extending from 1975 to 2050) is examined in three variations that differ primarily in location of synfuel plants--minemouth, dispersed, and limited minemouth scenarios. Under the minemouth scenario, the coal mine shows a boom-bust cycle for Wyoming,

201 (Continued)

Abstract: continued
Montana and North Dakota. Included are significant local and regional costs stemming from the social disruption of boom-town-style of rapid urbanization followed by rapid economic decline. In the dispersed scenario boom-bust impacts are reduced, but synfuel costs are raised. Limited minemouth conversion offers mid-ground fuel cost and avoids the boom-bust cycler.

202

U.S. Energy Research and Development Administration
Synthetic Liquid Fuels Development: Assessment of Critical Factors, Energy/Economic Comparison of Coal-Based Automotive Energy Supply Systems, ERDA 76-129/4, Washington, D.C., GPO, 110 pages, May 1977.

Availability: Environmental Library

Purpose/Topic:
Impact Overview

Not Relevant

Reviewer's Comments:
None

Abstract:
An additional factor in the assessment of synthetic liquid fuels development--the analysis of energy resources required to produce and deliver useful forms of energy--is provided in this volume. The study objective was to compare choices that result from a traditional economic analysis of energy supply systems with those obtained from an energy analysis to see if similar or divergent options emerge. The comparison was focused on energy supply systems that could provide automotive energy. Six coal-based energy forms--gasoline refined from synthetic crude oil, methanol, gasoline produced by Fischer-Tropsch synthesis, liquid hydrogen, liquid methane, and electricity--were analyzed in terms of cost and energy consumption. A range of costs representing the effects of varying coal types, conversion plant locations, and market locations was determined for each energy supply option.

203

U.S. Environmental Protection Agency
Action Handbook: Growth Management for Small Communities; Case Study: Sheridan, Wyoming, Boulder, Colorado: Briscoe Maphic Murray and Lamont Inc., 51 pages + appendices, June 1977.

Availability: Environmental Library

Purpose/Topic:
Impact Overview — Useful

Reviewer's Comments:
None

Abstract:
Major impacts facing the city of Sheridan, its neighboring communities, and the rural areas in Sheridan County, the area's preparedness, and necessary responses to impacts are the subject of this study. Suggestions and recommendations pertaining to management processes, programming and budgeting procedures are made, along with liberal references to EPA's Action Handbook (see title). The major emphasis in this case study is on the citizen involvement aspect. The report evaluates the current setting of the community (its problems, current capabilities, and opportunities for managing new growth).

204

U.S. Environmental Protection Agency
"Applicability of Coke Plant Water Treatment Technology to Coal Gasification," by W.A. Parsons and W. Nolde, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, III, EPA-600/7-78-063, Springfield, Virginia, NTIS, pgs. 519-527, April 1978.

Availability: Montana State University Library

Purpose/Topic:
Biodegradability of Organics in Synfuel Wastewater — Useful

Reviewer's Comments: (N.Z.)
This report describes processes in treating coke plant water and relates them to treating synthetic fuel plant wastes. The authors conclude that activated sludge processes, which are commonly employed for wastewater treatment at modern coke plants, would be equally useful in the synfuels industry. By applying existing technology from another industry, much time can be saved in the development stage. This article would be of interest to someone studying biological treatment specifically. Information is general but the authors indicate the direction needed to apply biodegradation technology of the coke industry to the synfuels industry.

205

U.S. Environmental Protection Agency
Assessment of Energy Resource Development Impact on Water Quality: The Tongue and Powder River Basins, EPA-600/7-79-249, by B.C. Hess and R.W. Thomas, Springfield, Virginia, NTIS, 197 pages, December 1979.

Availability: University of Montana Library

Purpose/Topic:

Water Use/Synfuel Development	Useful
Water Availability and Quality in Montana	Significant
Recommended Water Monitoring to Determine Impacts of Energy Development	Significant

Reviewer's Comments: (N.Z.)
This report is very good in its description of the quantity and quality of water available in the study region. There is an excellent section on recommended water quality monitoring parameters needed to assess the impact of energy development in the study area. The report does not contain substantial information specific to synfuel plants but is directed more toward energy development in general. The report is unique in its detail of water use with energy for Montana. The report describes a monitoring system consisting of 21 stations throughout the area and presents baseline data of existing water quality.

206

U.S. Environmental Protection Agency
Bibliography of the Interagency Energy/Environment R&D Program EPA-600/9-79-015, by F.S. Jacoff, Ed., Springfield, Virginia, NTIS, 330 pages, August 1979.

Availability: Civil Engineering, Montana State University

Purpose/Topic:

Lists of Government Documents on Synthetic Fuel	Significant

Reviewer's Comments: (N.Z.)
This bibliography lists publications resulting from research and development performed under the Interagency Energy/Environment Research and Development Program which is comprised of more than a dozen federal agencies and departments and is coordinated by the Office of Energy, Minerals and Industry within EPA's Office of Research and Development. A good source of publications with a short abstract on each one.

U.S. Environmental Protection Agency
"Chemical Analysis and Leaching of Coal Conversion Solid Wastes," by R.A. Griffin, et al., in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 521-530, September 1979.

Availability: Environmental Library

Purpose/Topic:

Chemical Constituents of Leachates	Significant
Solubility of Chemicals	Significant
Trace Metals	Significant

Reviewer's Comments: (R.E.)
One of the ash samples studied was Rosebud coal from the Lurgi facility in Scotland (R.E. attempted to get such a sample for such a purpose in 1976 but was too late).
The paper does not give much data on the Montana coal sample (though it must exist) but does conclude or show that:

1) "...removal of trace metals such as Cd, Co, Cr, Cn, Ni, Pb, and Zn from slurry pond leachates may be controlled by adsorption on or coprecipitation with iron, magnesium and aluminum oxides and hydroxides."
2) B, Ca, Cd, F, K, Mo, NH_4, Pb, SO_4 and Sb are leached from Rosebud gasification ash.

Reviewer's Comments: (N.Z.)
Good report on how solubility, pH, chemical complexation, etc., can affect quantity and quality of leachates. An equilibrium solubility model is attempted which gives good insight to the complexities of such a model. The data from this study strongly suggest that removal of trace metals such as Cd, Co, Cr, Cu, Ni, Pb, and Zn from slurry pond leachates may be controlled by adsorption on, or coprecipitation with, iron, manganese and aluminum oxides and hydroxides. This type of information is extremely important in understanding the potential pollution of water from solid wastes and in determining the requirements necessary for preventing leaching.

Abstract:

Five solid wastes from coal conversion processes were characterized chemically and mineralogically. The wastes included three Lurgi gasification ashes and mineral residues from the SRC-I and H-Coal liquefaction processes. Chemical analyses of the solid wastes were performed for 60 constituents. Mineralogical characterization of the solid wastes was carried out using X-ray diffraction, Mössbauer spectroscopy, scanning electron microscopy, and optical techniques.

Leachates generated from the solid wastes at eight pH levels and under two different gas atmospheres were analyzed for over 40 chemical constituents. Thermodynamic speciation of inorganic ions and complexes in solution were modeled. There were 115 aqueous species considered in the model, and saturation data were computed for over 100 minerals.

Results of the mineralogical characterization and leachate analyses showed a wide range in constituent concentration and in the minerals present in the solid wastes. However, thermochemical modeling demonstrated that similar mineral phases controlled the aqueous solubility of the major ionic species for all five solid wastes.

U.S. Environmental Protection Agency
Coal Conversion Control Technology Volume I. Environmental Regulations; Liquid Effluents, EPA-600/7-79-228a, by L.E. Bostwick, et al., Pullman Kellogg, Springfield, Virginia, NTIS, 538 pages, October 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Fairly Useful
Health	Useful

Reviewer's Comments: (G.B.)
This report is basically preliminary in that much of the environmental analysis (emissions, hazards, etc.) is based on estimations as opposed to quantifications. Large data gaps are apparent and much more comprehensive sampling/monitoring air and health programs are advised. Useful portions of the report include reference to existing regulations for air quality (ambient and emission) and recommended control technologies for meeting those standards. Non-regulated pollutants are not fully addressed. Most of Volume I covers water pollution/control technology issues.

Abstract:

This volume is the product of an information-gathering effort relating to coal conversion process streams. Available and developing control technology has been evaluated in view of the requirements of present and proposed federal, state, regional, and international environmental standards. The study indicates that it appears possible to evolve technology to reduce each component of each process stream to an environmentally acceptable level. It also indicates that such an approach would be costly and difficult to execute. Because all coal conversion processes are net users of water, liquid effluents need be treated only for recycling within the process, thus achieving essentially zero discharge. With available technology, gaseous emissions can be controlled to meet present environmental standards, particulates can be controlled or eliminated, and disposal of solid wastes can be managed to avoid deleterious environmental effects. This volume (I) focuses on environmental regulations for gaseous, liquid, and solid wastes, and the control technology for liquid effluents.

U.S. Environmental Protection Agency
Coal Conversion Control Technology Volume II. Gaseous Emissions; Solid Wastes, Report No. EPA-600/7-79-228b, by L.E. Bostwick, et al., Pullman Kellogg, Springfield, Virginia, NTIS, 381 pages, October 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Not Directly Relevant
Solid Wastes	Significant

Reviewer's Comments: (G.B.)
This report is very useful as it contains Pullman Kellogg's recommended emission control systems for both air streams and solid wastes, emanating from a "typical" Lurgi and SRC II coal conversion plants. The first section (Chapter 9) of this volume contains a useful summary of the authors' findings. Other sections are more technical and describe the pollution control options and costs in detail. The report also contains a section on needs for additional data and research. This report may be best utilized after the reader has become familiar with the major air emission streams (composition and quantities) from other EPA reports on Lurgi or SRC II.

Reviewer's Comments: (C.K.)
Good basic discussion on all types of solid wastes generated during coal conversion processes. Several methods of control are considered for each waste along with their advantages and disadvantages. There is little data on what toxic elements are actually in the wastes, although information on how much waste (in TPD) will be generated is given. A large percentage of the study deals with the various types of liners that might be used in landfills. There are problems with all of them and the leachate must be collected from these lined landfills and treated. No mention is made of how many years the landfills will have to be monitored.

Reviewer's Comments: (R.E.)
This is by far the best document we have read comparing technologies for sulfur removal. It is best read after understanding those technologies, and several other documents describe those technologies adequately.
A must for DNRC.

209 (Continued)

Abstract:

This volume is the product of an information-gathering effort relating to coal conversion process streams. Available and developing control technology has been evaluated in view of the requirements of present and proposed federal, state, regional, and international environmental standards. The study indicates that it appears possible to evolve technology to reduce each component of each process stream to an environmentally acceptable level. It also indicates that such an approach would be costly and difficult to execute. Because all coal conversion processes are net users of water, liquid effluents need be treated only for recycling within the process, thus achieving essentially zero discharge. With available technology, gaseous emissions can be controlled to meet present environmental standards, particulates can be controlled or eliminated, and disposal of solid wastes can be managed to avoid deleterious environmental effects. This volume (II) deals with the control technology of gaseous emissions and solid wastes.

210

U.S. Environmental Protection Agency
Coal Conversion Control Technology Volume III. Economic Analysis; Appendix, Interagency Energy/Environment R&D Program Report, EPA-600/7-79-228c, by L.E. Bostwick, et al., Pullman Kellogg, Springfield, Virginia, NTIS, 376 pages, October 1979.

Availability: Environmental Library

Reviewer's Comments:
Received too late for comment.

211

U.S. Environmental Protection Agency
Coal Liquefaction Update, June 1980 (May 1980, April 1980, March 1980, February 1980, January 1980, December 1979, November 1979, October 1979, September 1979, August 1979), by Hittman Associates, Inc., Research Triangle Park, North Carolina, U.S. Environmental Protection Agency, 10 pages, June 1980.

Availability: Environmental Library

Purpose/Topic:

Technology Newsletter	Useful

Reviewer's Comments: (R.E.)
This newsletter, sponsored by EPA and compiled by Hittman, screens 42 references (e.g., Coal News, Oil & Gas Journal) that report on coal liquefaction. It's a very useful source of "news."

As a single example, the June 1980 issue reports (from May issues of Synfuels and Chemical Week) that DOE has received 48 proposals for feasibility study grants or cooperative agreements for liquefaction and 66 such proposals for coal gasification. They have only $\$100x10^6$ in feasibility study funds.

212

U.S. Environmental Protection Agency
"Composition and Biodegradability of Organics in Coal Conversion Wastewaters," by P.C. Singer, et al., in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, III, EPA-600/7-78-063, Springfield, Virginia, NTIS, pgs. 461-486, April 1978.

Availability: Montana State University Library

Purpose/Topic:

Biodegradability of Organics in Synfuel Waste Water	Significant

Reviewer's Comments: (N.Z.)
This report has substantial data and information pertaining to 1) the specific organic constituency of synthetic fuel plant wastewater, and 2) the requirements for treating such wastes biologically. The authors pool data from a number of sources (including measurements at Lurgi-Sassol) and summarize a list of the organic constituents in coal conversion wastewaters. The authors conclude with a list of requirements to further assess the viability of biological treatment:

1) A need for assessing the biodegradability of the constituent compounds.
2) A need for biokinetic information describing the rates of biodegradation.
3) A need for knowing the concentration levels at which microbial degradation of the constituents is inhibited.
4) A need for knowing how the constituents will behave in a composite mixture representative of coal conversion wastewaters.

U.S. Environmental Protection Agency
"Control Technologies for Particulate and Tar Emissions from Coal Converters," by K.M. Kennedy, L. Breitstein, and C. Chen, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 479-497, September 1979.

Availability: Environmental Library

Purpose/Topic:
Control Technology Assessment Significant

Reviewer's Comments: (R.E.)
This is the best paper on particulate control we've seen. Several tables and graphs from the paper are included in the appendix.
In particular, the authors show that:
1) Particulate loading is in the order (average figures) fixed bed 3.0 g/m^3; fluid bed 26.0 g/m^3, entrained bed 110.0 g/m^3.
2) On the other hand only fixed bed gasifiers have appreciable tar loading (18.0 g/m^3).
3) Note that the three gasifiers which have been suggested (at one time or another) for Montana include one in each category (Lurgi--fixed bed; Winkler--fluid bed; and K-T--entrained bed).
4) Rosebud coal yields considerably fewer small particles than does Illinois 6 with fixed bed gasifiers.
5) Data on tables clearly show that either Electrostatic Precipitation or baghouse filters are best for removing small (and large) particles. Electrostatic precipitators are said not to be applicable for fixed bed gasifiers because of the high carbon content (fabric filters wouldn't work either but this is of little concern for the Lurgi system since most of the tar ends up as waste water problem, not an air problem).
6) It is suggested that ceramic fabrics may be applicable for dealing with high temperature, high pressure gas streams.
7) The paper analyzes best controls for two situations--boiler fuel and gas turbines. Unfortunately, or fortunately, neither of these uses are likely in Montana.

Abstract:

Raw product gases from coal converters generally contain particulates and tars that must be controlled to a level compatible with environmental regulations and process and equipment requirements. Alternate control technologies for removing particulates and tars from product gases were identified and evaluated.

213 (Continued)

Particulate and tar emissions in raw product gases from several types of coal gasifiers were characterized in terms of their total quantities, chemical composition, and size distribution. The emissions data were organized and summarized according to generic gasifier type, with fixed-, fluid-, and entrained-bed gasifiers being considered. The design and operating features of each identified alternate control technology were described, with emphasis on characterizing collection efficiencies as a function of particle size and other important parameters. These data were also organized into generic categories such as cyclones, wet scrubbers, electrostatic precipitators, fabric filters, and granular bed filters.

The applicability of each of the identified control technologies was assessed with respect to the generic gasifier types and various end uses. These assessments were based on existing and proposed environmental regulations and process requirements for product gas purity. End uses considered include combined cycles and gas-fired boilers. The fate of the particulate and tar emissions from the various gasifiers was assessed in terms of their presence in the purified product gases, liquid effluents, and solid wastes or sludges. In addition, gaps in the data base required for these assessments were identified.

214

U.S. Environmental Protection Agency
<u>Emissions from Synthetic Fuels Production Facilities. Volume I. Executive Summary</u>, EPA-908/4-77-010a, by J.D. Colley, W. A. Gathman, and M.L. Owen, Radian Corporation, Springfield, Virginia, NTIS, 25 pgs., September, 1977.

Availability: Environmental Library

Reviewer's Comments:
Not received in time for review.

Abstract:
Abstract: This report was compiled to provide the Environmental Protection Agency with an assessment of multi-media pollutants from oil shale processing and coal gasification facilities. The report examines oil shale and coal extraction methods in addition to fuel conversion processes. Three oil shale conversion processes are considered: the TOSCO II, Paraho, and Union Oil processes. The Lurgi process is considered for coal gasification. Process descriptions and module definitions are presented for each operation. Potential air emissions, water effluents, and solid wastes are then identified and quantified for each module. Emissions of trace elements and organics are determined qualitatively. An assessment of resources required to support the production facilities is also included. The overall report is presented in two volumes. Volume I summarizes the objectives, the approach, and the results of the study. Volume II gives detailed descriptions of the methodology and the results.

215

U.S. Environmental Protection Agency
Emissions from Synthetic Fuel Production Facilities. Volume II. Report., EPA-908/4-77-010b, by J.D. Colley, W.A. Gatham, and M.L. Owen, Radian Corp., Springfield, Virginia, NTIS, 218 pages, September 1977.

Availability: Environmental Library

Purpose/Topic:

Water Pollution Technologies	Useful
Potential Problems with Water Pollution Technologies	Significant

Reviewer's Comments: (N.Z.)

This report has a particularly good section on potential problems with waste water treatment in a Lurgi gasification plant. The potential problem areas involve Phenosolvan effluent streams, the system blowdown streams, and the ash sluicing line. Minor Phenosolvan streams may be subject to calcium carbonate scaling, and biological fouling from organic constituents. Scaling also can be a problem in the brine evaporator and the ash sluicing line.

The authors also address the problems of siting synthetic fuel plants and a number of potential sites are analyzed. Criteria for analyzing a site are discussed.

Abstract:

Abstract: This report was compiled to provide the Environmental Protection Agency with an assessment of multi-media pollutants from oil shale processing and coal gasification facilities. The report examines oil shale and coal extraction processes in addition to fuel conversion methods. Three oil shale conversion processes are considered: the TOSCO II, Paraho, and Union Oil processes. The Lurgi process is considered for coal gasification. Process descriptions and module definitions are presented for each operation. Potential air emissions, water effluents, and solid wastes are then identified and quantified for each module. Emissions of trace elements and organics are determined qualitatively. An assessment of resources required to support the production facilities is also included. The overall report is presented in two volumes. Volume I summarizes the objectives, the approach, and the results of the study. Volume II gives detailed descriptions of the methodology and the results. (Portions of this document are not fully legible)

U.S. Environmental Protection Agency
Energy from the West - Policy Analysis Report - Interagency Energy/Environment R&D Program Report, EPA-600/7-79-083, by I. L. White, University of Oklahoma, Springfield, Virginia, NTIS, 826 pages, March 1979.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (J.M.)
This 800+-page document offers a good deal of information about prevailing problems with energy development in an eight-state area that includes Montana. Also mentions strategies states have used to alleviate some of them. The report was done by an interdisciplinary team whose task was to identify energy development alternatives to lessen impacts on communities and then to evaluate and compare those alternatives. Areas studied intensively were those thought to produce major potential interest and value conflicts, e.g., housing, transportation, land use, air and water quality, et al. Various management strategies are offered at the end for dealing with change. The emphasis appears to be on helping local and state governments shed their traditional reactive role to energy development and get involved at earliest possible stages. The report is too generalized to be very pertinent to Montana, although the information presented provides good background material for looking at impacts.

Abstract:
This is a report of the results of policy analyses conducted as a part of a three-year "Technology Assessment of Western Energy Resource Development." The study examines the development of six energy resources (coal, geothermal, natural gas, oil, oil shale and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming) during the period from the present to the year 2000. Previously published reports have described the analytical structure and conduct of the study and reported results of a preliminary analysis of the impacts that are likely to result when western energy resources are developed. This report relates those impacts to the social and political context within which this development is and will be taking place. Part I describes the national and regional context; Part II describes how the policy analyses were performed and reports the results of analyses of nine major problem and issue categories: Water Quality, Water Availability, Air Quality, Land Use, Housing, Planning and Growth Management, Capital Availability, Transportation, and Energy Facility Siting; and Part III identifies and discusses problems and issues which cut across either several or all of the separate problems and issues analyzed in Part II.

U.S. Environmental Protection Agency
Energy from the West: A Progress Report of a Technology Assessment of Western Energy Resource Development, 3 volumes, by I.L. White, et al., Washington, D.C.: U.S. Environmental Protection Agency, July 1977.

Availability: Environmental Library

Purpose/Topic:
National Policy Useful

Reviewer's Comments: (R.E.)
This lengthy (826 pages) volume is directed mainly towards questions of national rather than state policy. Although there is some data of interest (e.g., Table 6.1, p. 234, gives an overview of air emissions for standard-size energy facilities), the document has little pertinence to environmental impacts of the Synfuel industry.

Abstract:
This is a progress report of a three-year technology assessment of the development of six energy resources (coal, geothermal, natural gas, oil, oil shale, and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming) during the period from the present to the year 2000. Volume I describes the purpose and conduct of the study, summarizes the results of the analyses conducted during the first year, and outlines plans for the remainder of the project. In Volume II, more detailed analytical results are presented. Six chapters report on the analysis of the likely impacts of deploying typical energy resource development technologies at sites representative of the kinds of conditions likely to be encountered in the eight-state study area. A seventh chapter focuses on the impacts likely to occur if western energy resources are developed at three different levels from the present to the year 2000. The two chapters in Volume III describe the political and institutional context of policy making for western energy resource development and present a more detailed discussion of selected problems and issues. The fourth volume presents two appendices, on air quality modeling and energy transportion costs.

U.S. Environmental Protection Agency
Energy from the West: Summary Report, EPA-600/9-79-027, by I.L. White, et al., University of Oklahoma, Washington, D.C., GPO, 38 pages, August 1979.

Availability: Environmental Library

Purpose/Topic:

Impact Overview	Not Relevant

Reviewer's Comments: (J.M.)
This is a summary report of various energy development scenarios (including some mention of coal gasification) in a six-state region that includes Montana. The studies condensed in the summary were undertaken to identify the trade-offs among alternative energy technologies and impact mitigation measures. The summary treats all of these cursorily. Obviously, the summary needs to be read along with the previously published project reports in order for the information in it to be meaningful.

Abstract:
This report summarizes the results of a three-year Technology Assessment of Western Energy Resource Development, a study which examined the development of coal, geothermal, natural gas, oil, oil shale, and uranium resources in an eight-state area in the western United States (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming). The overall purposes of this study are to identify and analyze a broad range of consequences of energy resource development in the western United States and to evaluate and compare alternative courses of action dealing with the problems and issues raised by development of these resources. The summary should be read along with the other publications of the project in order for information in it to be meaningful.

Purpose/Topic:

Employment Estimates by Skill	Useful
Fuel and Material Impacts	Significant

Reviewer's Comments: (T.S.)
Offers little new analysis, but is a good summary of a few major technical reports dating from 1974-77. The authors advise caution with respect to using estimates on costs and manpower requirements, because of technological advances and inflation.
Most of the information used in the preliminary assessment's economic impacts section derived from the study's Energy Resource Development Systems Report, VII Coal.

U.S. Environmental Protection Agency
Engineering Evaluation of Control Technology for the H-Coal and Exxon Donor Solvent Processes, EPA-600/7-79-168, by K.R. Sarna and D.T. O'Leary, Dynalectron Corporation, Springfield, Virginia, NTIS, 122 pages, July 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment — Significant

Reviewer's Comments: (R.E.)
The significant assessments, briefly, for H-Coal:

1) Coal Handling and Particulate Control
   Basically deemed inadequate for reliability. It's suggested that alternatives should be used.
2) Tail Gas Cleanup
   Discharge of 100 ppm stream to either the atmosphere or to the boiler furnaces. Deemed adequate because known technologies can remove 99.7%. (In our minds, the question is not whether the technology is available, but whether it will be used.)
3) Waste Water Treatment
   An emerging technology. Obvious questions as to the fate of trace metals, PNAs and ground water contamination.
4) Solid Wastes
   These authors suggest that landfill disposal techniques, similar to those used for coal ash will be adequate for EDS.
   a) The present pilot plant simply ships all wastes next door for a large refinery to handle. Thus less data is available than for some other systems. In particular, there is no detailed mass balance for major unit processes within the plant.
   b) Because so little information is available on all emission sources, no real assessment could be made in this report.

Abstract:

The report gives results of an evaluation of the control technology of two coal liquefaction processes, H-Coal and Exxon Donor Solvent. The effluent streams were characterized and quantified for both processes and plants (pilot and conceptualized commercial). The gaseous-; liquid-, and solid-stream emissions were analyzed for their controllability, process complexity, and efficiency. Extrapolations to the larger commercial size were based partly on pilot plant data and (where such data was unavailable) engineering judgment. Several information gaps were encountered for liquid and solid effluent streams, especially as to composition. These deficiencies were pointed out and recommendations were outlined. Present control technology for the H-Coal process seems to be barely adequate: present designs are inadequate for zero discharge criteria. Control technology for the EDS process depends on being able to rely on the facilities of an adjacent refinery's controls: the scalability of present control technologies, especially in the case of the bag filter operation, is not confirmed.

U.S. Environmental Protection Agency
"Environmental and Engineering Evaluation of the Kosovo Coal Gasification Plant - Yugoslavia (Phase I)," by B. Salja, M. Mitrovic, and D. Petkovic, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 137-140, September 1979.

Availability: Environmental Library

Purpose/Topic:
Lurgi Air Quality/Pollution Control		Significant

Reviewer's Comments: (G.B.)
This report gives a detailed account of monitoring studies and results from this group's investigation and sampling in and around this Lurgi plant. In general, they found fairly extensive emissions of acid gases, particulates and volatile organics and inorganics. They identify sources and amounts. However, this plant would be significantly modified and improved if built in U.S. to meet our environmental standards (or so they say). Has many tables of data (36) on emissions.

U.S. Environmental Protection Agency
Environmental Assessment Data Base for Coal Liquefaction Technology: Volume I. Systems for 14 Liquefaction Processes, EPA-600/7-78-184a, by S.C. Koralek and S.S. Patel, Hittman Associates, Inc., Springfield, Virginia, NTIS, 118 pages, September 1978.

Availability: Environmental Library

Purpose/Topic:	
Air	Useful
Health	Useful
Technology Assessment - Liquefaction	Useful

Reviewer's Comments: (G.B.)
This volume contains useful summarial reviews of the major technologies and their histories for 14 promising liquefaction processes. The information in useful for understanding and evaluating the environmental impacts described in Volume II and in subsequent reports on liquefaction (i.e., standards of practice manual for SRC).

Reviewer's Comments: (R.E.)
Brief technical descriptions of 14 liquefaction systems (86 pages), with no critical analysis. There is also a 74-page section on system operations and auxiliary processes, and a brief section (10 pages) on environmental assessment requirements (abstracted elsewhere in this report).

The section on "operations and auxiliary equipment should prove most useful because few general compilations devote much time to these systems. No critical analysis of problems for these operations is given.

Perhaps the most significant generality about unit processes for liquefaction is that all processes involve gasifiers somewhere in the process and that all of the technical and environmental problems inherent in the gasification of coal exists for liquefaction technologies.

Abstract:

16. ABSTRACT The two-volume report, prepared as part of an overall environmental assessment (EA) program for the technology involved in the conversion of coal to clean liquid fuels, and the Standards of Practice Manual for the Solvent Refined Coal Liquefaction Process (EPA-600/7-78-091) represent the current data base for the EA of coal liquefaction technology. This volume summarizes pertinent information about 14 prominent coal liquefaction systems now being developed. For each system, it includes a brief description, a flow diagram, and a list of materials entering and leaving the system. Potential applicable control techniques are described generally, along with the current status and development plans for the 14 systems. The main conclusion from this volume is that these processes are not environmentally defined in the published literature; however, there is some indication that current development plans may help to correct this situation. Volume II is an environmental characterization of three of four selected coal liquefaction systems: Synthoil, H-Coal, and Exxon Donor Solvent.

U.S. Environmental Protection Agency
Environmental Assessment Data Base for Coal Liquefaction Technology: Volume II. Synthoil, H-Coal, and Exxon Donor Solvent Processes, EPA-600/7-78-184b, by C.J. Parker and D.I. Dykstra, editors, Hittman Associates, Inc., Springfield, Virginia, NTIS, 480 pages, September 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Significant
H-Coal and Exxon Donor Solvent	Significant
Common Operations and Processes	Significant

Reviewer's Comments: (G.B.)
The chapters on H-Coal and Exxon Donor Solvent supply specific emission estimates and waste stream composition data for the various modules. Further, the document contains chapters summarizing chief emission streams and environmental hazards, which are useful for comparative purposes amongst different technologies. Later reports on H-Coal and Exxon Donor should be consulted.

Reviewer's Comments: (R.E.)
Considerably more technical detail for H-coal and Exxon Donor Solvent processes than in Volume I. Several excellent comparative tables have been included in the appendix. Other data includes: thermal efficiency--H-coal, 70%; EDS, 58% (difference noted and explained through the fact that EDS uses coal for hydrogen, while H-coal uses char). Solids from the H-coal plant would be used to generate hydrogen using the Texaco process. Because this process is proprietary, data on both gas streams and solid wastes is unavailable. The document makes all of its assumptions using a Koppers-Totzek gasifiers.
Relatively detailed descriptions of unit processes--particularly those associated with pollutants--is given.

Abstract:

This volume is an environmental characterization of three selected coal liquefaction systems: Synthoil, H-Coal, and Exxon Donor Solvent. It documents and evaluates existing environmentally significant data. System characterization includes an integrated multimedia assessment of discharges to the environment from conceptualized 7,950 cu m (50,000 bbl) per day systems. Estimates are given for the raw waste streams, treatment and control processes, treated waste stream discharges, and the effects of these discharges on the environment. Conclusions include: (1) carbon-containing residues from process phase separations are major potential environmental problems; (2) except for solid carbon-containing residues from phase separations, treatment and controls exist for removing most major waste components--however, their efficiency in controlling coal liquefaction waste streams needs to be tested; and (3) less attention has been addressed to trace organic and inorganic compounds.

U.S. Environmental Protection Agency
Environmental Assessment Data Base for High-BTU Gasification Technology: Volume I. Technical Discussion, EPA-600/7-78-186a, by M. Ghassemi, K. Crawford, and S. Quinlivan, TRW Environmental Engineering Division, Springfield, Virginia, NTIS, 169 pages, September 1978.

Availability: Environmental Library

Purpose/Topic:	
Air	Useful
Health	Useful
Solid Wastes	Significant
Technology Assessment - Gas Purification	Significant
- Gas Upgrading	Significant

Reviewer's Comments: (G.B.)
Although this report contains some important and general background information on high-BTU gasification technologies and environmental problems, it is now outdated. Part of the report addresses data gaps and needs. Most of these gaps are currently being filled by efforts with DOE and EPA.

Reviewer's Comments: (C.K.)
Another discussion on background information on solid wastes generated by high-BTU gasifiers. The wastes are described by source and general characteristics, but due to a lack of data, almost nothing is said about specific components or any hazards that would be associated with them.

Reviewer's Comments: (R.E.)
Other than the fact that the document is already "old," it offers significant data and commentary. We have included six pages of data from it in the appendix. Particularly significant is Table 8-2, which summarizes data gaps for gas purification unit processes and commentary on likely acid gas removal systems.

We would like to note that the EPA work at North Carolina State University (see reference) will be useful with regard to acid gas removal.

"Unknowns" include energy use for several air pollution removal systems and waste generation for given coals with given technologies.

223 (Continued)

Abstract:

The report is part of a comprehensive EPA program for the environmental assessment (EA) of high-Btu gasification technology. It summarizes and analyzes the existing data base for the EA of technology and identifies limitations of available data. Results of the data base analysis indicate that there currently are insufficient data for comprehensive EA. The data are limited since: (1) there are no integrated plants, (2) some of the pilot plant data are not applicable to commercial operations, (3) available pilot plant data are generally not very comprehensive in that not all streams and constitutents/parameters of environmental interest are addressed, (4) there is a lack of experience with control processes/equipment in high-Btu gasification service, and (5) toxicological and ecological implications of constituents in high-Btu gasification waste streams are not established. A number of programs are currently under way or planned which should generate some of the needed data. The report consists of three volumes: Volume I summarizes and analyzes the data base; Volume II contains data sheets on gasification, gas purification, and gas upgrading; and Volume III contains data sheets on air and water pollution control and on solid waste management.

U.S. Environmental Protection Agency
Environmental Assessment Data Base for High-BTU Gasification Technology: Volume II. Appendices A, B, and C, EPA-600/7-78-186b, by M. Ghassemi, K. Crawford, and S. Quinlivan, TRW Environmental Engineering Division, Springfield, Virginia, NTIS, 414 pages, September 1978.

Availability: Environmental Library

Purpose/Topic:

Technology Assessment	- Gasifiers	Significant
	- Acid Gas Removal	Significant

Reviewer's Comments: (R.E.)
Appendix A: Gasification Operation, Brief (15-25 pages) descriptions of gasifiers which EPA concedes might be used for high BTU gas (11 processes). For each process there is a section "Data Gaps and Limitations." For example, under Lurgi it is noted that ". . . not all streams (e.g., lockhopper vent gas) are addressed and not all potential pollutants and toxicological and ecological properties are identified." Other notable gaps are:

Slagging Lurgi: No data on quench or cooling water available.
COGAS: Properties of most processes and discharge streams unknown because there has never been an integrated operation.
HYGAS: Surprising lack of data on numerous components of several process streams.
BIGAS: Pilot plant had not reached equilibrium--no data available.
Koppers-Totzek: No data from American coals on clarifier effluent and sludge. No data on trace sulfur and nitrogen compounds on raw or cleaned gas.
Texaco: Very limited data on all process streams.

We believe that this source might furnish comparable data for thermal efficiency and utility requirements for gasifiers. In fact, such data is apparently not available. One surprising comparison was between KT and Lurgi for electrical requirements:

Lurgi	23 kwh/ton
K-T	232 kwh/ton

Appendix B: 163 pages of description of Gas Purification (acid gas removal) systems. Again, good analyses of data gaps.
Appendix C: Gas Upgrading Operation. Two sections, one on the Shift Conversion Module, the other on the Methanation and Drying Module. Notable data gaps are:

1) What happens to COS and CS_2 in the Shift Conversion process?
2) For fixed bed methanates (and others as well) the amounts of $Ni(CO)_4$ in the gas streams are not well documented.
3) Less data of any kind is available for fluidized and liquid phase methanation processes.

Abstract:
See Volume I.

U.S. Environmental Protection Agency
Environmental Assessment Data Base for High-BTU Gasification Technology: Volume III. Appendices D, E, and F, EPA-600/7-78-186c, by M. Ghassemi, K. Crawford, and S. Quinlivan, TRW Environmental Engineering Division, Springfield, Virginia, NTIS, 340 pages, September 1978.

Availability: Environmental Library

Purpose/Topic:

Technology Assessment	- Hydrogren Sulfide Control	Significant
	- Water Pollution Control	Significant
	- Solid Waste Management	Significant

Reviewer's Comments: (R.E.)
Claus Plants: Significant data and comments:
- a) 97% sulfur recovery with three-stage plant,
- b) For 40% HS feed, use of electricity at 100 kwh/ton,
- c) Process doesn't work as well if impurities such as hydrocarbons, ammonia, HCN and H_2O are present,
- d) COS and CS_2 not converted to S,
- e) Process applicability to coal conversion process gas purification systems not entirely established.

Scot tail gas treatment (Shell Claus Off-Gas):
- a) Useful only with Claus tail gas,
- b) Not all COS or CS_2 converted,
- c) Information unavailable on effect of numerous contaminants on process,
- d) Information unavailable on effect of excess CO_2 in process stream.

Beavon:
- a) Used in conjunction with Stretford Unit,
- b) Uses 64 kwh/ton of S in the tail gas,
- c) Efficiency of COS and CS_2 removal compared by high concentration of CO_2,
- d) No good data on the fate of various contaminents (NH_3, HCN, carbonaceous matter, trace metals, etc.) or on their effect on process efficiency.

Several other processes reviewed (IFP, Sulfneen and Cleanair).

Abstract:
See Volume I.

226

U.S. Environmental Protection Agency
Environmental Assessment Data Base for Low/Medium-BTU Gasification Technology: Volume I. Technical Discussion, EPA-600/7-77-125a, by E.C. Cavanaugh, et al., Radian Corp., Springfield, Virginia, NTIS, 169 pages, November 1977.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - Low BTU Gas Significant

Reviewer's Comments: (R.E.)
Some date on 65 different gasifiers, but 14 gasifiers (see Appendix) are identified as "promising."
We have chosen several tables from this publication for inclusion in the appendix. For technology assessment, the distinction among gasifiers as to the end-use of the product should be pertinent.

227

U.S. Environmental Protection Agency
Environmental Assessment Data Base for Low/Medium-BTU Gasification Technology: Volume II. Appendices A-F, EPA-600/7-77-125b, by E.C. Cavanaugh, et al., Radian Corp., Springfield, Virginia, NTIS, 365 pages, November 1977.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - Low BTU Gas Significant

Reviewer's Comments: (R.E.)
We have commented upon Volume I. Volume II gives good descriptions of 14 technologies and brief descriptions of gas purification, air pollution control, water pollution control and solid waste control. The latter section is particularly useful because "Process Advantages" and "Process Disadvantages" are stated for every control technology. For example, Stretford doesn't remove organic sulfur compounds, but Beavon does, Beavon and SCOT both require fuel gas for operation, etc.

U.S. Environmental Protection Agency
Environmental Assessment of Coal Cleaning Processes: First Annual Report; Volume I. Executive Summary, EPA-600/7-79-073b, by A.W. Lemmon, Jr., et al., Battelle-Columbus Laboratories, Springfield, Virginia, NTIS, 72 pages, June 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - Coal Cleaning   Useful

Reviewer's Comments: (R.E.)
Volume II, which provides more detail than this summary, has been reviewed.

Reviewer's Comments: (G.B.)
Principal coal cleaning air pollutants are dusts from coal handling and particulates and combustion products from coal dryers. This report primarily describes Battelle's preliminary results on characterizing these pollutants. It also describes their future work.

Abstract:

16. ABSTRACT The report gives results of the first year's work on an environmental assessment of coal cleaning processes. A strong base of engineering, ecological, pollution control, and cost data is being established through data gathering and systems analysis efforts. In addition to program management, three task areas are defined: system studies, data acquisition, and general program support. Early availability is anticipated for draft reports of progress for three subtasks: (a) developing information on on coal cleaning process technology; (b) defining the technological and cost status of the control of pollutants from coal cleaning and refusal disposal; and (c) establishing criteria for meeting environmental goals. (A fourth subtask, acquiring process data, was terminated to avoid duplication.) Progress has been made on data acquisition subtasks, aimed at the planning needed as the forerunner of the anticipated environmental field testing program: (a) developing and describing the overall environmental test program; (b) developing the rationale for selection and selecting the evaluation sites; (c) specifying the experimental testing techniques to be used; and (d) developing the master site test plan. (Ten site categories have been specified for testing.) General program support includes: (a) obtaining background environmental data, and (b) operating a coal cleaning information center.

U.S. Environmental Protection Agency
Environmental Assessment of Coal Cleaning Processes: First Annual Report; Volume II. Detailed Report, by A.W. Lemmon, Jr., et al., Battelle-Columbus Laboratories, Springfield, Virginia, NTIS, 173 pages, June 1979.

Availability: Environmental Library

Purpose/Topic:
Technology - Coal Cleaning — Useful

Reviewer's Comments: (R.E.)
1) This is an initial report--most of the work remains to be done.
2) "Coal Cleaning" is mainly concerned with Eastern coals to be used for coal-fired power plants (only 12 of 435 coal cleaning plants are in the West and 6 of those are in Utah).
3) Several of the synfuel technologies require specifically treated and/or sized coal. Both coal pre-treatment and coal cleaning deserve review and this series of documents for EPA (and Battelle) should be obtained.
4) "The disposal of coal cleaning plant waste is a worldwide problem of increasing magnitude" (page 7 of report).

U.S. Environmental Protection Agency
Environmental Assessment of Coal Liquefaction: Annual Report, EPA-600/7-78-020, by K.T. Budden, et al., Springfield, Virginia, NTIS, 200 pages, February 1978.

Availability: Civil Engineering, Montana State University

Purpose/Topic:

Current Technology	Useful
Water Pollution Constituents	Useful
Potential and Existing Regulations	Significant
Methods for Analyzing and Determining Environmental Effects	Significant

Reviewer's Comments: (N.Z.)
A very general treatment of environmental problems associated with liquefaction but worthwhile reading. General categories of pollutants are defined and possible treatment alternatives discussed. The authors present a detailed analysis of current and potential environmental regulations affecting the liquefaction industry. The most unique and valuable aspect of this report is the development of procedures for sampling and analyzing environmental effects of a liquefaction plant, including establishing baseline data prior to the building of such a plant. This report is an annual report for a program to develop a Standards of Practice Manual for each liquefaction technology and it would be prudent to monitor the progress of this report.

Abstract:
The report summarizes results of a study of the environmental aspects of 14 of the most prominent coal liquefaction systems, in terms of background, process description, major operations, input and output streams, status and schedule of system development. As a result of the study, four systems -- SRC, H-Coal, Exxon Donor Solvent, and Synthoil were selected for in-depth study. The first Standards of Practice Manual, under preparation for the SRC-I system, will include descriptions of modules, control/disposal practices, environmental emissions, and control/disposal costs.

231

U.S. Environmental Protection Agency
"Environmental Assessment of SRC-II, An Update," by C.R. Moxley, and D.K. Schmalzer, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pg. 357-382, September 1979.

Availability: Environmental Library

Purpose/Topic:

Air Quality/Emissions/Control	Significant
Health - General	Useful

Reviewer's Comments: (G.B.)
This report reviews results of ambient air monitoring around the SRC-II pilot plant; also it reviews in-plant monitoring levels of some substances (PAH, benzene). Health-related aspects or results are generally discussed, with authors implying more monitoring research is necessary as potential health problems do exist.

Abstract:

Environmental assessments reports (EARs) have been developed by the U.S. Environmental Protection Agency (EPA) to provide assistance in meeting commitments to preserve environmental quality. EARs are applicable both to emerging coal gasification and liquefaction systems. This paper addresses the environmental assessment of coal liquefaction via solvent refined coal (SRC).

An overview of the hypothetical SRC system considered is made. Potential sources of air emissions, water effluents, and solid waste discharges are identified. Applicable control alternatives for the discharges are discussed. Based on utilization of these controls, a summarized version of the multimedia environmental goals (MEGs) and source analysis models (SAMs) applied to SRC system discharges is presented, highlighting existing areas of environmental concern. Research needs for subsequent environmental assessments of SRC also are noted.

U.S. Environmental Protection Agency
"Environmental Assessment Report: High-BTU Gasification Technology," by M. Ghassemi, et al., in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 203-250, September 1979.

Availability: Environmental Library

Purpose/Topic:
Air/Pollution Control - General Significant

Reviewer's Comments: (G.B.)
This report reviews many significant aspects of high-BTU technology and identifies important data gaps. Most of this discussion is technology oriented: reviews many processes--Lurgi, Hygas, Cogas, CO_2 Acceptor, Bigas, Synthane, Hydrane; air pollution control processes; wastewater processes. Examples of data gaps are: emissions associated with decommissioning spent catalysts and treatment of sludges; trace element, toxicological and ecological characteristics of waste streams and performances of control systems.

Abstract:

As part of a comprehensive program for the environmental assessment of high-Btu gasification technology, the available data on high-Btu gasification and associated operations and processes have been analyzed, and gaps in the existing data base have been identified. This paper describes the data analysis methodology and identifies limitations of the available data. The program was sponsored by the Fuel Process Branch of the U.S. Environmental Protection Agency's Industrial Environmental Research Laboratory (EPA IERL), Research Triangle Park, N.C.

U.S. Environmental Protection Agency
Environmental Assessment Report: Lurgi Coal Gasification Systems for SNG, Interagency Energy/Environment R&D Program Report, by M. Ghassemi, et al., EPA-600/7-79-120, Springfield, Virginia, NTIS, 325 pages, May 1979.

Availability: Environmental Library

Purpose/Topic:	
Air - Specific	Significant
Health - General and Specific	Significant
Solid Wastes	Significant
Water Treatment Technologies	Significant
Water Pollutants	Significant
Needs for More Information/Data	Significant
Water Standards Applied to SNG	Significant
Lurgi Technology	Significant

Reviewer's Comments: (G.B.)

This report is extremely comprehensive in terms of reviewing the basic Lurgi unit processes and in identifying major air (also water and solid waste) pollutants and pollution control systems from each of these unit processes. The report also points out data gaps. Extremely valuable document for comprehending major environmental hazards associated with Lurgi gasifier, but lacks a little detail on quantifying some aspects of these hazards (i.e., certain emission streams, effectiveness of new control technologies, data on health hazards).

Reviewer's Comments: (C.K.)

Good review of the sources of solid wastes generated at a Lurgi SNG plant and the sources of each type. Gives data on what is known about each type of waste, alternative disposal methods and the potential environmental impacts each waste may have. Also explains environmental assessment methodologies intended for use in determining the controls needed once the plant is in operation.

Reviewer's Comments: (N.Z.)

Excellent and complete information on Lurgi coal gasification (useful also for evaluating environmental effects of SNG plants in general). This report has good summaries and tables on each topic. Requirements for more data to evaluate environmental effects are fully discussed.

All U.S. Lurgi plants are designed for zero-discharge; therefore, area of concern is hazards associated with accidents and spills during handling and transportation. Also, water pollution may result from leachate in landfill operation and runoff from storage piles.

Indirect water quality impacts include "washout" and "fallout" of air pollutants from the facility. Indirect impacts may be minimized through proper plant siting and proper design and operation of landfills, impoundments, air pollution control systems and runoff

233 Cont.

Reviewer's Comments: (N.Z.) continued
containment measures.

This report would be an excellent choice to include in any synfuel library collection.

Abstract:

Abstract: The report is a compilation and analysis of data on the equipment and processes constituting the Lurgi Substitute Natural Gas (SNG) systems, the control/disposal alternatives for a media, the performance and cost of control alternatives, and present and proposed environmental requirements. It provides the best technical basis currently available for establishing environmental standards for Lurgi SNG plants. Lurgi SNG systems are divided into four operations (coal preparation, coal gasification, gas purification, and gas upgrading) and a number of auxiliary processes (air pollution control, raw water treatment, oxygen production, etc.); each operation consists of a number of processes. Data are provided on the characteristics of input materials, products, and waste streams associated with each process. Pollution control alternatives for air emissions, water effluents, solid wastes, and toxic substances in an integrated facility were examined for performance, costs, energy requirements, and ability to comply with current and anticipated environmental standards. The adequacy of the data was evaluated and the additional data needed to support standards development and enforcement and health and ecological effects and control research and development were identified. On-going and planned programs which may supply some of the needed data are reviewed.

U.S. Environmental Protection Agency
"Environmental Assessment Report: Solvent-Refined Coal," by K.J. Shields, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 383-404, September 1979.

Availability: Environmental Library

Purpose/Topic:
Air Quality | Significant

Reviewer's Comments: (G.B.)
This report summarizes SRC I and II technology and gives data on major waste streams, particularly on air emissions (also water and solid). The review of significant sources of air pollution and control technologies is particularly useful. Other EPA reports on SRC would expand the data base.

Abstract:

This paper describes the activities that have been undertaken, as well as future environmental activities that will occur in the succeeding phases of the 6,000 T/D SRC-II Coal Liquefaction Demonstration Project. This plant will be built in the Morgantown, West Virginia area under sponsorship of the U.S. Department of Energy (DOE).

Currently, the phase is characterized by efforts in two main areas:

1. *Collection of baseline data for incorporation into an environmental impact statement. A brief description of our data-gathering effort is given with special attention to:*
   - *Results from the air-monitoring station, especially regarding the ozone attainment/nonattainment status in the area.*
   - *Existing levels of PNAs in soils, ambient suspended particulate matter, groundwaters, and surface waters/sediments in the Monongahela River and the various tributaries that traverse the project site.*
   - *Expected impact of the project on the existing socioeconomic climate of the region.*
2. *Identification of the following anticipated major environmental concerns of the project:*
   - *Current plans for the onsite disposal of approximately 800 T/D of a potentially hazardous waste.*
   - *Industrial hygiene and potential health effects of the plant. A medical surveillance program for plant workers and the status of the toxicology programs for SRC-II (solvent refined coal) products and intermediate streams will be addressed.*
   - *Consumptive use of water and its impact on the Monongahela River.*
   - *Status of combustion tests on SRC-II product oil and anticipated environmental concerns of its use.*

U.S. Environmental Protection Agency
Environmental Assessment Report: Solvent Refined Coal (SRC) Systems, EPA-600/7-79-146, by K.J. Shields, et al., Hittman Associates, Inc., Springfield, Virginia, NTIS, 846 pages, June 1979.

Availability: Environmental Library

Purpose/Topic:

Solid Wastes	Significant
Technology Description	Useful
Air	Significant
Health	Significant

Reviewer's Comments: (C.K.)
Contains lengthy descriptions of sources of wastes from SRC I and II processes, as well as methodologies to determine the impact of the wastes on the environment. However, the control of the solid wastes is given very superficial treatment. Land or mine fill is the major type of disposal recommended, but little is said about the consequences of this method or about how much space would be required.

The methodology presented for determining impacts on the environment is seriously flawed. Too much emphasis is placed on acute toxicity rather than chronic effects, nothing is said about the effects of trace elements on aquatic or terrestrial systems, and synergistic effects would likely be ignored by the proposed assessment technology. The entire treatment of the disposal/environmental impact problem has virtually no biological basis. (I feel that a .05 significance level may be too high when dealing with powerful carcinogens, as is proposed in this report.)

Reviewer's Comments: (R.E.)
Most of the document is "environmental." However, there is an excellent 100-page description of the technical process, including short descriptions of individual unit processes. Significant points include:

1) The entire document is based on a facility which purchases electric power. In fact, a commercial facility would produce its own power, causing additional environmental impacts.
2) The major technical problem in the development of SRC systems was the separation of solids from the hot liquid stream. For SRC II the problem appears to be solved by the use of vacuum distillation. For SRC I filtration would be used, yielding a filter cake. No analysis is given as to the viability of this process.
3) This design uses a Koppers-Totzek gasifier for the production of the hydrogen necessary for the process. Other gasifiers could be used in a commercial facility. Because of the need for hydrogen, all of the normal, low-BTU gasification unit processes must be used (oxygen plant, shift conversion, acid gas removal, sulfur removal, ammonia recovery, and phenol recovery.

Reviewer's Comments: (R.E.) Continued

These plans call for acid gas removal through the use of monoethanolamine, sulfur removal through the Stretford process and phenol removal through an extraction process using naphtha.

Reviewer's Comments: (G.B.)

This lengthy document represents the most comprehensive environmental report on SRC I and II technologies to date. It contains essential background information on air, solid wastes, water and health hazards, control technology and emissions associated with pilot-scale SRC plants. However, informational deficiencies on many environmental aspects are evident, e.g., estimated fugitive emissions (in plant) and compositions of gas streams (or wastes) for commercial-scale operations. (According to as least one Hittman representative, this report was more restrictive, environmentally, than deemed necessary. This is possible when considering pilot plants do not have the environmental controls that will be used in commercial plants.

Abstract:

The report is an integrated evaluation of air emissions, water effluents, solid wastes, toxic substances, control/disposal alternatives, environmental regulatory requirements, and environmental effects associated with solvent refined coal (SRC) systems. It considers the SRC-I (solid product) and SRC-II (liquid product) variations of solvent refining in terms of a hypothetical facility to produce 7950 cu m/day liquefied coal products. Discussions emphasize SRC-II production, identifying differences applicable to SRC-I production. An overview of the SRC system processes is followed by characterizations of applicable input materials, process streams, waste streams, products, and byproducts. Control and disposal options are surveyed to determine their applicability to subject discharges. Potentially applicable regulatory requirements are reviewed and compared to estimated after-treatment discharge levels. Source Analysis Model (SAM) analyses indicate that solid wastes produced by SRC systems are the greatest source of current environmental concern. The major environmental difference between SRC-I and SRC-II systems is the potential for particulate emissions of SRC-I solid product dust. Additional information needs for future environmental assessment are discussed. Supplemental information pertinent to the discussions is included in appendices.

U.S. Environmental Protection Agency
Environmental Assessment: Source Test and Evaluation Report, Lurgi (Kosovo) Medium-BTU Gasification, Phase 1, EPA-600/7-79-190, Springfield, Virginia, NTIS, 141 pages, August 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Useful
Solid Wastes	Not Relevant

Reviewer's Comments: (G.B.)
This report is the first in a series of four documents that address the multimedia emissions and potential hazards from the Kosovo (Lurgi) plant. Results of Phase I (this report) indicate that significant and potentially hazardous quantities of benzene, mercaptans, CO, NH_3 and HCN pollutants are being released within or from the Kosovo plant. Further studies (to be continued through 1980) will shed more light on the extent of and control for these emissions.

Reviewer's Comments: (C.K.)
The solid wastes from the Kosovo Lurgi gasifier were not really analyzed during the "Phase I" part of the study program. The "Phase II" part will study the solid and liquid waste streams.

Abstract:

16. ABSTRACT The report summarizes an ongoing test program involving a commercial medium-Btu Lurgi coal gasification plant in the Kosovo region of Yugoslavia. The environmental data acquisition program is sponsored by the U.S. EPA and the government of Yugoslavia. The objective of the program is to characterize potential environmental problems and control technology needs associated with the gasification of lignite coal in a state-of-the-art Lurgi gasification plant. This timely program is enabling the EPA to study firsthand the environmental problems which may be encountered by future operators of U.S. gasification plants. Phase I of the tests, now complete, concentrated on the characterization of major pollutants in the plant's gaseous emissions. Some characterization of the plant's liquid and solid waste streams and its by-products were also performed. A SAM/IA analysis of the gaseous emissions indicated that the major pollutants of concern are CO, benzene, H2S, mercaptans, and NH3. The Phenosolvan effluent contained a high concentration of organics and had a high (11-12) pH. The sulfur concentration of lights (i.e., gasoline) in the by-product streams was significantly higher than that of the heavies (i.e., tar). Phase II will emphasize detailed characterization of trace organics and trace elements in the plant's multimedia waste streams and control options.

U.S. Environmental Protection Agency
Environmental Effects of Increased Coal Utilization: Ecological Effects of Gaseous Emissions From Coal Combustion, EPA-600/7-78-108, Springfield, Virginia, NTIS, 60 pgs., June, 1978.

Availability: Environmental Library

Purpose/Topic:
General - Environmental

Useful, But Not Too Relevant to Synfuels

Reviewer's Comments: (G.B.)
This report broadly addresses ecological and environmental effects of NO_x, SO and fine particulates which are emitted from coal combustion. Thus, the document focuses primarily on coal-fired power plant fuel conversion emissions and effects. Some generalization can probably be made, however.

Abstract:

16. ABSTRACT
This report is provided for the "Health and Environmental Effects of Coal Utilization" Committee (Dr. David Rall, Chairman) which was created by the request of the DOE in response to the President's Environmental Message. It evaluates ecological and environmental effects of gaseous emissions and aerosols of various types which result from coal combustion. The report deals with NO_x, SO_x. fine particulate, photochemical oxidant and acid precipitation as these pollutants affect natural and managed resources and ecosystems.

The economic implications of ecological effects are identified within acceptable limits. In addition, the reliability of the data base upon which conclusions or estimates are made is evaluated to the degree possible. Aquatic and terrestrial effects are distinguished where the pollutants in question are clearly problems in both media.

Sulfur oxide (SO_x) emissions and nitrogen oxide (NO_x) emissions are projected to be higher in 1985 and 2000 than in 1975. Since SO_x and NO_x are major contributors to acid precipitation, substantial increases in total acid deposition can be expected in the nation as a whole. At present, acid precipitation is most abundant in the North Central and Northeastern States.

Estimates of the non health-related cost of air pollutants range from several hundred million dollars per year to \$1.7 billion dollars per year. In general, these estimates include only those relatively easily measured considerations such as crop losses resulting from acute pollution episodes or cost of frequent repainting as a result of air pollution.

U.S. Environmental Protection Agency
Environmental Standards for Coal Conversion Processes, Volume II: Selected State, Mexican, and Canadian Regulations, EPA-600/8-89-231b, by D.K. Webber and D.E. Whittaker, Pullman Kellogg, Springfield, Virginia, NTIS, 364 pages, October 1979.

Availability: Environmental Library

Purpose/Topic:
Air | Very Useful

Reviewer's Comments: (G.B.)
Volume II of this lengthy document series (600 pages) reviews Canadian and Mexican as well as additional selected state water, air and solid waste standards applicable to synfuels. This document will serve as an excellent reference for regulatory as well as control technology information.

Abstract:

Existing and proposed environmental standards have been gathered and synopsized to serve as a guide for evaluation of the efficiency of available and developing technology for control of liquid effluents, gaseous emissions and solid wastes from coal conversion processes. Within the United States, the Federal and EPA standards and guidelines for air, water and solid wastes were gathered, together with the standards for 22 states selected for their potential in installation of coal conversion facilities and the standards for two regional commissions. With a view toward the possibility of environmental effects crossing national borders, the standards and guidelines for Mexico, the Dominion of Canada, two Canadian provinces and the International Joint Commission of U.S. and Canada, were synopsized and added to the U.S. standards.

All of the standards and guidelines were compared and from them a summary of the most stringent of the standards was developed. This summarization, reduced as far as possible to engineering terms, can serve as a guide in the design of coal conversion plants on the premise that if the effluents, emissions and wastes from the conversion process steps are so treated that the final releases to the environment meet the criteria in the summary of most stringent standards, then the conversion plants can be built anywhere in the U.S., Mexico or Canada.

U.S. Environmental Protection Agency
"Evaluation of Coal Conversion Wastewater Treatability," by P.C. Singer, et al., in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 457-478, April 1979.

Availability: Environmental Library

Purpose/Topic:
Biodegradability of Synthetic Fuel Wastewater — Significant

Reviewer's Comments: (N.Z.)
This is a good report on the biodegradation of simulated synfuel wastewater using laboratory reactors. The results indicate good BOD, COD and TOC removal with removal improving with longer detention times. The report gives kinetic analyses useful for design of biological waste treatment. A mammalian cytotoxicity assay, used as an indicator of potential human health effects of the wastewater, showed that cytotoxicity decreased with increasing degrees of biological treatment. Information in this article is included in the report Treatability and Assessment of Coal Conversion Wastewaters: Phase I, by P.C. Singer, et al. (EPA-600/7-79-248).

Abstract:
This paper describes preliminary results from an experimental program that evaluates biological treatability of coal conversion wastewater. The experimental approach includes preparation of a synthetic wastewater designed to simulate a practical coal conversion discharge. Design and operation of four biological reactors and the preliminary results from the first few months of synthetic waste-waster treatment are described. Data analyzed include chromatographic analyses of the wastewater and reactor effluents, as well as cyto-toxicity analyses using Chinese Hamster V79 cells.

U.S. Environmental Protection Agency
"Fate of Phenols During the Gasification of Coal," by J.P. Fillo and M.J. Massey, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 279-301, April 1979.

Availability: Environmental Library

Purpose/Topic:

Importance of Phenols (Commercial Use and Toxicity)	Not Relevant
Source of Phenol in Water	Significant
Chemistry and Reactivity of Phenols	Significant

Reviewer's Comments: (N.Z.)
Phenols comprise 60-80% of TOC in synfuel wastewaters and is important both commercially and as a waste requiring treatment. This report is useful only for someone studying phenols in details. The information contained in this report is not directly pertinent to the role phenols play in aqueous contamination.

U.S. Environmental Protection Agency
Health Impacts of Environmental Pollution in Energy-Development Impacted Communities; Executive Summary, by Copley International Corporation, Denver, Colorado, EPA, Office of Energy Activities, 68 pages, January 1977.

Availability: R. Gold

Purpose/Topic:

Preparing for and Handling Impacts	Useful
Impact Overview	Useful

Reviewer's Comments: (J.M.)

Although the survey done as part of this report is now 5-6 years old, data offered are still generally pertinent to our purposes (80% of the communities surveyed had populations under 2500, and the appendices at the back offer state-specific information on available health services, etc.)

The study showed an inverse relationship between the extent of impacts on health and the ability of a community to evaluate the potential detrimental situations. It covered two general groups of health effects due to energy development: 1) effects associated with industrial processes (little substantiation here), and 2) effects associated with rapid growth of a community, i.e., impacts on water and sewage systems, and direct effects on people (overcrowding, alcoholism, child abuse, deprivation of health services). Some largely "subjective reports" cited as reflecting occurrences of direct health effects due to energy development. Implication is that "good" planning has managed to avert major epidemics.

Major flaw in the study is that data on impacts due to energy development are inadequate and unreliable, at least at the time the study was done. Specific information on annual population projections and development schedules are important to apply data for planning purposes.

Methodology included questionnaires (1974-75) completed by health officials and designation of "impacted" status to communities by weighted and non-weighted variables.

Abstract:

This report summarizes work designed to assist EPA in evaluating the environmentally-related health impacts associated with developing energy resources in Federal Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming). Results of the following activities are condensed in sections of the report: 1) exploration of means for appraising the current extent of health impacts in affected communities; 2) determination of the scope and adequacy of pertinent health information available in state repositories; 3) identification of the potential health impacts resulting from development of energy resources; 4) definition of approaches and

241 Cont.

Abstract: continued
economic considerations in providing health services in communities affected by energy developments; and 5) development of formats and protocols for collecting and consolidating data needed for adequate planning to prevent or reduce adverse health effects related to energy developments. A total of 212 impacted communities was identified during the course of this study.

U.S. Environmental Protection Agency
"Kosovo Gasification Test Program Results; Part II, Data Analysis and Interpretation," by K.J. Bombaugh, W.E. Corbett, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 181-202, September 1979.

Availability: Environmental Library

Purpose/Topic:
Air Quality/Lurgi Pollution Control   Very Useful

Reviewer's Comments: (G.B.)
This report is useful for interpreting the significance of the previous report's data (Phase I, Kosovo Plant). The significant emission streams are identified in Tables 1 and 2; also, the quantities of major pollutants are given (Tables 3 and 4) in terms of their respective MATE values and PDOH, PTUDR values. Liquid by-products and wastewater properties are given in Tables 7 and 8.

These Kosovo studies contain some of the only air pollution data taken from currently operating Lurgi plants.

Abstract:

This presentation is a progress report on an EPA-sponsored program to characterize environmental problems associated with the gasification of lignite in a commercial-scale plant using Lurgi gasifiers. The data acquisition activities associated with this program are being conducted at a gasification complex in the Kosovo region of Yugoslavia as an international, cooperative effort between the United States and Yugoslavia.

The Kosovo test program is being implemented in two phases. Phase I, now completed, addressed major and minor pollutant emissions. Phase II, to begin in the summer of 1979, will focus on significant trace pollutant emissions, such as trace elements and hazardous trace organics.

Because this presentation is based on the data that was gathered during the first test phase, it addresses primarily the bulk properties of the plant's major emission and effluent streams. It will be presented in two parts. The first part, by M. Mitrović, addresses test procedures and results. The second part, by Radian Corporation, considers the implications of those results in relation to control requirements for U.S. gasifications plants.

243

U.S. Environmental Protection Agency
"Liquefaction Environmental Assessment," by D.B. Emerson, in
<u>Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, III</u>, EPA-600/7-78-063, Springfield, Virginia, NTIS, pgs. 208-219, April 1978.

Availability: Montana State University Library

Purpose/Topic:
Water Pollution/Liquefaction Useful

Reviewer's Comments: (N.Z.)
This report is very general and does not give any comprehensive information on water use or pollution in a liquefaction plant. The only useful aspect of this report is a table summarzing the sources and characteristics of liquefaction wastewater streams.

U.S. Environmental Protection Agency
Managing Growth in the Small Community. Part 1: Getting a Picture of What's Ahead; Part 2: Getting the Community Involved and Organized; Part 3: Community Action and Growth Management, Action Handbook, EPA-908/4-78-005a,b,c, by Brisco, Maphis, Murray, Lamont, Inc., Washington, D.C., GPO, 160 pages, July 1978.

Availability: Environmental Library

Purpose/Topic:
Preparing for and Handling Impacts Useful

Reviewer's Comments: (J.M.)
The handbook is designed to be a detailed "how to manage" manual for small communities undergoing or facing the prospects of accelerated growth. Part I includes worksheets to enable locals to estimate impacts on public services (employment, housing, population), although very little is said about anticipating impacts in other areas, e.g., quality of life, social structure, culture, etc. The need for local government intervention is stressed, as is community organization skills (a step-by-step guide for same is included in Part II).

Although not focused on specific resource development projects, the handbook offers very practical aids for understanding and dealing with some socioeconomic impacts on the community level due to the influx of outsiders. Should be viewed as supplement to other studies.

Abstract:
The Action Handbook consists of three parts designed to be used together. It represents a detailed "how to manage" manual for small communities undergoing or facing the prospect of accelerated growth. Part I is intended to give an overview of the community management process and to assist the user in estimating how development of a certain type might affect the community's needs for various public services, such as police officers, sewage treatment capacity, park land, etc. This part should be of interest to all those who wish to understand potential community impact, and especially those who would initiate community management and organization. Part II deals with approaches to getting the community involved and organized. It suggests a working model for the community organizers. Part III focuses on community action and growth management. This part will be of greatest interest to those closely involved in making government work to manage growth.

245

U.S. Environmental Protection Agency
Monitoring Environmental Impacts of the Coal and Oil Shale Industries: Research and Development Needs, EPA-600/7-77-015, by D.C. Jones, et al., Springfield, Virginia, NTIS, 193 pages, February 1977.

Availability: Montana State University Library

Purpose/Topic:

Summaries of Technologies	Useful
Potential Water Pollution	Useful

Reviewer's Comments: (N.Z.)
This report has summaries on almost every type of synthetic fuel process (including many outdated ones). The summaries are brief and do not contain much detail. There is some mention of the in-situ process. The report is only marginally useful and is not very current (1977). Most of the information is brief and can be obtained elsewhere.

246

U.S. Environmental Protection Agency
"Multimedia Environmental Goals," by G.L. Kingsbury and J.B. White, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 7-21, April 1979.

Availability: Environmental Library

Purpose/Topic:

Review Strategy of Determining Multimedia Environmental Goals (MEGS)	Useful

Reviewer's Comments: (N.Z.)
Multimedia environmental goals are defined as levels of contaminants or degradents (in ambient air, water or land or in emissions or effluents conveyed to ambient media) that will not produce negative effects in the surrounding populations or ecosystems, or that represent control limits demonstrated to be achievable through technology.

This is important for projecting optimum control strategies for the future operation of synthetic fuel plants. However, determining MEGs for synfuel production is in its infancy and this report does not present much information on actual priorities in control of pollution. This report is useful in detailing what the strategy is for deriving MEG values and the importance of MEGs in controlling pollution. MEG values are important in deriving effluent or emission regulations for synfuel industries.

U.S. Environmental Protection Agency
Multimedia Environmental Goals for Environmental Assessment; Volumes III and IV. MEG Charts and Background Information Summaries (Categories 1-26), EPA-600/7-79-176a and b, by G.L. Kingsbury, et al., Research Triangle Institue, Springfield, Virginia, NTIS, 940 pages, August 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Very Useful
Health	Very Useful

Reviewer's Comments: (G.B.)
These two volumes contain the raw data for EPA's determinations of MEGs for 586 organic compounds contained in 26 classes. These are the basic reference documents for toxicity data utilized by EPA.

Abstract:

These volumes provide charts and background information summaries for MEG Categories 1-12 and 13-26. They address 586 organic compounds. In the context of deriving MEGs, the volumes: (1) offer perspective on the broad range of contaminants whose control is of vital interest to both industry and the public; (2) further develop and define indicators designating contaminants to be given priority consideration for immediate control and for subsequent research; (3) bring together existing and emerging data in a format efficient for use in environmental assessment; and (4) explore some basic methodologies which both provide the present goals, and suggest directions for refined methodologies. MEGs (multimedia environmental goals) are levels of significant contaminants or degradents (in ambient air, water, or land or in emissions of effluents conveyed to the ambient media) that are judged to be (1) appropriate for preventing certain negative effects in the surrounding populations or ecosystems, or (2) representative of the control limits achievable through technology. MEGs are predicted for more than 650 pollutants.

U.S. Environmental Protection Agency
"NIOSH Programs for Evaluation and Control of Industrial Hygiene Hazards in Coal Conversion," by J. Evans and B.G. Pallay, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 59-70, September 1979.

Availability: Environmental Library

Purpose/Topic:
Health - General — Significant

Reviewer's Comments: (G.B.)
Although somewhat general, this "article" describes NIOSH's previous and proposed programs for identifying the health hazards associated with gasification and liquefaction and recommending standards. Has several useful tables on potential exposures and toxic compounds. Gives names and projects of NIOSH persons working on their synfuels programs.

Abstract:

It is well known that hazardous chemical substances and physical agents are present in coal liquefaction and gasification and that the potential for occupational exposure is high. To make certain that the workers in this new industry will be protected, NIOSH first had defined practical means of protecting the worker and now has initiated a multidisciplinary, in-depth assessment of occupational health characteristics and control technology for these conversion processes through their principal investigator, Enviro Control, Inc. This paper summarizes the efforts to date.

The first NIOSH work was directed toward protecting the worker from apparent problems. This effort and its results are defined in the documents, Recommended Health and Safety Guidelines for Coal Gasification Plants *and* Criteria for a Recommended Standard: Occupational Exposures in Coal Gasification Plants. *This is currently being followed by three in-depth studies: Industrial Hygiene Characterization of Coal Gasification Plants, Industrial Hygiene Characterization of Coal Liquefaction Plants, and the Assessment of Engineering Control Technology for Coal Gasification and Liquefaction. This paper describes the techniques used for sampling and analyzing in liquefaction and gasification plants and for the ultimate use of the data. The interdependency of the two characterization projects with the Engineering Control Project will also be discussed. While hard data are not included in this paper, sufficient information will be available to show the direction the three projects are taking.*

U.S. Environmental Protection Agency
Ohio River Basin Energy Study, Volume III-D, Special Study Report: Social Aspects, by S. Johnson, and E. Weil, Springfield, Virginia, NTIS, 370 pages, May 1977.

Availability: R. Gold

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
The study places emphasis on demographic and socioeconomic profiles rather than impact assessment per se. Included in the discussions of each county is the information: land use, residence, age structure, marital structure, education, housing, economic activities, and income. Each profile ends with brief statements addressing impact concerns, i.e., economic infrastructure to cope with boom town syndrome. Statistical data is utilized and expanded on in the discussions. The study's presentation of a paradigm and hypotheses to provide guidelines for assessing impacts is of limited usefulness in assessing interactive effects (i.e., social fragmentation into opposition and proponent groups). This is pointed out by the researchers who are concerned that "too little attention has been paid to negative social costs in the literature."
Its usefulness is its presentation of the "profiling" stage in impact assessment. The researchers' own critical evaluation of the significance of presenting general demographic makeup of an area is noteworthy: that it can "only be suggestive of what kinds of people live there and what their values and attitudes toward power plant development might be . . . also only suggestive of receptiveness to externally-imposed change . . . given our time and money constraints, we feel it is better than nothing."

Abstract:
The major study goal was to try to assess, using secondary data, what kinds of environmental orientations were likely to be present in Ohio counties where power plants (nuclear and coal-fired) are planned. It attempts a qualitative analysis guided by a theoretical paradigm of environmental orientations which seeks to describe, at the county level, the potential impact of a power plant. The prevailing environmental orientation of a county is related to likely reaction of the county's residents to this kind of developmental change. The analysis is carried out as if all events were happening in the present or near future. Demographic profiles are given in detail (more so than the impact assessment) to enable the reader to draw her/his own conclusions concerning likely impact.

U.S. Environmental Protection Agency
"Pollutant Evaluations for a Laboratory Semi-Batch Coal Gasifier," by J.G. Cleland, J. Pierce, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 113-136, September 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Not Relevant

Reviewer's Comments: (G.B.)
RTI personnel are quantifying emission streams from their laboratory gasifier as a function of different coals as well as gasifying conditions (i.e., temperatures, pressures, Oz/steam ratios, etc.) Their results are extremely useful for predicting emission rates and compositions of various gasification technologies on a commercial scale.

Abstract:

Nine U.S. solid fuels have been gasified in the RTI laboratory unit. Gasifier streams have been extensively and quantitatively defined in terms of process and chemical pollutant parameters. Experimental results have received preliminary analysis on the basis of:

- *Coal-associated influences on pollutant production,*
- *Stream pollutant level comparisons,*
- *Comparison with similar pollutant and process operations data reported in the literature,*
- *Correlation of process parameters with pollutant production, and*
- *Cross-correlations of pollutant data.*

Integrated results from the semibatch gasifier have evidenced good simulation of fixed-bed, full-scale, continuous units in terms of product composition, throughputs, and effects of operational variables. Mass balances have been improved, and consistent chemical analyses of potential environmental hazards have allowed evaluation of production trends. Specific compounds consistently contributing to significant potential environmental hazards have been identified. Compounds posing threats to health (on the bases of both quantity and toxicity/carcinogenicity) appear to be limited to a reasonable number, allowing routine quantitation. Analysis of this limited number of compounds is being augmented by bioassay research to encompass total materials and synergistic effects.

U.S. Environmental Protection Agency
Pollutants from Synthetic Fuels Production: Coal Gasification Screening Test Results, EPA-600/7-79-200, by J.G. Coeland, et al., Research Triangle Institute, Springfield, Virginia, NTIS, 100 pages, August 1979.

Availability: Environmental Library

Reviewer's Comments:
Received too late for comment.

Abstract:

Coal gasification test runs have been conducted in a semibatch, fixed-bed laboratory gasifier in order to evaluate various coals and operating conditions for pollutant generation. Thirty-eight tests have been completed using char, coal, lignite, and peat. Reactor temperatures ranged from 790°C to 1035°C with high carbon and sulfur conversions in the bed.

Extensive analyses were performed for organic and inorganic compounds and trace elements in the tars and hydrocarbon oils, aqueous condensates, and reactor residues resulting from the gasification tests. Over 300 compounds were identified from the various gasifier streams, and more than 100 of these compounds were quantified for several of the test runs.

Statistical analyses have been performed on the data. The quantity and composition of the various effluents have been examined in relation to coal type and operating variables. Results are reported for sulfur species in the product gas stream, for consent decree pollutants contained as volatile organic compounds in the product gas, for phenol and related compounds in the aqueous condensate and tar/oil sample, and for polynuclear aromatic hydrocarbons (PNA) species in the tar/oil.

U.S. Environmental Protection Agency
Pollutants from Synthetic Fuels Production: Sampling and Analysis Methods for Coal Gasification, Report No. EPA-600/7-79-201, by S.K. Gangwal, et al., Research Triangle Park Institute, Springfield, Virginia, NTIS, 102 pages, August 1979.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful

Reviewer's Comments: (G.B.)
This report describes the stream sampling methods and results (liquid, solid, gaseous) from a laboratory-scale, semi-batch gasification unit. Data from these base-line experimental studies are useful for predicting effluents from commmercial-scale operations under varying conditions and with different coals. However, this report does not evaluate these effluents in terms of health or environmental hazards. (Follow-up reports address significance of results in terms of environmental and health concerns.) The report is useful from the analytical point of view because it points out the weaknesses in existing sampling protocols and analytical techniques.

Abstract:
The report describes sampling and analysis methods involving a laboratory-scale coal gasification facility used to study the generation, sampling, chemical analysis, process evaluation, and environmental assessment of pollutants from coal gasification. It describes methods for particulates, organic condensibles, and vapors or gases in the raw product stream of the gasifier as well as for solid residues. It describes gas chromatography (GC) procedures for measuring fixed gases, C1-C5 hydrocarbons, sulfur gases, and C6-C8 aromatics. Atomic adsorption (AA) procedures for measuring toxic trace elements include those for arsenic, selenium, lead, cadmium, chromium, and mercury. Volatile organics are collected from the gas stream using polymeric sorbents (Tenax GC and XAD-2), and analyzed by glass capillary GC/mass spectrometry (MS). The major nonvolatile byproduct (tar) is prefractionated by solvent partitioning into acid, base, and neutral fractions. Each fraction is analyzed by capillary GC/MS or high-performance liquid chromatography (HPLC). Typical results are given to illustrate the nature of the compounds studied, the methodologies, and their sensitivities.

253

U.S. Environmental Protection Agency
"Predictions on the Disposition of Select Trace Constituents in Coal Gasification Processes," by G.L. Anderson, A.H. Hill, D.K. Fleming, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 303-332, September 1979.

Availability: Environmental Library

Purpose/Topic:

Air Quality/Pollutants/Control	Significant

Reviewer's Comments: (G.B.)
This report gives a technical and theoretical account by unit process and the fates of As, Se, Pb, Hg, and B (boron) as they pass through three different gasification systems: Koppers-Totzek, Lurgi and HYGAS. Predicted emissions into air and concentrations expected in solid wastes are given in tables. Essentially 99% (or better) removal is expected from any of these gasification processes of these elements. However, significant quantities of As and Hg may be emitted depending on process used. But these will be much less than coal-fired power plants.

254

U.S. Environmental Protection Agency
Regional Assessment of the Impact of Synthetic Fuel Projection, Ohio River Basin Energy Study, Vol. III-J, Special Study Report by D.A. Blome & J.E. Jones, Jr., Springfield, VA., NTIS, 21 pgs., May 15, 1977.

Availability: Montana State University

Purpose/Topics:

Direct Employment Estimates	Useful
Manpower Needs by Year/by Skill	Useful
Fiscal Impacts	Not Relevant

Reviewer's Comments: (T.S.)
Brief, but generally useful summary of several key original sources of information (1974 industry EISs). No original data or research presented. Usefulness is hindered by the fact that technological changes in conversion processes may have made the 1974 estimates out-of-date.

U.S. Environmental Protection Agency
SAM/IA: A Rapid Screening Method for Environmental Assessment of Fossil Energy Process Effluents, EPA-600/7-78-015, by L.M. Schalit and K.J. Wolfe, Acurex Corp., Springfield, Virginia, NTIS, 166 pages, February 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Useful
Health	Useful
Solid Wastes	Significant

Reviewer's Comments: (G.B.)

This document essentially explains the purposes and procedures for EPA's screening and ranking program for identifying hazardous or toxic substances produced by a coal conversion plant. The SAM/IA (Source Analysis Models, the simplest version) is EPA's method for undertaking their first cut analyses of potentially toxic substances, be they liquid, gaseous or solid. Major assumptions of the SAM/IA model are:

-- the 650 substances are all that need to be analyzed by by model,
-- dispersion of effluents will be adequate and will offset any transformation to more toxic substances,
-- the associated Minimum Acute Toxicity Exposure values (MATEs) of these substances which go into the SAM/IA model are adequate,
-- no synergistic effects exist.

Later applications of SAM models (SAM/IIA and SAM/IIIA) will consider these assumptions once more background toxicity and bioassay data are generated.

Even though EPA's bureaucratic "professional" approach to evaluating hazardous pollutants may seem foreign, unnecessarily complicated and possibly totally inadequate, this is the system they have adopted. Therefore, learning their language is essential to understanding their approach to control strategies as well as their publications.

(The appendix includes lists of 650 toxic substances associated with fuel conversion, keyed to each type of effluent, air, water, solid.)

Reviewer's Comments: (C.K.)

This paper defines Multi-media Environmental Goals (MEG), Minimum Acute Toxicity Effluent (MATE), Source Analysis Models (SAM) and Environmental Transport and Transformation Analyses (ETTA). These standards and system approaches developed for the EPA are to be used in controlling toxic effluents from coal conversion facilities. Included are explanations of where the MATE and MEG values come from and the assumptions they are based on.

255 Cont.

Abstract:

The report describes the simplest member of a sequence of Source Analysis Models (SAMs) of increasing complexity and thoroughness which can be used as tools to help with one or more of five tasks involved in the environmental assessment of energy and industrial processes. The tasks are: (1) ranking individual effluent streams by the expected toxicity of their discharges; (2) establishing sampling priorities; (3) determining problem pollutants; (4) recommending best multimedia control technology alternatives; and (5) recommending control/disposal technology development programs. This model, SAM/IA, is useful for rapidly screening each effluent stream from a specific source: it is based on comparing effluent concentrations with the set of Minimum Acute Toxicity Effluent (MATE) criteria established by the EPA. The report explains the purposes of SAM/IA, the format used, and the MATE criteria against which pollutants are gauged. Several examples are included to illustrate specific facets of the model and of the format.

U.S. Environmental Protection Agency
SASOL: South Africa's Oil from Coal Story--Background for Environmental Assessment, EPA-600/8-80-002, by J.L. Anastai, TRW, Inc., Washington, D.C., EPA, 39 pages, January 1980.

Availability: Environmental Library

Purpose/Topic:	
Air	Not Relevant
Health	Not Relevant
SASOL Technology Description	Useful
Water Quantity Required by SASOL	Not Relevant
Water Pollution from SASOL Plant	Not Very Useful
Water Treatment Processes in SASOL II	Not Very Useful

Reviewer's Comments: (G.B.)
This report primarily reviews the SASOL facility and major processes, but does not describe or detail air emissions or health hazards. Some idea of problems may be inferable from the process descriptions, but little useable information is presented.

Reviewer's Comments: (R.E.)
As the title say, this is a story. The description of the process and the history of its development is briefly told (36 pages) by an advocate. Considerably more data are needed for any environmental assessment work.

Reviewer's Comments: (N.Z.)
This report has very little useful information pertaining to water use and water quality in the SASOL design. There is a very brief paragraph (page 31) on the water treatment scheme for the SASOL design but little technical information is given. In general, this report is not worth reading.

Abstract:

The report describes the world's only oil-from-coal plant, known as SASOL, operated by South Africa since 1955. When almost $7 billion worth of expansion is completed in the early 1980s, three SASOL plants will produce a total of 112,000 barrels of oil per day, or about half of South Africa's needs. Production costs average $17 per barrel, well below the 1979 OPEC price of more than $20 per barrel. South African motorists pay about $2.40/gallon ($0.63/liter) of gasoline at the pump. SASOL converts coal to liquid fuels in two steps: (1) the coal is gasified with oxygen and steam under pressure to yield a mixture of reactive gases, and (2) after being cleaned of impurities, the mixture is passed over an iron-based catalyst in Fischer-Tropsch synthesis units to produce liquid fuels. SASOL's operation is helped by South Africa's abundance of cheap labor and low cost coal. The U.S., like South Africa, has vast coal reserves. Although comparisons are difficult, it has been estimated that oil could not be produced from coal in the U.S. for less than $27 per barrel and perhaps as much as $45. The South African system is the only commercially proven process for the production of synthetic liquid fuels. The report provides some of the background on a process that will receive high priority for environmental assessment.

U.S. Environmental Protection Agency
SRC Site-Specific Pollutant Evaluation: Volume I. Discussion, EPA-600/7-78-223a, by H.C. Hopkins, et al., Hittman Associates, Inc., Springfield, Virginia, NTIS, 440 pages, November 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Significant
Solid Wastes	Useful

Reviewer's Comments: (G.B.)
This volume contains many specific emission rates and composition data for SRC process and waste streams based on Illinois Coal #6. Much of the information generated for this report is included in the Environmental Assessment Report (EPA-600/7-79-146), which was completed later.

Reviewer's Comments: (C.K.)
This report essentially reiterates what the EPA Environmental Assessment Report on SRC Systems (EPA-600/7-79-146) covers. No new information on environmental impacts is given, partially because of the lack of data on solid wastes and their real or potential hazards.

Abstract:

The report characterizes the potential environmental effects of the multimedia waste streams from the operation of a standard-size Solvent Refined Coal (SRC-I and SRC-II) liquefaction facility utilizing 28,123 Mg of Illinois No. 6 coal per day. The report gives: (1) a more detailed evaluation of the SRC pollutants characterized in a report, Standards of Practice Manual for the SRC Liquefaction Process; (2) an estimate of the potentially adverse effects of pollutant stressors emanating from a hypothetical SRC facility on the Wabash River, White County, Illinois; and (3) substantial background information in a form usable for an Environmental Assessment Report (EAR) on SRC technology. Regulatory standards and guidelines are discussed relative to the emerging synthetic fuels technology. Research needs are identified in terms of SRC technology, monitoring, and environmental sciences. Study results indicate concern for emissions from auxiliary units (e.g., cooling towers, boilers, sulfur recovery), fugitive process discharges, solid wastes, leachate contamination of water, polycyclic aromatic hydrocarbon emissions, hazardous wastes, water treatment effectiveness, interactions within and among media, etc. Volume 2 of the report includes supporting appendices.

U.S. Environmental Protection Agency
SRC Site-Specific Pollutant Evaluation: Volume II: Appendices, EPA-600/7-78-223b, by H.T. Hopkins, Hittman Associates, Inc., Springfield, Virginia, NTIS, 271 pages, November 1978.

Availability: Environmental Library

Purpose/Topic:

Air	Significant
Health	Significant

Reviewer's Comments: (G.B.)
This volume gives all the technical background information for the results of pollutant emissions described in Volume I. Examples of data in the Appendices are: MEG charts, MATE and EPC values, SAM/IA models, Emission Level goals and discharge levels, regulations, etc. Updated MATE values for many pollutants are included, notably for carbon disulfide (CS_2), Cd, F, NH_3, NO_x, ozone (O_3), H_2S, SO_2 and other metals. Little evaluation of organics has been undertaken.

Abstract:

This volume of the report contains appendices supporting the Volume 1 discussion of the environmental effects of the multimedia waste streams from a standard Solvent Refined Coal liquefaction facility. It provides information on the methodologies involved, including Multimedia Environmental Goals (MEGs) and Source Analysis Methodology (SAM). It also summarizes the 1977 amendments to the Clean Air, Clean Water, and Hazardous Waste Acts. The report provides a compilation of site-specific information as background for the pollutant effects study results given in Volume 1.

U.S. Environmental Protection Agency
Standards of Practice Manual for the Solvent Refined Coal Liquefaction Process, EPA-600/7-78-091, by P.J. Rogoshewski, et al., Hittman Associates, Inc., Springfield, Virginia, NTIS, 369 pages, June 1978.

Availability: Environmental Library

Purpose/Topic:

Technology Description - Unit Processes	Useful
Air	Useful
Health	Not Too Useful
Solid Wastes	Significant

Reviewer's Comments: (R.E.)
The volume is descriptive. Control systems for SRC are described in fair detail.
An interesting feature of the Appendix is a summary of pertinent state laws on water, air and waste dispoal in North Dakota, New Mexico, Montana, etc. Because New Mexico is the only state with specific emission control rules for gasification plants, their regulations should be studied.

Reviewer's Comments: (G.B.)
This report primarily compares estimated (from pilot plant data and engineering theory) stack air (and other media) emissions from a hypothetical SRC II plant with MEG values established (in 1978) by EPA. The data base is highly theoretical and may now be outdated. The comparisons showed few pollutants (Al, Ax, V, Cr) will exceed MEG values. As a result, this document appears to play down potentially hazardous air emissions, especially fugitives. (It does not discuss any environmental/health effects.) The report also dwells on criteria pollutants and regulations as opposed to unregulated ones.

Reviewer's Comments: (C.K.)
Contains basic information on three types of solid waste disposal--incineration, land disposal and chemical fixation/encapsulation--including the disadvantages and advantages of each. There is almost nothing on environmental consequences or the disposal techniques, or what is in wastes that might cause specific problems.

U.S. Environmental Protection Agency
Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, by F.A. Ayers and N.S. Jones, Research Triangle Institute, Springfield, Virginia, NTIS, 583 pages, September 1979.

Availability: Environmental Library

Purpose/Topic:	
Solid Wastes	Useful
Air Effects	Significant
Health Effects - General	Significant

Reviewer's Comments: (C.K.)
Basically useful for background information, with the exception of an article entitled "Chemical Analysis and Leaching of Coal Conversion Solid Wastes" by R.A. Griffin, et al. This article discusses a study analyzing potential toxic leachates from unquenched Lurgi gasification ash and liquefaction mineral residues.

Reviewer's Comments: (G.B.)
This document contains a number of useful and informative articles, some of which are very specific, i.e., about a particular technology or testing program. Subjects covered include: EPA's approach to synfuel programs; review of NIOSH programs; review of emissions from gasification plants (Kosovo in Yugoslavia, Wellman-Galusha).

U.S. Environmental Protection Agency
Treatability and Assessment of Coal Conversion Wastewaters: Phase I, EPA-600/7-79-248, by P.C. Singer, et al., University of North Carolina, Springfield, Virginia, NTIS, 192 pages, November 1979.

Availability: Environmental Library

Purpose/Topic:

Biological Water Treatment in Synthetic Fuel Processes	Significant
Toxicity of Effluents	Useful

Reviewer's Comments: (N.Z.)

This report has very good, detailed information on the biodegradability of synthetic fuel plant effluents, including Kinetic parameters for design of the biological process. The information is preliminary, however, and the tests were done on a laboratory-made wastewater. Tests on actual wastewater will be conducted in the future. Toxicity testing was performed on raw waste samples and biologically treated samples.

The report is mostly of interest to someone designing an aerobic biological treatment process for a synthetic fuel plant or for someone evaluating such a process.

The investigators reported some problems and failures with their biological reactor systems, which were unexplainable but guessed to be from operational errors and not due to any nonbiodegradability of the waste. Otherwise, prospective problems with the biological treatment process were not discussed.

Abstract:

The report gives Phase I results of (1) an assessment of the environmental impact of wastewaters originating from the production of synthetic fuels from coal, and (2) an evaluation of alternative technologies for treating these wastewaters. Work on coagulation, adsorption, and preliminary biological treatment studies is continuing. Future reports, representing successive phases, will update these results. The major focus is on aerobic biological treatment which is projected to be the principal means of removing organic impurities from these wastewaters and a cornerstone of any overall wastewater treatment program. A synthetic wastewater, designed to simulate a real conversion process wastewater, was fed to a series of aerobic biological reactors. Design and operation of the reactors is described, along with performance data spanning two 6-month operating periods. In addition to TOC, BOD, and COD data, the treated wastewaters were analyzed for phenolic content and residual organics, using chromatographic techniques. Aquatic bioassays and mammalian cytotoxicity tests were performed on the raw and treated wastewaters to evaluate their potential environmental impact.

U.S. Environmental Protection Agency
Water Conservation and Pollution Control in Coal Conversion Processes, EPA-600/7-77-065, by D.J. Goldstein and D. Yung, 151 pages, June 1977.

Availability: Civil Engineering, Montana State University

Purpose/Topic:	
Water Quantity	Significant
Water Quality	Significant
Water Treatment	Significant
Synfuel Technologies	Useful

Reviewer's Comments: (N.Z.)

This is a particularly useful report. The information is specific to problems in Western United States; however, Montana is not included as one of the study sites. Nevertheless, there is substantial information which can be applied to Montana.

The most significant and unique aspect of this report is the detail on water treatment. The authors apply knowledge of coke plant wastewater treatment and other treatment technologies to the problems which are expected in synthetic fuel plants. A number of water treatment technologies are discussed including some promising (but unproven) new technologies. The authors present a series of site studies detailing the best wastewater treatment schemes for the areas investigated.

This report is one of the best sources of information on treating synthetic fuel plant wastewaters, but it is three years old and could be supplemented with more recent information.

Abstract:

The report gives results of a study to determine water consumption and environmental impacts of coal conversion processes in Western States. Part 1 gives brief descriptions and process water requirements for nine conversion processes. Detailed designs and analyses are given for the Hygas, Synthane, and Solvent Refined Coal (SRC) processes, and for Lurgi combined-cycle power generation. At three proposed sites (in North Dakota, New Mexico, and Wyoming), complete water requirements and effluents, including all mining and related off-site uses are given for the power, Hygas and SRC plants. The Synthane process is analyzed only at the Wyoming site. Part 2 gives analyses of influent and effluent waters, with examples for study, For the three selected plants at the North Dakota site, source water will be available but is brackish. All the plants at the Wyoming site receive sewage from a satellite town; additional fresh water is available but is assumed to be expensive. The plants, being net consumers of water, are designed for no discharge of water. For each process at each site (10 cases) an integrated water treatment plant block flow diagram is given with approximate costs and energy requirements.

U.S. Environmental Protection Agency
Water Requirements for Steam-Electric Power Generation and Synthetic Fuel Plants in the Western United States, EPA-600/7-77-037, by H. Gold, D.J. Goldstein, R.F. Probstein, J.S. Shen, and D. Yung, Water Purification Associates, Springfield, Virginia, NTIS, 276 pages, April 1977.

Availability: Environmental Library

Purpose/Topic:

Projections of Water Requirements	Significant
Information Specific to Montana	Significant
Water Needs for Synfuel Plants	Significant

Reviewer's Comments: (N.Z.)

This report contains water balances for various types of synthetic fuel plants and estimates water requirements for synfuel plants at specific sites in the Western United States. Powder River, Big Horn and Rosebud counties in Montana are included in the authors' estimation of water requirements.

Much of the information in this report is included in Water in Synthetic Fuel Production: The Technology and Alternatives (Probstein and Gold, 1978); however, in this report the information is specific to Montana. The authors include projections of total water requirements for a synthetic fuels industry in the year 2000. The report also includes substantial information which is not pertinent to synfuel production.

Abstract:

The study describes the procedures for the detailed determination of the water consumed for mining and processing of coal and oil shale, and for determing the residuals generated. The processes considered are Lurgi, Synthane, and Synthoil for coal conversion, TOSCO II for shale conversion, coal-fired steam electric power generation and slurry pipeline.

U.S. Environmental Protection Agency
"Water Requirements for Synthetic Fuel Plants," by H. Gold and D.J. Goldstein, in Symposium Proceedings: Environmental Aspects of Fuel Conversion Technology, IV (April 1979, Hollywood, Florida), EPA-600/7-79-217, Springfield, Virginia, NTIS, pgs. 539-558, April 1979.

Availability: Environmental Library

Purpose/Topic:
Water Quantity Requirements of Synfuel Plants   Significant

Reviewer's Comments: (N.Z.)
This report gives very good summaries of water requirements for major types of synfuel plants. Water requirements are given for various geographical areas including Montana. Emphasis is on cooling water requirements because of its high degree of water use and the significant differences which can result from using all-wet cooling, dry cooling or a combination of both. Costs of water determine the degree to which wet cooling should be used. If water costs less than $0.25/1000 gal, a high degree of wet cooling is most economical. If water costs greater than $1.50/1000 gal, then minimum wet cooling is demanded. The authors suggest intermediate cooling (combination of wet and dry) is most economical in Montana. Information in this article is included in Water in Synthetic Fuel Production by Probstein and Gold.

U.S. Executive Office of the President, Council on Environmental Quality, et al.
Socioeconomic Impact of Western Energy Resource Development, (4 Volumes) by Denver Research Institute & Resource Planning Associates, Washington, D.C., GPO, June 1979.

Availability: Montana State University

Purpose/Topic:
Assessment Methodologies
(Esp. for Population Distribution and Settlement Impacts) Useful

Reviewer's Comments: (T.S.)
V1. Summary and Implications (28 pgs.)
V2. Assessment Methodology (159 pgs.)
V3. Case Studies (352 pgs.)
V4. Computer Program

Although not specifically addressed to synfuels, this study is a useful, well-written, comprehensive treatment of socioeconomic impacts and assessment methodologies, and includes a good bibliography. Case studies deal with northwest Colorado and southeastern Utah. Identifies difficulties in forecasting the magnitude, timing and duration of development in the embryonic synfuels industry, as well as the difficulty in forecasting the geographical distribution of impacts.

U.S. Federal Energy Administration
A Report: Regional Profile: Energy Impacted Communities, Lakewood, Colorado, Federal Energy Administration, 364 pages, July 1977.

Availability: R. Gold

Purpose/Topic:
Impact Overview   Useful

Reviewer's Comments: (K.E.)

Problems of the report are those related to: 1) time frame for submission of data and the subsequent analysis; 2) the estimates of data as provided by some individual communities; and 3) the categories selected for accessing the data. Since the study relied on staff members of local and state governments for data collection, reporting of data was sporadic, and much of the sought-after information was not obtained. The usefulness of the report is that the statistical information which is provided is specific to certain communities. State figures should be considered only with the awareness of data gaps at the individual community levels. Other assumptions of the study that a researcher or agency worker should make note of are: 1) energy development proceeding in the areas identified and at the rate projected; 2) provided data are accurate and current; 3) the communities identified are those discernible by the public and industry as impacted. The study did not employ data other than those which could be quantified or put in tabular form.

Abstract:

Baseline data and comparisons for energy impacted communities in Region 8 are reported. Data have been compiled from the qúestionnaires completed by designated local or state personnel for each of the impacted communities. The status of impact as it is recorded under the categories of: community information; administration and planning; housing; health and safety; education; and community services and financing. Included in the Montana summary are data from 23 communities concerning: population, housing needs, water services, financial planning and fiscal management, and state payments to schools. Tables designed by the federal energy administration present statistics regarding the following: types of energy development (i.e., coal); population (1970, 1977, 1980); if incorporated; city government; housing (permanent dwellings, for rent/sale, mobile dwellings, subsidized housing); medical services; police; fire; emergency, education.

267

U.S. Mountain Plains Federal Regional Council
Federal Assistance for Energy Impacted Communities, Denver, Colorado, Mountain Plains Federal Regional Council, 78 pages, 1979.

Availability: Environmental Library

Purpose/Topic:
Impact Overview Useful

Reviewer's Comments: (K.E.)
This catalog was prepared to help increase municipal and rural administrators' awareness of available Federal programs that offer financial assistance which can be used to help minimize the gap between a community's needs and its revenues. Initial information about Federal assistance programs and who to contact for more information is provided in this brief document. The catalog is divided into functional areas such as housing and education.
This is helpful to community leaders who are looking for ways of dealing with an insufficient financial base to support new and expanded services required by a larger population.

268

Van Der Burgt, M.J., Shell Int. Pet. Maatsch
"Clean Syngas from Coal", Hydrocarbon Process., Vol. 58, No. 1, pgs. 161-164, January, 1979.

Availability: Environmental Library

Purpose/Topic:
Technology Description - Shell-Koppers Useful

Reviewer's Comments: (R.E.)
This is the best short description of the Shell-Koppers Gasification System we've seen. The system is basically a high-pressure Koppers-Totzek and has many of the advantages of that system (relatively good thermal efficiency at 77%, no tars or phenols, useful with all coals). Its product composition (about 66% CO, 30% H_2 for Wyodak coal) is such that extensive shifting would be necessary to convert the mixture to high-BTU gas. They estimate the price for synthesis gas from western coals to be $2.50 per MMBTU (1977 prices).

Abstract:

THIS PAPER DESCRIBES TECHNOLOGY AND COSTS OF THE SHELL-KOPPERS PROCESS WHICH OFFERS THE POSSIBILITY OF VIRTUALLY COMPLETE CONVERSION OF ANY TYPE OF COAL INTO A CLEAN PARTICULATE-FREE SYNTHESIS GAS. SPECIAL FEATURES INCLUDE: A COMPACT DESIGN WITH LARGE SINGLE REACTOR CAPACITY. THE ABSENCE OF TARS AND PHENOLIC BYPRODUCTS. THE OPTION OF SUPERHEATED STEAM PRODUCTION FOR AN EFFICIENT HEAT RECOVERY AND THE ELIMINATION OF ENVIRONMENTAL PROBLEMS. IT IS DEMONSTRATED THAT THE ECONOMICS OF THE SHELL-KOPPERS COAL GASIFICATION ARE ONLY MARGINALLY AFFECTED BY VARIATIONS IN COAL RANK, ASH CONTENT OR MOISTURE CONTENT. ONLY THE COSTS OF THE COAL MILL AND DRYER AND OF THE ASH DISPOSAL FACILITIES ARE SIGNIFICANTLY INFLUENCED, BUT THESE HAVE A MINOR IMPACT ON THE OVER-ALL ECONOMICS.

Vogwill, R.I.J.
"Hydrogeological Testing Associated with Underground Coal Gasification," Canadian Geotechnical Journal, pgs. 59-68, February 1979.

Availability: Abstract only

Purpose/Topic:
Effects of In-Situ Gasification on Groundwater Quality — Useful

Reviewer's Comments: (N.Z.)
The report indicates that in-situ gasification, at least this method, can affect the groundwater regime.

Abstract:
Four aquifer tests were completed at a site near Forestburg, Alberta, Canada, to determine aquifer parameters of a coal seam and thus aid in the evaluation of an underground gasification experiment and assess the effects of gasification on the groundwater regime. Analysis of the two pre-gasification aquifer tests indicated that the coal seam was a confined aquifer with small aquifer parameters and strongly anisotrophic hydraulic conductivity that appeared unrelated to known regional fracturing directions. The effect of this anisotrophy on controlling directions of gasification was not established. The first post-gasification aquifer test indicated that the groundwater regime of the coal seam had been changed in various ways. The second post-gasification aquifer test indicated that fracturing in the coal seam was not consistent and that in undisturbed coal seams the direction of regional major fracturing and the major axis of anisotrophy do, in fact, coincide.

270

Waitzman, D.A.
"Ammonia From Coal: A Technical/Economic Review," Chemical Engineering, Vol. 85, pgs. 69-71, January 30, 1978.

Availability: Environmental Library

Purpose/Topic:
Technology Assessment - Low BTU Gasification Useful

Reviewer's Comments: (R.E.)
A quick, three-page review of technologies useful for ammonia production. The economics of the situation are that 3.00/mcf gas and \$25/ton (presumably Eastern) coal give equivalently priced ammonia. In 1978, 12% of the world's ammonia was produced from coal.

It is only a matter of time before proposals for such plants resurface in Montana and/or North Dakota. Other papers suggest the possibility of pipeline ammonia from Western states.

271

Waitzman, D.A.
The TVA Ammonia from Coal Project, presented at Fifth Annual International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Muscle Shoals, Alabama, Tennessee Valley Authority.

Availability: Environmental Library

Purpose/Topic:
Technology Description - ammonia useful

Reviewer's Comments: (R.E.)
A description of a plan to convert an ammonia plant (now reforming natural gas) to coal. They will use a Texaco gasifier to produce 60% of the required synthesis gas for the plant and will retain the capability of producing all of their ammonia from natural gas. A new desulfurization and purification section is being designed.

Illinois coal will be used, but other coals may be tested. They will emit 500 ppm CO, 160 ppm H_2S (with COS) and 270 lbs/day of particulate.

The plant was to be complete in 1980 and a three-year assessment period is planned.

Economically, coal at \$25/ton would be competitive with \$3.25/mcf gas.

Other gasifiers could be used.

272

Washington Natural Gas Company
Redwater Coal Gasification Project: Response to DOE Solicitation No. DE-PA01-80RA50185, Seattle, Washington, Washington Natural Gas Company, u.p., April 25, 1980.

Availability: DNRC

Purpose/Topic:	
Water Requirements	Not Relevant
Water Pollution	Not Relevant
Technology Used for Gasification	Useful
Approach Company Would Take in Building a Gasification Plant	Significant

Reviewer's Comments: (N.Z.)
This report has no information relating to water requirements of the Washington Natural Gas Company's coal gasification plant. However, the report gives insight into the approach the company would take in evaluating the feasibility of such a plant. In evaluating environmental effects of a gasification plant, the company would: 1) establish baseline data for existing environmental conditions, 2) identify permitting requirements (federal, state and local), 3) evaluate and choose treatment schemes, and 4) develop predictive models to assess the environmental impact of the plant.

273

White, C.M., et al.
"Some Analytical Aspects of the Quantitative Determination of Polynuclear Aromatic Hydrocarbons in Fugitive Emissions from Coal Liquefaction Processes," in Polynuclear Aromatic Hydrocarbons: Third International Symposium on Chemistry and Biology--Carcinogenesis and Mutagenesis, Ann Arbor, Michigan, Ann Arbor Science Publishers Inc., pgs. 261-275, 1979.

Availability: Environmental Library

Reviewer's Comments:
Not received in time for comment.

274

Woods, R.W.
The Kilngas Coal Gasification System, West Allis, Wisconsin, Allis-Chalmers Corporation, 8 pages, August 1978.

Availability: Environmental Library

Purpose/Topic:
Description of a Technology | Useful

Reviewer's Comments: (R.E.)
This low-BTU technology for coal gasification is unlikely to be used in Montana. It is intended for use with Eastern coals for combined-cycle power generation.
Allis-Chalmers has developed the system with funding from a number of Eastern utility companies.
Several features, such as ability to build kilns economically in large sizes (6000 tons/day/kiln) and ease of control of gas production, make it likely that the technology will be successful.
The article has no environmental information.

275

Yan, T-Y, and W.F. Espenscheid
"Removal of Thiosulfate/Sulfate from Spent Stretford Solution," Environmental Science & Technology, Vol. 14, No. 6, pgs. 732-735, June 1980.

Availability: Environmental Library

Purpose/Topic:
Acid Gas Removal | Useful

Reviewer's Comments: (R.E.)
This laboratory study, if substantiated on a large scale, could make sulfur removal cheaper.

Abstract:

■ Thiosulfate accumulation presents a serious disposal problem in the Stretford process for removing hydrogen sulfide from contaminated gas streams. A method for treating spent Stretford solution to dispose of thiosulfate and recover the chemicals that it contains is presented. In this technique the solution is acidified with sulfuric acid to decompose the thiosulfate to sulfur and sulfur dioxide, and limed to remove added sulfate and restore the pH of the solution. The extent of reaction and recovery of chemicals has been investigated for each step of the method, and the feasibility of the process scheme as a whole has been investigated.

Synfuel References

Abstract Only Documents

(Actual document not ordered or examined)

276

Anderson, G.L., A.H. Hill, D.K. Fleming, Institute of Gas Technology
"Environmental Quality and Energy Conservation in Coal Conversion Processes" in <u>6th National Conference on Energy and the Environment</u>, CONF-790571-5, Chicago, Illinois, Institute of Gas Technology, 9 pgs., 1979.

Abstract:

IN GENERAL, CONTROLLING EMISSIONS FROM A COAL CONVERSION PROCESS IS AN ENERGY CONSUMING PROCESS. IN THIS PAPER, A PARAMETRIC ASSESSMENT OF ENERGY REQUIREMENTS FOR SULFUR MANAGEMENT IN A COAL GASIFICATION PROCESS TO PRODUCE SUBSTITUTE NATURAL GAS IS PRESENTED. THE RESULTS OF THIS ASSESSMENT SUGGEST THAT THE LEAST ENERGY INTENSIVE SULFUR MANAGEMENT PRACTICE TO UTILIZE IN COAL GASIFICATION PLANTS USING LOW SULFUR COAL (< 3.5%) IS AN H_2S SELECTIVE REMOVAL PROCESS PROVIDING A CLAUS PLANT FEED-STREAM CONTAINING 10% OR LESS H_2S WITH TAIL GAS FROM THE CLAUS PLANT BEING INCINERATED IN THE COAL-FIRED BOILER AND THE ADDITIONAL SO_2 REMOVED IN THE FLUE GAS DESULFURIZATION (FGD) SYSTEM. FOR HIGH SULFUR COALS (> 3.5%), ENERGY CONSUMPTIONS FOR ALL COMBINATIONS WERE SIMILAR FOR A GIVEN FGD SO_2

277

Baker, N.R., et al., Institute of Gas Technology
<u>Coal Liquefaction Processes</u>, ANL/CES/TE--79-6, Springfield, Virginia, NTIS, 95 pgs., July, 1979.

Abstract:

COAL LIQUEFACTION IS AN EMERGING TECHNOLOGY RECEIVING GREAT ATTENTION AS A POSSIBLE LIQUID FUEL SOURCE. CURRENTLY, FOUR GENERAL METHODS OF CONVERTING COAL TO LIQUID FUEL ARE UNDER ACTIVE DEVELOPMENT: DIRECT HYDROGENATION; PYROLYSIS/HYDROCARBONIZATION; SOLVENT EXTRACTION; AND INDIRECT LIQUEFACTION. THIS WORK IS BEING CONDUCTED AT THE PILOT PLANT STAGE, USUALLY WITH A COAL FEED RATE OF SEVERAL TONS PER DAY. SEVERAL CONCEPTUAL DESIGN STUDIES HAVE BEEN PUBLISHED RECENTLY FOR LARGE (MEASURED IN TENS OF THOUSANDS OF TONS PER DAY COAL FEED RATE) COMMERCIAL LIQUEFACTION PLANTS, AND THESE REPORTS FORM THE DATA BASE FOR THIS EVALUATION. PRODUCTS FROM A LIQUEFACTION FACILITY DEPEND ON THE PARTICULAR METHOD AND PLANT DESIGN SELECTED, AND THESE PRODUCTS RANGE FROM SYNTHETIC CRUDE OILS UP THROUGH THE LIGHTER HYDROCARBON GASES, AND, IN SOME CASES, ELECTRICITY. VARIOUS PROCESSES ARE EVALUATED WITH RESPECT TO PRODUCT COMPOSITIONS, THERMAL EFFICIENCY, ENVIRONMENTAL EFFECTS, OPERATING AND MAINTENANCE REQUIREMENTS, AND COST. BECAUSE OF THE LARGE PLANT CAPACITIES OF CURRENT CONCEPTUAL DESIGNS, IT IS NOT CLEAR AS TO HOW, AND ON WHAT SCALE, COAL LIQUEFACTION MAY BE CONSIDERED APPROPRIATE AS AN ENERGY SOURCE FOR INTEGRATED COMMUNITY ENERGY SYSTEMS (CES). DEVELOPMENT WORK, BOTH CURRENTLY UNDER WAY AND PLANNED FOR THE FUTURE, SHOULD HELP TO CLARIFY AND QUANTIFY THE QUESTION OF APPLICABILITY.

278

Clark, D., Fuel Res. Inst. of S. Afr.
"South Africa's Coal Gasification: Prospects for the Future", <u>Hydrocarbon Process</u>, Vol, 58, No. 1, pgs. 56C-56J, January, 1979.

Abstract:

THIS PAPER DISCUSSES TECHNOLOGICAL AND ECONOMIC ASPECTS OF THE COAL CONVERSION PROCESSES USED IN SOUTH AFRICA TO COVER THE MATERIALS USED FOR FUEL AND PROCESS GASES FROM CHEAP COAL. THIS REPORT FIRST DESCRIBES THE CURRENT GASIFICATION PROCESSES (TOWN GAS, PRODUCER GAS, SYNTHESIS GAS). DETAILS ARE GIVEN ON TWO ADVANCED TECHNOLOGIES, KOPPERS-TOTZEK PROCESS (AECI), AND LURGI PROCESS (SASOL). PROSPECTS FOR THE FUTURE INCLUDE DIRECT REDUCTION OF IRON ORE, AND INDIRECT LIQUEFACTION OF COAL.

279

Colaluca, M.A., M.A. Paisley, and K. Mahajan
"Tri-Gas Gasification Process", Chem. Eng. Prog., Vol. 75, No. 6, pgs. 33-40, June, 1979.

Abstract:

THIS PAPER DESCRIBES THE NEWLY DEVELOPED TRI-GAS PROCESS. A MULTIPLE FLUID-BED COAL GASIFICATION SYSTEM, WHICH HAS BEEN DESIGNED TO GASIFY A RANGE OF COALS WITH THE ONLY PRODUCT BEING A CLEAN, LOW-HEAT CONTENT FUEL GAS. NO LIQUIDS, TAR, OR CHAR ARE PRODUCED AS A WASTE OR BYPRODUCT. THE PROCESS CONSISTS OF THREE, FLUIDIZED-BED REACTORS CONNECTED IN SERIES. EACH REACTOR HAS ITS OWN SPECIFIC FUNCTION. STAGE 2 IS THE MAIN GASIFICATION STAGE. HERE, DEVOLATILIZED COAL (CHAR) AND THE VOLATILE PRODUCTS FROM STAGE 1 ARE GASIFIED WITH AIR AND STEAM, PRODUCING A FUEL GAS OF ABOUT 150 BTU/CU FT (5,586 KJ/M;SUP 3;). UNREACTED CHAR FLOWS OUT OF STAGE 2 TO STAGE 3, WHERE THE REMAINING CARBON IS CONSUMED. STAGE 3 OFF GAS IS DIRECTED TO STAGE 1 TO PROVIDE HEAT FOR A LOW TEMPERATURE DEVOLATILIZATION OF THE FEED. STAGE 1, IN TURN, PRODUCES A FREE-FLOWING, DEVOLATILIZED CHAR TO STAGE 2, WHILE ACCEPTING COAL AS A FEED. SUCCESS OF LABORATORY STUDIES LED TO THE DESIGN OF A 0.01 KG/S PROCESS AND EQUIPMENT DEVELOPMENT UNIT (PEDU), WHICH WAS DESIGNED TO DEMONSTRATE THE TECHNICAL FEASIBILITY OF THE TRI-GAS GASIFICATION PROCESS FOR THE COMMERCIAL PRODUCTION OF LOW-HEAT CONTENT FUEL GAS. TECHNOLOGICAL DETAILS ARE GIVEN ALONG WITH SOME DESIGN SUGGESTIONS.

280

Danyluk, S. G.M. Dragel, D. Dubis, Argonne National Laboratory
"Materials Problems Experienced at the Synthane Coal-Gasification Pilot Plant", J. Eng. Mater. Technol., Vol. 101, No. 2, pgs. 105-113, April, 1979.

Abstract:

SOME FAILURE EXPERIENCES WITH METALLIC COMPONENTS AT THE SYNTHANE COAL-GASIFICATION PILOT PLANT ARE PRESENTED. IN SOME CASES, CORROSION CAUSED BY A SULFUR ENVIRONMENT WAS A MAJOR FACTOR IN THE FAILURE INITIATION. SEVERAL INSTANCES OF IMPROPER COMPONENT MANUFACTURE OR HEAT TREATMENT LED TO FAILURES. CHLORIDE-ASSISTED STRESS-CORROSION CRACKING AND AN IMPROPER MATERIALS CHOICE CONTRIBUTED TO TWO CASES OF FAILURE. IN MOST CASES, THE RECOMMENDED CHANGES IN MATERIALS, DESIGN OR PROCESS CONDITIONS HAVE RESULTED IN AN INCREASE IN COMPONENT LIFE.

281

Davis, J.C.
"HYGAS at the Crossroads", Chemical Engineering (N.Y.), Vol. 86, No. 14, pgs. 33-36, July 2, 1979.

Abstract:

A DISPUTED TECHNOLOGY, THE HYGAS COAL-GASIFICATION PROCESS, IS DISCUSSED. IT INVOLVES: THE ORGANIZATION THAT HAS DEVOTED MORE THAN 15 YEARS DEVELOPING THE TECHNOLOGY TO ITS CURRENT PILOT-PLANT LEVEL; AN ENGINEERING-DESIGN FIRM THAT HAS PERFORMED A CRITICAL TECHNICAL AUDIT, AND THE U.S. DEPT. OF ENERGY, WHICH IS CAUGHT IN THE MIDDLE OF THE DEBATE, ALONG WITH AN ASSORTMENT OF ENGINEERING FIRMS AND CONSULTANTS. OF THE THREE BASIC COAL-GASIFICATION METHODS, FIXED-BED, ENTRAINED-BED AND FLUIDIZED-BED, HYGAS FALLS INTO THE LAST CATEGORY. ITS CHIEF ADVANTAGE IS AN ABILITY TO PRODUCE A HIGH CONCENTRATION OF METHANE RIGHT IN A HIGH-PRESSURE GASIFIER (ABOUT 1,000 PSI), THEREBY CUTTING DOWN ON THE SIZE OF METHANATION EQUIPMENT NEEDED DOWNSTREAM. IT DOES THIS BY SETTING UP THREE SEPARATE ZONES OF GASIFICATION TO OPTIMIZE VARIOUS INTERMEDIATE REACTIONS. GENERAL REMARKS ON THE PRESENT STRUCTURE IN RANKS OF HYGAS ARE FOLLOWED BY A DETAILED DISCUSSION OF THE FOLLOWING SUBJECTS--HYGAS'S CRITICS' POSITIONS; THAT THE AUDITING (WHO) REACHED A VERDICT FOR ONE THAT STATES THAT HYGAS IS NOT YET READY FOR DEMONSTRATION SCALE-UP; THAT THERE ARE PROBLEMS WITH CLINKERING AND COAL PREPARATION.

282

Edgar, T.F., et al., University of Texas
<u>Support Research on Chemical, Mechanical, and Environmental Factors in Underground Coal Gasification. Quarterly Report</u>, SAN-2069-1-T1, Springfield, Virginia, NTIS, 71 pgs., April 24, 1979.

Abstract:

THIS QUARTERLY PROGRESS REPORT COVERS RESEARCH WORK PERFORMED AT THE UNIVERSITY OF TEXAS AT AUSTIN ON EVALUATING CHEMICAL, MECHANICAL AND ENVIRONMENTAL FACTORS IN UNDERGROUND GASIFICATION OF TEXAS LIGNITE.

283

Electric Power Research Institute
<u>Coal-to Methanol via New Processes Under Development: An Engineering and Economic Evaluation</u>, EPRI-AF-1227, by W.S. Chia, et al., C.F. Braun and Co., Springfield, Virginia, NTIS, 112 pgs., October, 1979.

Abstract:

THIS REPORT PRESENTS THE RESULTS OF A SCREENING STUDY EVALUATING TWO COAL-TO-METHANOL ROUTES VIA NEW PROCESSES UNDER DEVELOPMENT. FOR THE PURPOSE OF THIS STUDY, TWO COALS HAVE BEEN INVESTIGATED IN TWO DIFFERENT PLANT CONFIGURATIONS: (1) ILLINOIS NO. 6 BITUMINOUS COAL IN AN ALL METHANOL SCHEME, AND (2) WYODAK SUBBITUMINOUS COAL IN A METHANOL AND DISTILLATE FUEL OIL COPRODUCTION SCHEME. THE ALL METHANOL PRODUCTION SCHEME, PROPOSED FOR THE ILLINOIS NO. 6 COAL, INCORPORATES THE TEXACO COAL WATER SLURRY GASIFICATION PROCESS FOR THE PRODUCTION OF SYNTHESIS GAS. IN THE CASE OF WYODAK COAL A NONCATALYTIC LIQUEFACTION PROCESS WAS INCORPORATED TO FIRST LIQUEFY THE COAL TO PRODUCE DISTILLATE FUEL OIL AND THEN GASIFY THE LIQUEFACTION RESIDUE SLURRY IN THE TEXACO OIL SLURRY GASIFICATION TO PRODUCE SYNTHESIS GAS AND HYDROGEN. IN BOTH SCHEMES THE LIQUID PHASE METHANOL PROCESS WAS USED FOR THE SYNTHESIS OF METHANOL FROM CLEANED AND CONDITIONED SYNTHESIS GAS. ALL OTHER PROCESSES INCORPORATED IN THE PLANT CONFIGURATIONS HAVE BEEN COMMERCIALLY PROVEN IN THE PETROCHEMICAL, CHEMICAL, OR PETROLEUM REFINERY INDUSTRY. THE CONCEPTUAL DESIGNS FOR THE TWO GRASS ROOTS COAL CONVERSION COMPLEXES EACH DESIGNED TO PRODUCE APPROXIMATELY 300 BILLION BTU PER DAY OF STORABLE FUELS ARE PRESENTED; INCLUDED ARE OVERALL BLOCK FLOW DIAGRAMS, STEAM AND UTILITY BALANCES, AND WATER MANAGEMENT SCHEMES. COST ESTIMATES, ECONOMIC

284

Electric Power Research Institute
Combustion Demonstration of SRC II Fuel Oil in a Tangentially Fired Boiler by KVB, Inc., Springfield, Virginia, NTIS, 100 pgs., May, 1979.

Abstract:

A COMBUSTION DEMONSTRATION UTILIZING DISTILLATE FUEL OIL FROM THE SOLVENT REFINED COAL II (SRC II) PROCESS WAS CONDUCTED IN A UTILITY BOILER OF THE CONSOLIDATED EDISON COMPANY OF NEW YORK. EMISSIONS AND BOILER PERFORMANCE WERE INVESTIGATED AT FULL LOAD, HALF LOAD AND THREE-QUARTER LOAD FOR BASELINE AND LOW NOX (STAGED COMBUSTION) CONDITIONS. APPROXIMATELY 450,000 BARRELS OF SRC II FUEL OIL WERE UTILIZED DURING THE PROGRAM. MEASUREMENTS OF NITRIC OXIDES, OXYGEN, CARBON MONOXIDE, POLYCYCLIC ORGANIC MATTER, TOTAL UNBURNED HYDROCARBONS, SULFUR TRIOXIDE, PARTICULATE MASS, AND PARTICLE SIZE DISTRIBUTION WERE OBTAINED. THE PERFORMANCE OF SRC II FUEL OIL WAS ALSO EXAMINED WITH RESPECT TO COMBUSTION CHARACTERISTICS AND ADAPTATION TO EXISTING BOILER HARDWARE. THE NO. 6 FUEL OIL CURRENTLY BURNED IN THE TEST BOILER WAS ALSO TESTED TO COMPARE WITH THE SRC II FUEL OIL. IN GENERAL, NO MAJOR OPERATIONAL PROBLEMS OR ADVERSE BOILER PERFORMANCE EFFECTS WERE ENCOUNTERED DUE TO THE COMBUSTION OF SRC II FUEL OIL. NITROGEN OXIDE EMISSIONS WERE NOMINALLY 20% GREATER THAN THOSE OBTAINED FOR THE NO. 6 FUEL OIL CURRENTLY USED BY CONSOLIDATED EDISON. REDUCTIONS IN NOX LEVELS ON THE ORDER OF 35% WERE DEMONSTRATED THROUGH COMBUSTION MODIFICATIONS WITH BOTH FUELS. PARTICULATE MASS EMISSIONS WERE LOWER WITH THE SRC II FUEL OIL WHILE THE OTHER EMISSIONS MEASURED WERE ESSENTIALLY EQUIVALENT.

285

Exxon
"Exxon Drafts Synfuels Plan", Energy Res. Dig., Vol. 4, No. 16, pgs. 1, 3, July 31, 1978.

Abstract:

EXXON PROJECTS A LARGE DEMAND FOR SYNTHETIC FUELS BEGINNING AROUND 1990; HOWEVER, AFTER LOOKING AT CURRENT ECONOMIC AND ENVIRONMENTAL OBSTACLES, THEY CONCLUDE THAT 300 THOUSAND BARREL OIL EQUIVALENT A DAY (BDOE) OR LESS WOULD BE PRODUCED BY THAT TIME. FOR THESE REASONS THEY DRAFTED A MODEST PROPOSAL--A TWO-STEP LEGISLATIVE PROGRAM THAT BEGINS WITH FINANCIAL INCENTIVES AND THE REMOVAL OF ENVIRONMENTAL CONSTRAINTS TO DEMONSTRATE TECHNOLOGIES. THIS ALONE, EXXON BELIEVES, COULD LEAD TO 19 PLANTS PRODUCING 800 THOUSAND BDOE BY 1990; DIRECT PRESENT-VALUE COST TO THE GOVERNMENT OF SUBSIDIZING THE INCENTIVES WOULD BE $2 TO $3 BILLION. THE PLAN CALLS FOR MEDIUM-BTU COAL GASIFICATION, COAL LIQUEFACTION, AND SHALE OIL DEMONSTRATION PLANTS. THE COMPANY STRESSES THAT ECONOMIC INCENTIVES SHOULD ENCOURAGE BROAD PARTICIPATION WHILE MINIMIZING THE UNCERTAINTIES OF RAPID CHANGE AND THE IMPACT ON THE FEDERAL BUDGET. COAL LIQUEFACTION;COMMERCIALIZATION;DEMONSTRATION PLANTS; [illegible] ECONOMICS;ENERGY FACILITIES;ENVIRONMENTAL IMPACTS;FINANCIAL INCENTIVES; [illegible] INVESTMENT;LEGISLATION;[illegible] PROCESSING;OIL SHALE PROCESSING PLANTS;PILOT PLANTS; [illegible] SYNTHETIC FUELS; [illegible] TECHNOLOGY UTILIZATION

286

Feerrar, S. et al., Fluor Engineers and Constructors, Inc.
Effects of Sulfur Emission Controls on the Cost of Gasification Combined Cycle Power Systems. Final Report, EPRI-AF-916, Springfield, Virginia, NTIS, 270 pgs., October, 1978.

Abstract:

Abstract: Economic evaluations were performed for a series of coal gasification-combined cycle power generation facilities, each differing in the mode of operation of the sulfur removal unit. The objectives of the study were to determine the added cost of power associated with more stringent sulfur emission requirements as well as the economic impact of the pressure level at which sulfur removal unit was operated. Similar gasification and power generation facilities were used for each evaluation. Identical Texaco type, oxygen-blown, entrained gasifiers were used for all cases. All were integrated with an advanced combined cycle power generation plant based on a design by Westinghouse. The sulfur removal process in each case was Allied Chemical's proprietary Selexol physical solvent process. The mode of operation of the Selexol Unit was varied to achieve a moderate level of sulfur removal at 350 psig and at 1150 psig. Operation to achieve a very ''deep'' level of sulfur removal at 350 psig was also evaluated. The ability to currently achieve the emission requirements specified in the deep sulfur removal case was found questionable, and it was concluded that further development work is necessary. Barring development problems, the cost of power at the stricter emissions level was estimated as 7 to 8% higher than at moderate levels. The economic advantage of high pressure sulfur removal operation was concluded to be insignificant in the cases presented.

287

Finch, H.L.
"Coal Liquefaction at Cresap, West Virginia", in Proceedings of the Coal Processing and Conversion Symposium, Morgantown, West Virginia, West Virginia Geological and Economic Survey, pgs. 62-70, 1979.

Abstract:

THE CURRENT CRESAP PROGRAM IS NOT AN EXTENSION OF THE CONSOL EFFORT, BUT RATHER A NEW PROGRAM WITH NEW AND BROADER OBJECTIVES. A WIDE-RANGING PROGRAM OF EQUIPMENT AND MATERIALS TESTING AND DEVELOPMENT IS PLANNED IN ORDER TO ACHIEVE RELIABLE OPERATION OF ALL COMPONENTS IN THE LIQUEFACTION SYSTEM. INTEGRATION OF THE TOTAL FACILITY TO ACHIEVE MAXIMUM LIQUID YIELD (LOW-SULFUR FUEL OIL) IS NECESSARY TO PERFORM REQUIRED PROCESS STUDIES AND TO FULLY IMPLEMENT PLANNED EQUIPMENT DEVELOPMENT WORK.

288

Flanigan, J.
"Present at the Creation", Forbes, Vol. 124, No. 2, pgs. 34-38, July 23, 1979.

Abstract:

A PILOT PLANT TO TEST A PROCESS FOR TURNING COAL INTO LIQUID FUELS WILL OPEN JANUARY 1980 AT A COST OVERRUN OF 65% AT CATLETTSBURG, KENTUCKY, IF ALL GOES WELL. DOE FUNDED THE MAJORITY OF THE PROJECT WITH ASHLAND OIL AS PROJECT MANAGER, WHO HAS NOW BEEN RELIEVED, ACCUSED BY DOE OF MISMANAGEMENT. EXPERTS SCOFF AT THE NOTION THAT SYNFUEL PRODUCTION EQUIVALENT TO 2 MILLION BARRELS PER DAY BY 1990 CAN BE ACHIEVED. ONE OIL EXECUTIVE SAYS THAT HALF THAT AMOUNT BY 1990 WOULD BE MORE REALISTIC. AN OUTLAY OF $60 BILLION TO CREATE THAT PLANT TO PRODUCE 1 MILLION BARRELS PER DAY OF SYNTHETIC FUEL WILL BE NECESSARY. BUT AT OPEC'S LATEST PRICES, THE COST OF IMPORTING 1 MILLION BARRELS PER DAY FOR 15 YEARS ADDS UP TO SLIGHTLY MORE THAN $76 BILLION. PLANS BY OTHER COMPANIES TO BUILD SYNTHETIC FUELS PLANTS ARE BRIEFLY DESCRIBED. (MCW)

289

Fleming, D.K.
"Acid-Gas Removal Systems in Coal Gasification" in Ammonia-From-Coal Symposium, CONF-790599-21, Chicago, Illinois, Institute of Gas Technology, 28 pgs., 1979.

Abstract:

A LARGE NUMBER OF ACID-GAS REMOVAL SYSTEMS EXIST OR ARE UNDER DEVELOPMENT FOR THE REMOVAL OF H_2S AND CO_2 FROM PROCESS GAS STREAMS. A FEW SYSTEMS HAVE BEEN APPLIED TO COAL CONVERSION PROCESSES; OTHERS WILL REQUIRE EXTRAPOLATION OF PRESENTLY-PROVED COMMERCIAL OPERATION. THE FEED TO THE ACID-GAS REMOVAL SYSTEM FOR THE GENERIC COAL-TO-AMMONIA FACILITY IS NOT WELL-DEFINED; PARTICULARLY FOR MINOR AND TRACE CONSTITUENTS. THIS IS PARTICULARLY TRUE IN THE CASE OF NEWER GASIFICATION PROCESSES THAT MAY HAVE SIGNIFICANT ECONOMIC ADVANTAGES IN THE OVERALL PROCESS WHEN EVALUATED ON A TOTAL SYSTEMS ANALYSIS APPROACH. A NUMBER OF SPECIES THAT COULD BE PRESENT IN THE GAS FED TO THE ACID-GAS REMOVAL SYSTEM ARE DISCUSSED; THE DESIGN OF THAT SUBPROCESS SHOULD CONSIDER THE FATE OF THESE SPECIES FROM BOTH AN ENVIRONMENTAL AND AN ECONOMIC STANDPOINT. IN AN OVERALL EVALUATION, IT APPEARS THAT ACID-GAS REMOVAL SYSTEMS CAN BE SUCCESSFULLY APPLIED IN COAL CONVERSION; NO TECHNICAL OBSTACLE HAS YET BEEN DISCOVERED TO RESTRICT THEIR APPLICATION.

290

Gas Research Institute
Overview of National Research and Development Activities in Synthetic Natural Gas from Coal, GRI-79/0003, by Booz, Allen & Hamilton, Inc., Springfield, Virginia, NTIS, 64 pgs., September, 1979.

Abstract:

THE PURPOSE OF THIS REPORT IS TO PROVIDE THE GAS RESEARCH INSTITUTE (GRI) WITH AN OVERVIEW OF ACTIVITIES WHICH ARE RELATED TO GRI'S SYNTHETIC NATURAL GAS (SNG) FROM COAL SUBPROGRAM AREA. THE INFORMATION PRESENTED IS INTENDED TO ASSIST GRI IN GUIDING ITS OWN RESEARCH ACTIVITIES AN TO PROVIDE AN INFORMATION BASE FOR ENSURING THAT ITS PROGRAMS ARE COORDINATED WITH THE ACTIVITIES OF INDUSTRY AND GOVERNMENT.

291

German, M.
"Energy System Efficiency for Space Heating", American Gas Association Monograph, Vol. 61, No. 6, pgs. 13-14, June, 1979.

Abstract:

A NUMBER OF ANALYSES PUBLISHED IN THE LAST THREE YEARS HAVE SHOWN GAS TO BE THE MOST EFFICIENT RESIDENTIAL ENERGY FUEL. THIS ANALYSIS COMPARES THREE MAJOR RECENT ESTIMATES OF TOTAL ENERGY EFFICIENCY FOR RESIDENTIAL SPACE HEATING, AND THREE ESTIMATES OF THE TOTAL SYSTEM EFFICIENCY OF COAL GASIFICATION VERSUS COAL ELECTRIFICATION. THE FIVE REPORTS ON ENERGY EFFICIENCY EXAMINED HERE AGREE THAT NATURAL GAS IS THE MOST EFFICIENT ENERGY FORM FOR RESIDENTIAL SPACE HEATING, ASSUMING EITHER CONVENTIONAL OR ADVANCED END-USE EQUIPMENT.

292

Gladkii, A.V., et al.
"Removal of Sulfur Dioxide from Industrial Gases with the Aid of the Claus Liquid Phase Reaction", Khim. Tekhnol. Topliv Masel, No. 3, pgs. 36-37, 1979.

Abstract:

THE MOST EFFECTIVE ABSORBENT FLUID FOR REMOVING SULFUR DIOXIDE AND HYDROGEN SULFIDE FROM INDUSTRIAL GASES WITH THE AID OF THE CLAUS REACTION WAS SHOWN TO BE N-METHYLPYRROLIDON. THE DEGREE OF PURIFICATION IS 99% AND IS REDUCED TO 93% ONLY IN THE PRESENCE OF 50% WATER.

293

Goar, B.G.
"Fundamentals of Sulfur Recovery by the Claus Process", in 27th Proceeding of the Gas Conditioning Conference, Norman, Oklahoma, University of Oklahoma, pgs. E1-E15, 1977.

Abstract:

In today's society there is an increased concern about the potential threat of air pollution to the well being of mankind. Up until recent years, most Claus plants were considered to be of significant importance in reducing SO//2 emissions to the atmosphere. Nowadays, most Claus plants are considered to be potential major offenders of air pollution regulations. The tail Gas Clean-Up (TGCU) processes have been developed to clean-up the tail gas from Claus plants. In the future, new processes may be required to clean-up the tail gas from the TGCU processes. The paper discusses the basic reactions and processing in a Claus plant together with major operating control variables. Design considerations are included. When a TGCU system is planned, it may be advisable to install a Claus-plant tail-gas analyzer (possibly with feedback control) to monitor the H//2S/SO//2 ratio and permit adjustment of the combustion air flow to achieve the optimum ratio of 2/1 at all times. 9 refs.

294

Gray, J.A.
"Success at Westfield", <u>Energy Digest</u>, Vol. 6, No. 1, pgs. 39-43, February, 1977.

Abstract:

IN COMPARISON WITH THE WESTFIELD COAL. THE US COALS BECAUSE OF THEIR LOW FUSION POINT ASH NEEDED A HIGHER STEAM/OXYGEN RATIO TO PREVENT SINTERING AND PRODUCED A HIGHER YIELD OF LIQUOR. THERE WERE OTHER DIFFERENCES AS WELL BUT THE ONE IMPORTANT RESULT OF THE TRIALS WAS THAT AMERICAN COALS RANGING FROM THE SUBBITUMINOUS COALS OF THE WESTERN US TO HIGHLY CAKING COALS OF THE MID-WEST AND EAST. REPRESENTING LARGE AND IMPORTANT RESERVES IN THE USA. COULD BE SUCCESSFULLY GASIFIED IN A LURGI GASIFIER. IN THE CONVENTIONAL LURGI GASIFIER. EXCESS STEAM IS REQUIRED TO AVOID CLINKERING AND THE AMOUNT IS GREATER IF THE ASH IS OF LOW FUSION POINT AND THE COAL IS OF LOW REACTIVITY. WITH SLAGGING OPERATION THE STEAM IS REDUCED TO LITTLE MORE THAN THAT REQUIRED FOR GASIFICATION. AND AT THE HIGHER TEMPERATURE REACTIVITY IS OF LESS SIGNIFICANCE. THE REDUCTION IN STEAM IS MORE THAN FIVEFOLD AND THIS LARGE DECREASE RESULTS NOT ONLY IN HIGHER THERMAL EFFICIENCIES BUT ALSO IN GREATER THROUGHPUT AND REDUCED AMOUNTS OF THE LIQUOR PRODUCED. FURTHER INTERNATIONAL COOPERATION HAS LED TO THE CONVERSION OF ONE OF THE GASIFIERS TO SLAGGING OPERATIONS AT WESTFIELD WITH TRIALS THAT SHOWED CRUDE GAS PRODUCTION RATES OF ABOUT FOUR OR FIVE TIMES THOSE OF THE ORIGINAL WESTFIELD LURGI GASIFIER WITH VERY MUCH LOWER YIELDS OF GAS LIQUOR IN RUNS OF SEVEN DAYS DURATION.

295

Hass, R.H.
<u>Process for Removing Sulfur and NO_x Components From a Gas Stream</u>, U.S. Patent Report 4,123,507, Washington, D.C., U.S. Patent Office, 24 pgs., October 31, 1978.

Abstract:

A FEED GAS CONTAINING ONE OR MORE COMPONENTS SELECTED FROM THE CLASS CONSISTING OF H$SUB 2$S. SO$SUB 2$. SO$SUB 3$. COS. CS$SUB 2$. LIGHT MERCAPTANS. AND SULFUR VAPOR IS DESULFURIZED BY (A) HYDROGENATING AND HYDROLYZING ESSENTIALLY ALL NON-H$SUB 2$S SULFUR COMPONENTS TO H$SUB 2$S. (B) OXIDIZING MOST OF THE H$SUB 2$S IN THE RESULTING PRODUCT GAS TO SULFUR. AND REMOVING THE LATTER BY CONDENSATION. (C) OXIDIZING THE RESIDUAL H$SUB 2$S TO SO$SUB 2$. (D) ABSORBING ESSENTIALLY ALL THE SO$SUB 2$ IN AN AQUEOUS AMMONIA SOLUTION. (E) PASSING A PORTION OF THE SO$SUB 2$-CONTAINING AMMONIA SOLUTION TO STEP (A) . AND (F) DISCHARGING FROM STEP (D) A PURIFIED PRODUCT GAS ESSENTIALLY FREE OF SULFUR COMPONENTS. A FEED GAS. SUCH AS A STACK GAS. WHICH CONTAINS ONLY SO$SUB 2$ AND SO$SUB 3$ COMPONENTS TO BE REMOVED THEREFROM. MAY BE TREATED IF ALTERNATIVE EMBODIMENTS OF THE INVENTION INVOLVING THE PASSAGE OF ALL OR A MAJOR PROPORTION OF THE FEED GAS DIRECTLY TO ABSORPTION STEP (D). IN ALL EMBODIMENTS OF THE INVENTION A SUBSTANTIAL PROPORTION OF NO/SUB X/ COMPONENTS. IF PRESENT IN THE FEED GAS. IS ALSO REMOVED.

296

Hahn, O.J., et al., University of Kentucky
"Mass and Energy Balance of a Wellman-Galusha Gasifier", <u>Fuel Process. Technol.</u>, Vol. 2, No. 1, pgs. 1-16, February, 1979.

Abstract:

A TEST WAS RUN ON A COMMERCIAL-SIZE. MOVING-BED ATMOSPHERIC GASIFIER TO COLLECT PROCESS DATA AND TO QUANTIFY TRACE GASES WITH A CAKING BITUMINOUS COAL (FREE SWELLING INDEX (FSI) 3 TO 5). THESE DATA WERE DESIRED TO UPDATE AND EXPAND THE AVAILABLE INFORMATION USED IN THE DESIGN OF NEW GAS PRODUCERS AND ASSOCIATED GAS CLEANUP SYSTEMS. THE TEST RUNS WERE MADE WITH A SIZED 3.8 X 5 CM (1.5 X 2 INCH) EASTERN KENTUCKY ELKHORN NO. 3 BITUMINOUS COAL. AS EXPECTED. THE CARBON UTILIZATION WAS HIGH. > 99%. THE HEATING VALUE OF THE GAS WAS 5.6 MJ/M$SUP 3$ (150 BTU/FT$SUP 3$). AND THE COLD AND HOT GAS EFFICIENCIES WERE 77% AND 87%. RESPECTIVELY. THE TRACE GASES QUANTIFIED WERE HYDROGEN SULFIDE (0.10%). AMMONIA (0.09%). AND HYDROGEN CYANIDE (0.005%). CYCLONE DUST WAS EXAMINED USING A SCANNING ELECTRON MICROSCOPE AND FOUND TO BE POROUS. AN EARLIER TEST RUN OF RUN-OF-MINE EASTERN KENTUCKY ELKHORN NO. 3 COAL PROCESSED IN A MOVING-BED GASIFIER IS ALSO REPORTED. THE MOVING-BED ATMOSPHERIC GASIFIER WHICH WAS OF A SIZE SUITABLE FOR INDUSTRIAL DEMAND HAS BEEN TESTED AND DESIGN AND PROCESS DATA COLLECTED.

297

Institute of Gas Technology
U-Gas Process to Produce Medium-and Low-Btu Gas from Coal, Chicago, Illinois, Institute of Gas Technology, 19 pgs., 1979.

Abstract:

THE U-GAS PROCESS TO PRODUCE MEDIUM- OR LOW-BTU GAS FROM COAL HAS EVOLVED FROM MANY CONTINUOUS YEARS OF COAL GASIFICATION R AND D AT IGT. SPECIFIC U-GAS WORK WAS BEGUN ABOUT 1974 AND NOW TOTALS ABOUT 200,000 MAN-HOURS; COSTS TO DATE TOTAL APPROXIMATELY 17 MILLION AND THE WORK HAS PRODUCED A TOTAL OF NINE PATENT DISCLOSURES. THE U-GAS PILOT PLANT HAS BEEN OPERATIONAL FOR 5 YEARS, AND IS DESIGNED FOR A CAPACITY OF 24 TONS OF COAL DAILY. RECENT OPERATIONS HAVE PROVIDED DATA IN SUPPORT OF THE PRELIMINARY DESIGN OF A COMMERICAL FACILITY, UNDER DOE SPONSORSHIP, THAT IS PLANNED FOR CONSTRUCTION AT MEMPHIS, TENNESSEE, AND WOULD HAVE A CAPACITY TO PRODUCE 175 X 10$SUP 6$ CUBIC FEET OF MEDIUM BTU GAS DAILY FROM 2300 TONS OF COAL.

298

Kerr, R.K. and E.M. Berlie
"Claus Process: Reaction Furnace/Burner Operation", Energy Process Canada, Vol. 28, Part I, pgs. 42-44, February 1, 1977.

Abstract:

This article explores the Clauss process reaction furnace/burner operation. The most important control parameter for Claus plant operation is the air:acid gas ratio into the reaction furnace. It is shown that thermodynamic equilibrium calculations and field measurements that indicate air:acid ratios cannot be calculated based on acid gas analysis alone, but rather lie between the extremes of air demand based on total combustion of one-third of H//2S and air demand at equilibrium with the outlet H//2S:SO//2 ratio at 2:1. Conversion efficiencies, flame temperatures and acid gas and fuel-gas-fired burner operations were also studied.

299

Koppenaal, D.W., et al.
"Trace Element Distributions in Coal Gasification Products", in World Fuels, Structure of Coal, Trace Elements and Hazardous Compounds in Fossil Fuels, Am. Chem. Soc., Div. Fuel Chem., Prepr., Vol. 24, No. 1, pgs. 299-306, 1979.

Abstract:

THE DETERMINATION OF THE FATE AND DISTRIBUTION OF TRACE ELEMENTS DURING COAL CONVERSION IS AN IMPORTANT AND PREREQUISITE TASK IF SUCH AN INDUSTRY IS TO BE IMPLEMENTED ON A MASSIVE SCALE.- CONSIDERING THE OVERWHELMING ABUNDANCE OF NATIVE COAL RESOURCES, AN IMPLEMENTATION OF THIS MAGNITUDE IS A DISTINCT POSSIBILITY IN THE NEAR FUTURE. IN CONJUNCTION WITH ONGOING COAL GASIFICATION STUDIES AT THIS LABORATORY, TRACE ELEMENT INVESTIGATIONS HAVE BEEN PERFORMED TO HELP ASSESS POTENTIAL ENVIRONMENTAL IMPACTS OF COAL GASIFICATION PROCESSES. THIS WORK PRESENTS PRELIMINARY FINDINGS OF TRACE AND MINOR ELEMENT DISTRIBUTIONS IN THE PROCESS STREAMS OF THE SYNTHANE GASIFIER PROCESS DEVELOPMENT UNIT. ALL PROCESS STREAMS WERE SURVEYED FOR APPROXIMATELY 65 ELEMENTS BY CONVENTIONAL SSMS ANALYSIS. SUCH ANALYSES PROVIDE QUICK MULTI-ELEMENT ANALYSES THAT ARE VALUABLE WHEN INORGANIC COMPOSITION OF THE PROCESS STREAMS ARE UNKNOWN AND/OR UNSUSPECTED. THIS TYPE OF ANALYSIS IS ESPECIALLY USEFUL FOR PROCESS MONITORING APPLICATIONS, RESULTING IN AN ALMOST COMPLETE INORGANIC CHARACTERIZATION OF PROCESS STREAMS FROM SUCH A CONVERSION UNIT. THIS KIND OF CHARACTERIZATION IS ESPECIALLY USEFUL IN DELINEATING POTENTIAL PROBLEMS AND POINTING OUT THE NEED FOR MORE ACCURATE ANALYSES OF SPECIFIC ELEMENTS. BOTH THE SSMS SURVEY RESULTS AND THE MORE ACCURATE, PRECISE RESULTS OBTAINED BY ID-SSMS AND AAS SHOW THE GASIFIER CHAR TO BE THE MAJOR ELEMENTAL SINK FOR MOST ELEMENTS. THIS HAS IMPORTANT ENVIRONMENTAL RAMIFICATIONS IN THAT THIS MATERIAL MAY BE UTILIZED AS COMBUSTION MATERIAL FOR PRODUCTION OF PROCESS STEAM. THE FATE OF ENVIRONMENTALLY IMPORTANT ELEMENTS DURING THIS COMBUSTION WILL NEED TO BE DETERMINED. ON THE OTHER HAND, IF THE CHAR IS DISPOSED OF AS AN ALTERNATIVE TO ITS BY-PRODUCT UTILIZATION, SIGNIFICANT SOLID WASTE PROBLEMS WILL ALMOST CERTAINLY OCCUR. MASS BALANCES OF ELEMENTS ACROSS A CONVERSION UNIT MAY BE VALUABLE IN PREDICTING THE RELEASE RATES OF CERTAIN ELEMENTS TO THE ENVIRONMENT.

300

Kouzel, B., et al.
"Treat Low Sulfur Gases With Beavon Sulfur Removal Process and the Improved Stretford Process", in 27th Proceeding of the Gas Conditioning Conference, Norman, Oklahoma, University of Oklahoma, pgs. H1-H16, 1977.

Abstract:

In the petroleum refining industry the Claus process is most commonly used for the conversion of hydrogen sulfide to elemental sulfur. To reduce tail-gas sulfur emissions, the Claus process uses three and sometimes four catalytic stages at which point thermodynamic considerations limit increased plant efficiency by this technique. Further reduction in emissions of sulfur dioxide (SO//2), carbonyl sulfide (COS), carbon bisulfide (CS//2) and hydrogen sulfide (H//2S) has required the development of tail gas cleanup processes of which the Beavon Sulfur Removal Process (BSRP) is one of the most outstanding. This report describes the research work aimed at the development of BSRP process through a pilot plant to the industrial units installed at the refineries. Chemistry and operation techniques of the process are described. Performance of the system are given. It is concluded that the BSRP seems to be one of the most effective methods for controlling pollution from Claus plants. The concentration of sulfur compounds in effluents from BSRP plants is the lowest of any sulfur removal process. An attractive feature of the process is that no incineration of effluent gas is required.

301

Lee, W., J. Mazuik, & W.K. Thiemann, Mobil Research and Development Corp.
"New Process for the Conversion of Coal into Gasoline", in 26th General Meeting of the Deutsche Gesellschaft Fuer Mineraloelwissenschaft Und Kolhechemie E.V., Leinfelden-Echterdinger, Germany, F.R., Industrieverl. Von Hernhaussen, pp. 675-693, 1978.

Abstract:

THE PAPER DESCRIBES THE CONVERSION OF METHANOL INTO A HIGH OCTANE ENGINE FUEL. SINCE METHANOL CAN BE OBTAINED FROM COAL, THE SUCCESSFUL DEVELOPMENT OF THIS PROCESS OPENS A NEW WAY TO GASOLINE FROM COAL. THE PROCESS WAS EXTENDED TO A FLUIDISED BED PILOT PLANT WITH A CAPACITY OF 4 BARRELS/D (640 L/D). THE METHANOL/GASOLINE CONVERSION AND THE COMMERCIAL FISCHER-TROPSCH-SYNTHESIS ARE DISCUSSED. THE ADVANTAGES OF THE MOBIL-PROCESS ARE: LOWER COSTS, IMPROVED THERMAL EFFICIENCY, A BETTER GASOLINE SELECTIVITY AND QUALITY, LOWER INVESTMENTS AND A SIMPLIFIED PROCESS. ACCORDINGLY, THE CONVERSION OF METHANOL INTO GASOLINE IS AN ATTRACTIVE ALTERNATIVE TO THE DIRECT MIXING OF METHANOL TO ENGINE FUELS.

302

Loeding, J.W., I.G. Stanfill, Institute of Gas Technology
"Application of the U-Gas Process for the Production of Gas of Intermediate Calorific Value", in <u>14th World Gas Conference</u>, CONF-790512-4, Chicago, Illinois, <u>Institute of Gas Technology</u>, 26 pgs., 1979.

Abstract:

THIS PAPER DEALS WITH THE STATUS OF THE MEMPHIS (TENNESSEE) LIGHT, GAS AND WATER DIVISION'S (MLGW) INDUSTRIAL FUEL GAS PROJECT AND THE RECENT PROGRESS IN RESEARCH AND DEVELOPMENT ACTIVITIES DIRECTED AT GENERATING LOW- AND INTERMEDIATE-CALORIFIC VALUE GAS. THE DETAILED DESIGN OF A 2540 TONNES PER DAY COAL CONVERSION DEMONSTRATION PLANT TO PRODUCE 10.76 MJ PER M$SUP 3$ INDUSTRIAL FUEL GAS IS SCHEDULED FOR COMPLETION IN APRIL OF 1979. THE DESIGN INCORPORATES MANY PROVEN INNOVATIVE PROCESS DEVELOPMENTS AVAILABLE TO THE PROCESS DESIGNER AT THE TIME THE DESIGN WAS MADE FIRM. THE PRODUCT GAS, PRINICPALLY CO AND H$SUB 2$, IS INTENDED FOR SELECTED INDUSTRIAL OR COMMERCIAL CUSTOMERS AS A RELIABLE ALTERNATIVE TO NATURAL GAS. THE PAPER INCLUDES A STATUS REPORT ON WORK UNDERWAY.

303

Michaels, H.J., Koppers Company, Inc.
"Hydrogen Production via the K-T Gas Gasification Process: Current Economic and Technological Aspects" in <u>Hydrogen for Energy Distribution</u>, CONF-780748, Chicago, Illinois, Institute of Gas Technology, pp. 225-238, 1979.

Abstract:

THE USE OF GASEOUS HYDROGEN AS BOTH AN ENERGY CARRIER AND AS A FEEDSTOCK FOR VARIOUS CHEMICAL PROCESSES HAS BEEN WIDELY DISCUSSED AND INVESTIGATED IN THE PAST FEW YEARS PARTICULARLY WITH REGARD TO THE USE OF INDIGENOUS COAL SUPPLIES AS THE ENERGY SOURCE TO PRODUCE HYDROGEN. NEARLY ALL THE HYDROGEN THAT IS PRODUCED TODAY IS MANUFACTURED FROM NATURAL GAS AND LIGHT OILS BY STEAM REFORMING THESE FEEDSTOCKS. AS THESE SOURCES BECOME MORE COSTLY AND AS THE RELIABILITY OF THEIR DELIVERY BECOMES MORE QUESTIONABLE,' HYDROGEN FROM COAL WILL BECOME ECONOMICALLY COMPETITIVE. THE FOLLOWING INFORMATION PERTAINS TO THE ESTIMATED COST OF PRODUCING 100 MILLION SCFD OF HIGH PURITY (97.4%), LOW CARBON OXIDE CONTENT (< 10 PPM) HYDROGEN VIA THE K-T GASIFICATION PROCESS. DEPENDING ON FACTORS SUCH AS PLANT LOCATION, ENVIRONMENTAL REGULATIONS, AND THE AVAILABILITY AND COST OF UTILITIES, THE COST OF HYDROGEN RANGES FROM ABOUT $4.50/MILLION BTU TO $7.00/MILLION BTU. THESE COSTS ASSUME FINANCING WITH 75% DEBT CAPITAL AT 9% PER YEAR AND 25% EQUITY CAPITAL AT A 12% AFTER TAX DISCOUNTED CASH FLOW RATE OF RETURN. THE PRESENT PAPER ALSO CONTAINS INFORMATION REGARDING THE SENSITIVITY OF HYDROGEN COSTS TO FEEDSTOCK COSTS, PLANT SITE, AND FINANCING METHODS.

304

Moriguchi, S., et al.
<u>Methods of Removing Nitrogen Oxides From Exhaust Gas by Reduction</u>, U.S. Patent 4,125,604, Washington, D.C., U.S. Patent Office, 8 pgs., May 24, 1977.

Abstract:

POWDER AND/OR FINE PARTICLES CONTAINING MAINLY OXIDES OF IRON OR FERROALLOYS, WHICH ARE USED OR GENERATED IN IRONWORKS, STEELWORKS, ETC., ARE SIEVED TO A GRAIN SIZE RANGE BETWEEN ABOUT 32 MESH AND ABOUT 10 MM AND USED AS REDUCTION CATALYZER. A REACTOR IS FILLED WITH SAID REDUCTION CATALYZER. EXHAUST GAS CONTAINING NITROGEN OXIDES AND WITH ADDED AMMONIA IS PASSED IN CONTACT WITH SAID REDUCTION CATALYZER THROUGH SAID REACTOR, WHILE HEATING SAID REDUCTION CATALYZER TO A TEMPERATURE BETWEEN ABOUT 300$SUP 0$C AND ABOUT 370$SUP 0$C, WHEREBY NITROGEN OXIDES ARE REMOVED FROM SAID EXHAUST GAS BY REDUCTION. SAID REDUCTION CATALYZER CAN BE USED AS MATERIAL FOR IRONMAKING, WITHOUT REQUIRING ANY FURTHER TREATMENT, AFTER USE AS CATALYZER.

305

Moyes, A.J. and J.S. Wilkinson
"Development of the Stretford Process", in International Conference Control of Gaseous Sulphur Compound Emissions, London, England, Institute of Chemical Engineering, Vol. 2, 28 pgs., 1973.

Abstract:

A process description, plus a comprehensive survey of practical new developments incorporated into the process, are described. Basically, in the Stretford process, hydrogen sulphide is removed from a fuel gas by contact with an alkaline wash solution in an absorber. The wash liquor contains a mixture of sodium carbonate and sodium bicarbonate whose proportions are determined by the absolute partial pressure of carbon dioxide above the solution and the total sodium content as these two salts. The pH value of the wash solution is influenced by all cations and anions in solution. The dissolved hydrogen sulphide ionizes and, because of the pK value of the second proton in hydrogen sulphide is 12. 9 and the wash-liquor pH values not normally exceed 10. 9, the predominant species is the hydrosulphide ion. Developments in plant design and capital costs are also provided.

306

Nobles, J.E., J.W. Palm, and D.K. Knudtson
"Plant Performance Proves Process", Hydrocarbon Process, Vol. 56, No. 7, pgs. 143-145, July, 1977.

Abstract:

THIS PAPER DESCRIBES THE FIRST COMERCIAL INSTALLATION OF THE COLD BED ADSORPTION (CBA) PROCESS FOR IMPROVED CLAUS PLANT SULFUR RECOVERY WHICH PROVED TO BE SATISFACTORY. THIS CBA UNIT RAISED SULFUR RECOVERY OF THE 890 LT/D SULFUR PLANT TO 99.3%. THE PLANT HAS BEEN IN CONTINUOUS OPERATION SINCE STARTUP WITH ONLY MINOR DIFFICULTIES. THE SULFUR EMISSIONS HAVE REMAINED WELL BELOW REGULATION REQUIREMENTS THROUGHOUT THE ENTIRE PERIOD OF OPERATION. THE CBA PROCESS IS A DRY TYPE OF TAIL GAS CLEAN-UP PROCESS WHICH USES UNIT OPERATIONS SIMILAR TO THOSE USED IN CLAUS PLANTS. A CLAUS REACTOR OPERATED AT A LOW TEMPERATURE IS ADDED TO PROCESS THE EFFLUENT GAS FROM THE CONVENTIONAL. TWO CATALYTIC STAGE CLAUS PLANT. DESIGN AND OPERATIONAL DETAILS ARE GIVEN.
AIR POLLUTION ABATEMENT;CATALYSTS;CLAUS PROCESS: T2;DESIGN;DESULFURIZATION: O1;FLUE GAS: T1,O2;RECOVERY SULFUR

307

Pittsburg and Midway Coal Mining Co.
Solvent Refined Coal (SRC) Process: Health Program. Research and Development Report No. 53: Interim Report No. 28, July 1, 1977-June 30, 1978. Volume III. Pilot Plant Development Work. Part 4. Industrial Hygiene, Clinical, and Toxicological Programs, Springfield, Virginia, NTIS, 120 pgs., April, 1979.

Abstract:

THE MAJOR AREAS OF ACTIVITY WITHIN THE HEALTH PROGRAMS ARE: AN INDUSTRIAL HYGIENE MONITORING PROGRAM, A CLINICAL MEDICAL EXAMINATION PROGRAM, AN EDUCATIONAL AND PERSONAL HYGIENE PROGRAM, AND A TOXICOLOGICAL PROGRAM. CONTINUING INDUSTRIAL HYGIENE MONITORING INDICATED THAT WORKER EXPOSURES DURING SRC II OPERATION WERE GENERALLY VERY SIMILAR TO THE QUITE LOW EXPOSURES MEASURED DURING THE PREVIOUS SRC I OPERATION. SIGNIFICANTLY LOWER LEVELS OF TOTAL SUSPENDED PARTICULATES AND BENZENE SOLUBLE PARTICULATES WERE OBSERVED DURING SRC II OPERATION COMPARED TO SRC I OPERATION. THE MEDICAL EXAMINATION PROGRAM CONTINUED TO INDICATE THE ABSENCE OF DISCERNIBLE OCCUPATIONALLY RELATED CHANGES IN EMPLOYEE MEDICAL PROFILES. THE EMPLOYEE PERSONAL HYGIENE AND EDUCATION PROGRAM HAS CONTINUED TO BE GENERALLY SUCCESSFUL. ADDITIONAL VISUAL AIDS HAVE BEEN INCORPORATED IN THE EDUCATIONAL PROGRAM. THE TOXICOLOGY PROGRAM PROGRESSED VERY SLOWLY BECAUSE OF EXTRAORDINARY DIFFICULTIES AT THE CONTRACT TOXICOLOGY LABORATORY. THE INITIAL TOXICOLOGY SUBCONTRACT WAS TERMINATED IN JUNE AND A REVISED PROPOSAL SUBMITTED TO DUE TO COMPLETE THE SRC I TOXICOLOGY AND TO INITIATE ON SRC II TOXICOLOGY PROGRAM.

308

Process Engineering
"Krupp-Koppers Chosen For Coal Gasification Plant", Process. Eng., Vol. 13, pgs. VP, 1979.

Abstract:

PETROBRAS, THE BRAZILIAN STATE OIL AGENCY HAS AWARDED KRUPP-KROPPERS A CONTRACT FOR DESIGN AND CONSTRUCTION OF A PLANT TO PRODUCE SYNTHETIC GAS FROM BRAZILIAN COALS. THE CAPACITY OF THE PLANT WILL BE ADEQUATE TO SUPPLY AN AMMONIA FACILITY.

309

Reboul, J.L.
"Gas for the Next Century", Gaz Aujourd' Hui, Vol. 103, No. 4, pgs. 163-173, April, 1979.

Abstract:

IF THE PRESENT RATE OF CONSUMPTION CONTINUES (INCREASE IN CONSUMPTION [illegible]% PER ANNUM) THERE WILL BE A GAS SHORTAGE OF 5 G TOE IN THE YEAR 2000 (CONSUMPTION FORECAST 18 G TOE). IT WILL BE NECESSARY TO PRODUCE GAS BY COAL GASIFICATION. THIS ARTICLE DESCRIBES THE KNOWN GASIFICATION PROCESSES TO DATE : 1ST GENERATION : LURGI - KOPPERS - TOTZEK - TEXACO (LOW PRESSURE, LOW CALORIFIC VALUE GAS); 2ND GENERATION : THE COALCON HYGAS STEAM/WATER GASIFICATION PROCESSES (SUBSTANTIAL CONSUMPTION OF COAL FOR HEATING AND REFORMING PURPOSES); AND 3RD GENERATION : SPACE HEATER HEATING BY NUCLEAR REACTOR USING A HIGH PERCENTAGE OF HYDROGEN. DESCRIBES THE MAIN DIFFICULTIES ENCOUNTERED : CONTINUING HIGH COST, HIGH PRESSURE WORKING, DETERIORATION OF MATERIALS CAUSED BY HYDROGEN. DISCUSSES THE SEPARATE PRODUCTION OF HYDROGEN BY ELECTROLYSIS, THE PROSPECTS OF UNDERGROUND GASIFICATION OF COAL SEAMS BELOW THE 1,000 M LEVEL AND THE ADAPTATION OF BURNERS TO GAS CONTAINING A HIGH PROPORTION OF HYDROGEN (35%). (4 REFS.) (IN FRENCH)

310

Schmid, B.K.
Integrated Coal Liquefaction-Gasification Process, U.S. Patent 4,159-238, Washington, D.C., U.S. Patent Office, 26 pgs., June 26, 1979.

Abstract:

CONVERSION OF RAW COAL TO DISTILLATE LIQUID AND GASEOUS HYDROCARBON PRODUCTS BY SOLVENT LIQUEFACTION IN THE PRESENCE OF MOLECULAR HYDROGEN EMPLOYING RECYCLE OF MINERAL RESIDUE IS COMMONLY PERFORMED AT A HIGHER THERMAL EFFICIENCY THAN CONVERSION OF COAL TO PIPELINE GAS IN A GASIFICATION PROCESS EMPLOYING PARTIAL OXIDATION AND METHANATION REACTIONS. THE PRIOR ART HAS DISCLOSED A COMBINATION COAL LIQUEFACTION-GASIFICATION PROCESS EMPLOYING RECYCLE OF MINERAL RESIDUE TO THE LIQUEFACTION ZONE WHEREIN ALL THE NORMALLY SOLID DISSOLVED COAL NOT CONVERTED TO LIQUID OR GASEOUS PRODUCTS IN THE LIQUEFACTION ZONE IS PASSED TO A GASIFICATION ZONE FOR CONVERSION TO HYDROGEN, WHERE THE AMOUNT OF NORMALLY SOLID DISSOLVED COAL PASSED TO THE GASIFICATION ZONE IS JUST SUFFICIENT TO ENABLE THE GASIFICATION ZONE TO PRODUCE THE PROCESS HYDROGEN REQUIREMENT. THE PROCESS OF THE PRESENT INVENTION PROVIDES AN UNEXPECTED IMPROVEMENT IN THE THERMAL EFFICIENCY OF THE COMBINATION PROCESS BY INCREASING THE AMOUNT OF NORMALLY SOLID DISSOLVED COAL PREPARED IN THE LIQUEFACTION ZONE AND PASSED TO THE GASIFICATION ZONE TO ENABLE THE GASIFICATION ZONE TO GENERATE NOT ONLY ALL OF THE HYDROGEN REQUIRED BY THE LIQUEFACTION ZONE BUT ALSO TO PRODUCE SYNTHESIS GAS IN AN AMOUNT ADEQUATE TO SUPPLY ALL OR A SIGNIFICANT AMOUNT OF THE FUEL REQUIREMENTS OF THE PROCESS. IT WOULD HAVE BEEN EXPECTED THAT SHIFTING SOME OF THE PROCESSING LOAD FROM THE ORDINARILY MORE EFFICIENT LIQUEFACTION ZONE TO THE ORDINARILY LESS EFFICIENT GASIFICATION ZONE WOULD DECREASE PROCESS EFFICIENCY, BUT THE PRESENT COMBINATION PROCESS UNEXPECTEDLY ACHIEVES AN OVERALL EFFICIENCY INCREASE BY SAID SHIFT.

311

Shafer, J.R., R.W. Grendel, and D.R. Pogue
"Sulfuric Acid Plants for Handling H_2S Gases," Chemical Engineering Progress, Vol. 74, No. 12, pgs. 62-65, December 1978.

Abstract:

THIS PAPER DESCRIBES AN ECONOMIC ALTERNATIVE TO THE CONVENTIONAL CLAUS SULFUR RECOVERY SYSTEM, IN WHICH HYDROGEN SULFIDE IS CONVERTED INTO SULFURIC ACID. DETAILS OF THE PROCESS ARE GIVEN ALONG WITH ECONOMIC ANALYSIS.

312

Sibeud, J.P. and C.D. Ruff
Process for the Removal of Hydrogen Sulfide and Mercaptans From Liquid and Gaseous Streams, U.S. Patent 4,036,942, Washington, D.C., U.S. Patent Office, 22 pgs., July 19, 1977.

Abstract:

A PROCESS IS PROVIDED FOR REMOVING HYDROGEN SULFIDE AND ALKYL MERCAPTANS FROM FLUID STREAMS BY REACTION WITH OXYGEN IN THE PRESENCE OF A METAL AMINO ACID CHELATE IN AQUEOUS SOLUTION CONTAINING AN AMINE, CONVERTING HYDROGEN SULFIDE TO SULFUR AND ALKYL MERCAPTANS TO DIALKYL DISULFIDES, AND SEPARATING THESE FROM THE AQUEOUS METAL CHELATE SOLUTION. A PROCESS IS ALSO PROVIDED FOR REMOVING HYDROGEN SULFIDE AND ALKYL MERCAPTANS FROM FLUID STREAMS IN WHICH THE GASEOUS OR LIQUID STREAM IS DISPERSED IN AQUEOUS METAL CHELATE SOLUTION IN A FINE DISPERSION SHORT OF FOAM FORMATION AND PASSED THROUGH A REACTION ZONE AT A HIGH FLOW VELOCITY, WHERE HYDROGEN SULFIDE IS CATALYTICALLY OXIDIZED TO SULFUR, AND ALKYL MERCAPTANS TO DIALKYL DISULFIDES, AND THEN INTO A RELATIVELY WIDE QUIESCENT ZONE WHERE THE DISPERSION BREAKS, THE GASES ARE SEPARATED, AND THE METAL CHELATE SOLUTION RECOVERED.

313

Smith, C.R. and B. Mills
"Cost Effective Improvements to the Holmes-Stretford Process" in Inst. Chem. Eng. Symp. Ser., No. 57, Rugby, Warwickshire, England, Institute of Chemical Engineering, pgs. U1-U15, 1979.

Abstract:

The Holmes-Stretford process removes hydrogen sulfide from both fuel and waste gas streams with virtually 100% efficiency. By a process of continual evolution and development innovations, improvements have been made which have substantially reduced the cost of desulfurization. Apart from economic benefits, the changes have also made the process less dependent on manual labor and chemical reagents and have totally eliminated the need for effluent disposal.

314

Somerville, M.S.
"Engineering, Geological, Hydrological, and Environmental Assessment of a 250 Thousand Cubic Foot/Day Dry Ash Lurgi Coal Gasification Facility", Energy Commun., Vol. 3, No. 4, pgs. 317-342, 1977.

Abstract:

THE PROPOSED GASIFICATION PLANT WILL USE 13 MILLION TONS OF LIGNITE AND 17,000 ACRE FEET OF WATER PER YEAR, AND WILL CONSUME 6500 TONS OXYGEN PER DAY. THE STUDY INDICATES THE FEDERAL LIMITS ON SULFUR DIOXIDE EFFLUENT WILL BE MET AND THE MAJOR EFFLUENT WILL BE CARBON DIOXIDE. THE MAJORITY OF TRACE ELEMENTS WILL BE CONCENTRATED IN THE ASH. THE WATER TABLE IS LIKELY TO BE DEPRESSED AND SOME GROUND WATER POLLUTION WILL OCCUR. COST OF THE NORTH DAKOTA FACILITY IS ABOUT 314 MILLION DOLLARS. DETAILED ANALYSIS OF THE COAL TO BE USED IS GIVEN.

315

Somerville, M.H., J.L. Elder, and S.R. Moran
"Engineering, Geological, and Hydrological Environmental Assessment of a 250 Thousand Cubic Foot/Day Dry-Ash Lurgi Coal Gasification Facility", in Proceedings of the Second Annual UMR-MEC Conference on Energy, North Hollywood, California, Western Periodicals Co., pgs. 404-417, 1976.

Abstract:

A PRELIMINARY ENGINEERING, GEOLOGICAL, AND HYDROLOGICAL ENVIRONMENTAL ASSESSMENT OF A PROPOSED 250 MMSCFD DRY ASH LURGI COAL GASIFICATION FACILITY IS DISCUSSED. THE FACILITY'S EMISSION SPECTRUM IS EXAMINED ON THE BASIS OF THE PROPOSED DESIGN AND EMPIRICAL DATA. THIS SYSTEM UTILIZES APPROXIMATELY 13 MILLION TONS OF LIGNITE AND 17,000 ACRE FEET OF WATER PER YEAR AND CONSUMES 6500 TONS OF OXYGEN PER

DAY. THE RESULTS OF THE STUDY INDICATE THAT THE MAJOR GASEOUS EFFLUENT IS CO_2, THAT THE FEDERAL LIMITS ON SO_2 EFFLUENT MAY BE MET, AND THAT THE ATMOSPHERIC DEGRADATION CRITERION WILL BE THE MOST DIFFICULT ONE TO MEET. THE FATE OF TRACE ELEMENTS DURING THE GASIFICATION PROCESS IS DISCUSSED. AVAILABLE PRELIMINARY DATA INDICATE THAT THE MAJORITY OF THE TRACE ELEMENTS WILL BE CONCENTRATED IN AND LEAVE THE SYSTEM WITH THE ASH. THE PROBABLE HYDROLOGICAL AND GEOLOGICAL IMPACTS PERTINENT TO ASH AND SLUDGE DISPOSAL AND WATER TABLE DEPRESSION ARE DISCUSSED. THE RESULTS OF THE STUDY INDICATE THAT THE WATER TABLE WILL BE DEPRESSED DURING MINE OPERATIONS AND THAT SOME GROUNDWATER POLLUTION WILL OCCUR DUE TO WASTE DISPOSAL.

316

Staege, H.
"Entrained-Bed Coal Gasifiers Handle Double Throughput", Chem. Eng., (N.Y.), Vol. 86, No. 19, pgs. 106-107, September 10, 1979.

Abstract:

THE KOPPERS-TOTZEK PROCESS IS DESCRIBED. IT WOULD COST 45 MILLION DOLLARS TO BUILD A GASIFIER IN WESTERN EUROPE BIG ENOUGH TO PRODUCE SYNTHESIS GAS FOR A 900 TONS/DAY AMMONIA PLANT. GAS PRODUCED BY THE SHELL-KOPPERS PROCESS CAN BE 10% CHEAPER THAN THAT FROM KOPPERS-TOTZEK GASIFICATION.

317

Stettler, R.J. and M.C. Hardin
"High NO_x From Coal-Derived Fuels", <u>Mech. Eng.</u>, Vol. 98, No. 7, pgs. 50-51, July, 1976.

Abstract:

THREE COAL-DERIVED LIQUID FUELS EXPERIMENTALLY BURNED IN AUTOMOTIVE AND AIRCRAFT GAS TURBINE COMBUSTORS PRODUCED HIGHER NITROGEN OXIDES EMISSIONS AND SMOKE READINGS THAN PETROLEUM FUELS ACCORDING TO A REPORT TO THE COMBUSTION INSTITUTE BY R. J. STETTLER (GEN. MOT. CORP.) AND M. C. HARDIN (DETROIT DIESEL ALLISON DIV., GEN. MOT. CORP.). SINCE THE FUEL-BOUND NITROGEN CONCENTRATIONS MEASURED IN THE FUELS WERE BELIEVED TO CAUSE THE PROBLEM, IT WAS RECOMMENDED THAT FUEL-BOUND NITROGEN BE REMOVED FROM SUCH FUELS DURING PROCESSING. A 1:4 MIXTURE OF LIGHT AND HEAVY FRACTION FUELS PRODUCED BY THE CHAR OIL ENERGY DEVELOPMENT PROCESS, A TOPPED CRUDE PRODUCED FROM A MIXTURE OF ILLINOIS AND UTAH COALS, AND A FUEL PRODUCED BY THE SYNTHOIL PROCESS WERE TESTED WITH THREE DIFFERENT INJECTION SYSTEMS IN A REGENERATIVE LOW-EMISSION AUTOMOTIVE TURBINE COMBUSTOR AND A NONREGENERATIVE CONVENTIONAL AIRCRAFT TURBINE. EFFICIENCIES IN THE AUTOMOTIVE COMBUSTOR WERE ABOVE 99.5 PERCENT FOR BOTH COAL-DERIVED AND PETROLEUM FUELS. THE 0.5 TO 3.0 PERCENT VARIATION IN COMBUSTION EFFICIENCY AT LOWER POWER CONDITIONS IN THE AIRCRAFT COMBUSTOR APPEARED TO BE PRIMARILY A FUNCTION OF THE FUEL VOLATILITIES.

318

Stewart, J.T. and M.G. Klett, Gilbert Assoc.
"Converting Coal to Liquid/Gaseous Fuels", <u>Mech. Eng.</u>, Vol. 101, No. 6, pgs. 34-41, June, 1979.

Abstract:

THIS ARTICLE SUMMARIZES THE STATUS OF THE COAL GASIFICATION AND LIQUEFACTION PROCESSES THAT ARE CANDIDATES FOR COMMERCIALIZATION. INFORMATION IS INCLUDED ON THEIR DEVELOPMENTAL PROCESS. DATA ON THE CHARACTERISTICS OF THE PRODUCTS PRODUCED, AND ESTIMATES ON CAPITAL AND OPERATING COSTS FOR FULL-SCALE PLANTS. BASIC TECHNOLOGIES FOR PRODUCING SYNFUELS FROM COAL HAVE BEEN COMMERCIALIZED OUTSIDE OF THE U.S. THE LURGI AND KOPPERS-TOTZEK PROCESSES, FOR EXAMPLE, ARE OPERATING ON A COMMERCIAL SCALE IN EUROPE TO YIELD SYNTHETIC GAS FROM COAL. SEVERAL INDUSTRIAL PLANTS IN THE U.S. ARE PRESENTLY GENERATING LOW-BTU FUEL GAS FROM COAL, AND SEVERAL MORE ARE UNDER CONSIDERATION. SASOL OPERATIONS (FISCHER-TROPSCH PROCESSES) ARE PRODUCING LIQUID HYDROCARBON FUELS FROM COAL IN SOUTH AFRICA.

319

U.S. Department of Commerce, National Technical Information Service
<u>Coke Oven Air and Water Pollution (Citations From The Engineering Index Data Base) Report for 1970-March 1978</u>, Springfield, Virginia, NTIS, 177 pgs., March, 1978.

Abstract:

MONITORING, SAMPLING, ANALYZING, TRANSPORT PROPERTIES, AND CONTROL OF EMISSIONS AND EFFLUENTS ARE CITED IN THIS COMPILATION FROM WORLDWIDE JOURNALS. POLLUTANTS DESCRIBED ARE SULFUR DIOXIDE, HYDROGEN SULFIDE, AMMONIA, PHENOLS, BENZOPYRENE, PARTICULATES AND OTHER TRACE ELEMENTS AND COMPOUNDS. PROCESS AND EQUIPMENT MODIFICATIONS, SUCH AS PIPELINE CHARGING, WET AND DRY QUENCHING, RETROFITTING, AND OVEN LEAKAGE PREVENTIVES ARE INCLUDED. (CONTAINS 170 ABSTRACTS)

320

U.S. Department of Energy
Assessment of Advanced Process Concepts for Liquefaction of Low H_2:CO Ratio Synthesis Gas Based on the Koelbel Slurry Reactor and the Mobil-Gasoline Process, ORNL-5636, by M.L. Poutsma, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 47 pgs., February, 1980.

Abstract:

THE KOELBEL REACTOR IS A THREE-PHASE FISCHER-TROPSCH REACTOR IN WHICH SYNTHESIS GAS IS PASSED UPWARD THROUGH A SLURRY OF FINELY DIVIDED CATALYST IN A HEAVY OIL MEDIUM AND PRODUCTS ARE REMOVED OVERHEAD. KOELBEL CLAIMED THAT THIS REACTOR CONFIGURATION ALLOWED THE PROCESSING OF SYNTHESIS GAS WITH LOW H$SUB 2$:CO RATIOS AT HIGH SINGLE-PASS CONVERSION WITH EXCELLENT TEMPERATURE CONTROL AND WITHOUT THE RAPID AGING BECAUSE OF CARBON DEPOSITION NORMALLY ENCOUNTERED WITH SUCH FEEDS IN OTHER REACTOR TYPES. THESE REACTOR CHARACTERISTICS MIGHT THUS ALLOW CONVERSION OF THE LOW H$SUB 2$:CO RATIO OUTPUT FROM SECOND-GENERATION COAL GASIFIERS DIRECTLY WITHOUT PRELIMINARY WATER-GAS SHIFTING AND WITHOUT EXTENSIVE RECYCLE. SUCH OPERATION SHOULD RESULT IN IMPROVED THERMAL EFFICIENCY AND DECREASED PROCESSING COSTS. HOWEVER, THE PRODUCT DISTRIBUTION REPORTED WAS RELATIVELY CONVENTIONAL FOR FISCHER-TROPSCH PERFORMANCE SO THAT THE NEED FOR OCTANE IMPROVEMENT FOR GASOLINE PRODUCTION WOULD STILL EXIST. THE MOBIL-GASOLINE PROCESS CONVERTS METHANOL TO HIGH-OCTANE GASOLINE IN HIGH EFFICIENCY. THERE ARE RECENT INDICATIONS THAT THE SHAPE-SELECTIVE ZEOLITE CATALYST USED MIGHT ALSO ACCEPT CRUDE FISCHER-TROPSCH PRODUCTS AS A FEED INSTEAD OF METHANOL. CONCEPTUAL COMBINATION OF ALL THESE OBSERVATIONS LEADS TO AN ADVANCED INDIRECT LIQUEFACTION SCHEME FOR COAL CONSISTING OF A SECOND-GENERATION GASIFIER COUPLED TO A SLURRY FISCHER-TROPSCH REACTOR COUPLED TO A MOBIL-GASOLINE UPGRADING UNIT. THIS CONCEPT IS DEVELOPED FURTHER. BUT IT IS NOTED THAT OTHER INVESTIGATORS HAVE HAD SOME DIFFICULTY IN REPEATING KOELBEL'S VERY FAVORABLE RESULTS.

321

U.S. Department of Energy
"Assessment of Environmental Control Technologies for Koppers-Totzek, Texaco, and Winkler Coal Gasification Systems" in Pacific Northwest Laboratory Annual Report for 1979 to the DOE Assistant Secretary for Environment, Part 5, (PNL-3300 Pt. 5) by R.W. Baalman and C.W. Dotson, eds., Battelle Pacific Northwest Labs., Springfield, Virginia, NTIS, 53 pgs., February, 1980.

Abstract:

COMMERCIAL COAL CONVERSION PROCESSES EMPLOYING KOPPERS-TOTZEK (K-T), TEXACO, AND WINKLER GASIFIERS WERE REVIEWED TO DETERMINE THE AVAILABILITY OF ENVIRONMENTAL CONTROL TECHNOLOGIES FOR MEETING CURRENT RELEASE STANDARDS. INFORMATION ON MATERIAL AND ENERGY FLOWS IN THE CONVERSION PROCESSES WAS OBTAINED FROM MANUFACTURERS OF THE GASIFIERS AND FROM THE LITERATURE. TECHNOLOGIES FOR CONTROL OF RELEASES TO AIR, LAND, AND WATER ARE COMMERCIALLY AVAILABLE AND ARE ADEQUATE FOR MEETING CURRENT ENVIRONMENTAL RELEASE STANDARDS. THE BEHAVIOR OF TRACE ELEMENTS IN THE COAL FEED HAS NOT BEEN ADEQUATELY CHARACTERIZED. A FINAL REPORT HAS BEEN COMPLETED THAT DEFINES AREAS WHERE IMPROVEMENTS OF TECHNOLOGY WOULD BENEFIT THE CONVERSION PROCESSES. CONSTRUCTION OF A DEMONSTRATION PLANT EMPLOYING THESE TECHNOLOGIES FOR AMMONIA PRODUCTION IS RECOMMENDED.

322

U.S. Department of Energy
Assessment of Environmental Control Technologies for Koppers-Totzek, Winkler, and Texaco Coal Gasification Systems, PNL-3104, by L.K. Mudge, & L.J. Sealock, Jr., Battelle Pacific Northwest Labs., Springfield, Virginia, NTIS, 94 pgs., September, 1979.

Abstract:

THE US DEPARTMENT OF ENERGY, DIVISION OF ENVIRONMENTAL CONTROL TECHNOLOGY, SUPPORTS THE ASSISTANT SECRETARY FOR ENVIRONMENT IN DISCHARGING RESPONSIBILITIES FOR ENVIRONMENTAL CONTROL ASPECTS OF TECHNOLOGY IN USE AND DEVELOPMENT. THE COAL GASIFICATION TECHNOLOGIES EMPLOYED BY WINKLER, KOPPERS-TOTZEK (K-T) AND TEXACO ARE DESCRIBED. EVALUATION OF THE STATUS OF THESE TECHNOLOGIES FOR CONTROL OF MAJOR ENVIRONMENTAL POLLUTANTS INDICATES THAT A MINIMUM RISK TO THE ENVIRONMENT IS INVOLVED. THE COMPLETE GASIFICATION PROCESS INVOLVES COAL STORAGE, COAL PREPARATION, GASIFICATION, GAS COOLING, PARTICULATE REMOVAL, ACID GAS CLEANUP, SHIFT CONVERSION, OXYGEN MANUFACTURE, CLEANUP OF WASTE WATER AND MAKEUP WATER, AND UTILITY OPERATION. THE STATUS OF EACH OF THESE TECHNOLOGIES WITH RESPECT TO ENVIRONMENTAL ACCEPTABILITY IS DISCUSSED. VERY LITTLE IS KNOWN ABOUT THE BEHAVIOR OF TRACE ELEMENTS IN THE K-T, TEXACO AND WINKLER GASIFICATION SYSTEMS. AIRBORNE EMISSIONS OF TRACE ELEMENTS CAN OCCUR FROM THE UTILITY BOILER, AND FROM WIND ENTRAINMENT OF DISCHARGED RESIDUE AND STORED COAL. ASH COMPONENTS ARE DISCHARGED FROM THE GASIFICATION PROCESSES WITH GASIFIER RESIDUES AND GAS-CLEANUP SLUDGES AND RESIDUES. THE TRACE ELEMENT COMPOSITION OF COAL IS GEOCHEMICALLY SIMILAR TO THE MAKEUP OF THE EARTH'S CRUST AND INCLUDES ALMOST ALL OF THE ELEMENTS OF THE PERIODIC TABLE. THE POTENTIAL HAZARD FROM EMISSIONS OF TRACE ELEMENTS IS MAINLY FROM LONG-TERM, LOW-LEVEL EXPOSURES TO INCREASED ATMOSPHERIC POLLUTION LEVELS. DISCHARGES FROM THE K-T, TEXACO AND WINKLER PROCESSES CAN BE EXPECTED TO HAVE VERY MINOR CONTRIBUTIONS TO ATMOSPHERIC POLLUTION LEVELS OF TRACE ELEMENTS. TABLE I SUMMARIZES THE STATUS OF TECHNOLOGY AND DATA NEEDS FOR THE DIFFERENT PROCESSING STEPS. THE DIFFERENT PROCESS AREAS AND THEIR POTENTIAL FOR INTRUSION OF THE ENVIRONMENT ARE DISCUSSED.

323

U.S. Department of Energy
Coal Conversion Comparisons, Final Report on Task 002, FE-2468-51 by K.A. Rogers, & R.F. Hill, Engineering Societies Commission on Energy, Inc., Springfield, Virginia, NTIS, 99 pgs., July, 1979.

Abstract:

THIS ESCOE REPORT EXAMINES TECHNOLOGIES FOR PRODUCING SYNTHETIC FUELS FROM COAL. THE CONCLUSION IS MADE THAT MANY PROCESSES ARE READY FOR COMMERCIAL DEMONSTRATION BUT SYNTHETIC FUEL WILL BE GREATER THAN CONVENTIONAL PETROLEUM FUELS. ALL PRODUCT COSTS ARE ON A CONSISTENT BASIS USING THE PUBLISHED ESCOE COSTING GUIDELINES WITH BOTH UTILITY AND PRIVATE VENTURE FINANCING. ALL COSTS ARE IN MID-1979 DOLLARS. MOST OTHER STUDIES REPORT COST FOR DERIVED PRODUCTS SOLELY ON AN ENERGY BASIS, $/MILLION BTU. HOWEVER, BECAUSE THE ACTUAL FUELS HAVE DIFFERENT INHERENT VALUES (A GALLON OF BOILER FUEL IS NOT USUALLY WORTH AS MUCH AS A GALLON OF GASOLINE), AN ECONOMIC COMPARISON METHOD WAS DEVELOPED TO REFLECT THE VALUE DIFFERENCES OF THE DIFFERENT FUEL PRODUCTS. THE ESCOE VALUE METHOD ASSIGNS RELATIVE VALUES TO ALL PRODUCTS FROM A MULTI-PRODUCT SYNFUEL PROCESS. THIS METHOD INCORPORATES THE PREFERENCES OF THE MARKETPLACE TO ARRIVE AT THE NECESSARY SELLING PRICES FOR EACH PRODUCT. THIS REPORT ALSO GIVES PROCESS COSTS ON THE CONVENTIONAL ENERGY BASIS. TWO METHODS OF FINANCING, USING TYPICAL UTILITY AND PRIVATE VENTURE RETURNS ON INVESTMENT, ARE INCLUDED FOR ALL PRODUCTS. THE REPORT DIVIDES THE FOURTEEN CONVERSION PROCESSES STUDIED INTO SIX GROUPS: SOLID CLEAN FUEL, DIRECT LIQUEFACTION, INDIRECT LIQUEFACTION, SYNTHETIC NATURAL GAS, INDUSTRIAL GAS, INDUSTRIAL GAS, AND ELECTRIC POWER FROM A COMBINED CYCLE-INTEGRATED GASIFIER SYSTEM. THREE OF THE PROCESSES ARE SHOWN IN AN ALTERNATE MODE OF OPERATION GIVING A TOTAL OF SEVENTEEN SETS OF ENERGY COSTS. THE PREDICTION IS MADE THAT NO MAJOR TECHNOLOGICAL ADVANCES ARE EXPECTED WHICH WILL SIGNIFICANTLY DECREASE SYNFUEL COSTS.

324

U.S. Department of Energy
Coal Gasification Pilot Plant Support Studies. Project 61015 Quarterly Report, January 1-March 31, 1979, FE-2806-4, by Institute of Gas Technology, Springfield, Virginia, NTIS, 143 pgs., September, 1979.

Abstract:

SEVEN ADDITIONAL ISOTHERMAL DEVOLATILIZATION TESTS WERE MADE IN A CUICLTI-TUBE REACTOR WITH A COLORADO SUBBITUMINOUS B COAL AT TEMPERATURES RANGING FROM 800 TO 1400$SUP 0$F IN HYDROGEN AND HELIUM ATMOSPHERES AT A TOTAL PRESSURE OF 500 PSIG. THESE TESTS SHOWED A GOOD AGREEMENT OF CO AND CO$SUB 2$ YIELDS WITH PREDICTED VALUES. TO RESOLVE THE DISCREPANCY IN COMPARING HEAVY HYDROCARBONS (OILS, TARS, C/SUB 3+/ EXCLUDING C$SUB 6$H$SUB 6$) YIELDS WITH THE MODEL, A DIRECT MEASUREMENT TECHNIQUE WAS DEVELOPED, EMPLOYING TWO PORAPAK Q PACKED COLUMNS CONNECTED IN SERIES. PRELIMINARY CHROMATOGRAPHIC ANALYSIS OF THE PACKED COLUMN CONTENTS IDENTIFIED 20 TO 30 TYPES OF HYDROCARBON COMPOUNDS. FURTHER DATA ANALYSIS IS IN PROGRESS. THE ANALYSES OF PREVIOUS THERMOBALANCE GASIFICATION DATA WITH LIGNITE CHARS INDICATE THAT GASIFICATION CAN BE BROADLY DIVIDED INTO (A) RAPID-RATE, (B) TRANSIENT-RATE, AND (C) LOW-RATE GASIFICATION REACTIONS. THE KINETIC PARAMETERS, INCLUDING THE EFFECT OF INHERENT CATALYTIC CONSTITUENTS, FOR MONTANA, NORTH DAKOTA, AND DARCO LIGNITES WERE ESTIMATED. EXPERIMENTAL WORK TO DETERMINE THE EFFECT OF THE ADDITION OF CALCIUM AND SODIUM ON THE GASIFICATION OF BITUMINOUS COALS IS IN PROGRESS. DETAILED THERMODYNAMIC ANALYSIS OF THE STEAM GENERATION PROCESS STEPS IN THE HYGAS DESIGN BII-S WERE CONDUCTED TO IDENTIFY THE CAUSES OF EFFICIENCY LOSSES. FURTHER ANALYSES ARE IN PROGRESS TO DEFINE THE BASIS FOR THE OBSERVED IRREVERSIBILITIES AND TO EXPLORE EFFICIENT PROCESS ALTERNATIVES. THREE OTHER STUDIES ARE REPORTED.

325

U.S. Department of Energy
Coal Liquefaction Processes, ANL/CES/TE-79-6, by N.R. Daker, C. F. Blazek, R.R. Tison, Institute of Gas Technology, Springfield, Virginia, NTIS, 95 pgs., July, 1979.

Abstract:

COAL LIQUEFACTION IS AN EMERGING TECHNOLOGY RECEIVING GREAT ATTENTION AS A POSSIBLE LIQUID FUEL SOURCE. CURRENTLY, FOUR GENERAL METHODS OF CONVERTING COAL TO LIQUID FUEL ARE UNDER ACTIVE DEVELOPMENT: DIRECT HYDROGENATION; PYROLYSIS/HYDROCARBONIZATION; SOLVENT EXTRACTION; AND INDIRECT LIQUEFACTION. THIS WORK IS BEING CONDUCTED AT THE PILOT PLANT STAGE, USUALLY WITH A COAL FEED RATE OF SEVERAL TONS PER DAY. SEVERAL CONCEPTUAL DESIGN STUDIES HAVE BEEN PUBLISHED RECENTLY FOR LARGE (MEASURED IN TENS OF THOUSANDS OF TONS PER DAY COAL FEED RATE) COMMERCIAL LIQUEFACTION PLANTS, AND THESE REPORTS FORM THE DATA BASE FOR THIS EVALUATION. PRODUCTS FROM A LIQUEFACTION FACILITY DEPEND ON THE PARTICULAR METHOD AND PLANT DESIGN SELECTED, AND THESE PRODUCTS RANGE FROM SYNTHETIC CRUDE OILS UP THROUGH THE LIGHTER HYDROCARBON GASES, AND, IN SOME CASES, ELECTRICITY. VARIOUS PROCESSES ARE EVALUATED WITH RESPECT TO PRODUCT COMPOSITIONS, THERMAL EFFICIENCY, ENVIRONMENTAL EFFECTS, OPERATING AND MAINTENANCE REQUIREMENTS, AND COST. BECAUSE OF THE LARGE PLANT CAPACITIES OF CURRENT CONCEPTUAL DESIGNS, IT IS NOT CLEAR AS TO HOW, AND ON WHAT SCALE, COAL LIQUEFACTION MAY BE CONSIDERED APPROPRIATE AS AN ENERGY SOURCE FOR INTEGRATED COMMUNITY ENERGY SYSTEMS (CES). DEVELOPMENT WORK, BOTH CURRENTLY UNDER WAY AND PLANNED FOR THE FUTURE, SHOULD HELP TO CLARIFY AND QUANTIFY THE QUESTION OF APPLICABILITY.

326

U.S. Department of Energy
Conceptual Design of a Coal-to-Methanol-to-Gasoline Commercial Plant. Volume 1. Technical. Second Interim Final Report, August 31, 1977-March 1, 1979, FE-2416-43 (Vol. 1), by Badger Plants, Inc., Springfield, Virginia, NTIS, 311 pgs., March, 1979.

Abstract:

THIS SECOND INTERIM FINAL REPORT PRESENTS IN FIVE VOLUMES AN ENGINEERING AND ECONOMIC ASSESSMENT OF THE CONCEPTUAL DESIGN FOR AN INTEGRATED COMMERCIAL FACILITY TO CONVERT COAL-TO-METHANOL-TO-GASOLINE. THE PROCESS STEPS INVOLVE AN OXYGEN-BLOWN, HIGH-PRESSURE COAL GASIFICATION TECHNIQUE, FOLLOWED BY A CHEMICAL SHIFT REACTION, ACID GAS REMOVAL, SULFUR RECOVERY, METHANOL SYNTHESIS, METHANOL CONVERSION USING MOBIL TECHNOLOGY, GAS FRACTIONATION AND HF ALKYLATION. THE GASOLINE PRODUCT IS SUITABLE FOR DIRECT USE IN TODAY'S AUTOMOTIVE ENGINES. IT IS ASSUMED THAT A DEDICATED PIPELINE WILL TRANSPORT THE SYNTHETIC GASOLINE FROM THE PLANT TO EXISTING TERMINAL FACILITIES. THE CONCEPTUAL DESIGN INCORPORATES CURRENT INDUSTRIAL PROCESSES THROUGHOUT THE COMPLEX WITH THE EXCEPTION OF THE COAL GASIFICATION STEP AND THE MOBIL METHANOL-TO-GASOLINE CONVERSION PROCESS. VARIOUS HIGH-PRESSURE GASIFICATION PROCESSES ARE CURRENTLY UNDER PILOT DEVELOPMENT AND/OR DEMONSTRATION. THE MOBIL PROCESS HAS BEEN SUCCESSFULLY PILOTED AND SCALE-UP OF THE DATA TO COMMERCIAL-SIZE REACTORS IS NOT CONSIDERED A PROBLEM. THE OTHER PROCESSES, WELL-PROVEN IN COMMERCIAL PRACTICE, INCLUDE: COAL AND LIME PREPARATION, AIR SEPARATION, CHEMICAL SHIFT REACTION, ACID GAS REMOVAL, METHANOL SYNTHESIS, CRYOGENIC RECOVERY OF HYDROGEN, SULFUR RECOVERY, GAS CLEANUP, GAS FRACTIONATION, AND ALKYLATION. SOME EQUIPMENT ITEMS SPECIFIED IN THE ABOVE PROCESSES ARE LARGER THAN ANY PREVIOUSLY BUILT. FABRICATION OF SUCH EQUIPMENT WERE CONSULTED, AND THEY DO NOT FORESEE ANY MAJOR DIFFICULTY IN THE SCALE-UP OF CURRENT DESIGNS. THIS PROJECT INCORPORATES THE LATEST AVAILABLE TECHNOLOGY FOR ENVIRONMENTAL CONTROL METHODS.

327

U.S. Department of Energy
Conceptual Design of a Coal-to-Methanol-to-Gasoline Commercial Plant. Volume 3: Environmental. Second Interim Final Report, August 31, 1977-March 1, 1979, FE-2416-43 (Vol. 3) by Badger Plants, Inc., Springfield, Virginia, NTIS, 216 pgs., March, 1979.

Abstract:

THE COAL CONVERSION COMPLEX IS DESIGNED FOR A FEED RATE OF 63,000 TONS PER DAY OF SIZED, WASHED COAL. THE BASIC PROCESS INVOLVES HIGH TEMPERATURE (2800$SUP 0$F TO 3000$SUP 0$F), HIGH PRESSURE (500 PSIG) GASIFICATION OF PULVERIZED COAL IN AN OXYGEN-BLOWN GASIFIER TO PRODUCE A SYN-GAS THAT MUST BE CLEANED, SHIFTED TO THE PROPER HYDROGEN-CARBON MONOXIDE RATIO, AND CONVERTED TO METHANOL BY CATALYTIC SYNTHESIS. THE METHANOL THUS PRODUCED IS CONVERTED TO GASOLINE AND ASSOCIATED PRODUCTS BY THE MOBIL METHANOL-TO-GASOLINE PROCESS. OXYGEN WILL BE PRODUCED ON THE SITE AT A RATE OF APPROXIMATELY 50,000 TONS PER DAY. THE PLANT WILL PRODUCE 167,530 BARRELS PER DAY OF GASOLINE PRODUCT, 14,696 BARRELS PER DAY OF ISOBUTANE AND 9,140 BARRELS PER DAY OF C$SUB 3$ LPG. THE PLANT WILL OCCUPY ABOUT 1500 ACRES. THE COMPLEX IS ESTIMATED TO COST BETWEEN $3.5 AND $4.0 BILLION AND WILL REQUIRE AN ENGINEERING AND CONSTRUCTION PERIOD OF ABOUT EIGHT YEARS. VOLUME III OF THIS CONCEPTUAL DESIGN REPORT IS DEVOTED ENTIRELY TO ENVIRONMENTAL MATTERS. IT IS OUR CONSIDERED OPINION THAT THE CONTROL MEASURES OUTLINED WILL

328

U.S. Department of Energy
Conversion of Rapid City Pilot Plant. Phase II. Reliability Assessment of Char Transfer Lines and Ash Lock Hoppers, Using Fault Tree Analysis. Phase II. Addendum Report for Task 3, September 15, FE-2561-4, by E.V. Sommers, Westinghouse Research and Development Center, Springfield, Virginia, NTIS, 41 pgs., January, 1979.

Abstract:

THE TWO-STAGE PRESSURIZED LOW BTU FLUID-BED GASIFICATION PROCESS IS BEING DEVELOPED ON A PROCESS DEMONSTRATION UNIT (PDU) THAT GASIFIES ABOUT 0.6 TON OF COAL PER HOUR (TPH). RECOGNIZING THE NEED TO SCALE THE DEVELOPMENT TO A LARGER SIZE, US DOE CONTRACTED WITH WESTINGHOUSE TO EVALUATE THE POSSIBLE CONVERSION OF THE CO$SUB 2$-ACCEPTOR PILOT PLANT TO THIS PRESSURIZED GASIFICATION PROCESS TO OPERATE AT 2.5 TPH. THE CONTRACT CALLED FOR TWO PHASES: (1) TO ESTABLISH CONCEPTUAL DESIGNS FOR THE RAPID CITY PLANT; AND (2) TO ESTABLISH A PRELIMINARY AND MORE DETAILED PLAN FOR CONVERTING THE CO$SUB 2$-ACCEPTOR PLANT TO THIS GASIFICATION PROCESS. THE WORK ON BOTH THESE PHASES HAS BEEN COMPLETED AND REPORTED. THE CONTRACT WAS EXTENDED TO INCLUDE TWO ADDITIONAL TASKS: (1) TO DEVELOP A COMPUTER PROGRAM AND USER'S MANUAL FOR THE HEAT AND MASS BALANCES FOR THE PRESSURIZED FLUIDIZED-BED GASIFICATION PROCESS; AND (2) TO ANALYZE RELIABILITY OF THE CHAR TRANSFER LINE AND ASH LOCK HOPPERS BY FAULT TREES. THE FIRST ADDITIONAL TASK WAS COMPLETED AND REPORTED. THIS REPORT DESCRIBES THE ANALYSES AND RESULTS OF THE SECOND ADDITIONAL TASK.

329

U.S. Department of Energy
Demonstration Plant Process and Conceptual Mechanical Design. Volume 1. Synthesis Gas Demonstration Plant Program, Phase I, FE-2577-1 (Vol. 1), W.R. Grace and Co., and Ebasco Services, Inc., Springfield, Virginia, NTIS, 299 pgs., September, 1979.

Abstract:

SOME OF THE REQUIREMENTS OF THE COAL GASIFICATION AND CARBON/ASH SEPARATION SYSTEM ARE THAT IT SHALL: BE CAPABLE OF OPERATION AT HIGH PRESSURE (1200 PSIG FOR THE DEMONSTRATION PLANT); OPERATE WITH A RELATIVELY LOW REACTION TEMPERATURE (INCREASES REFRACTORY LIFE AND IMPROVES SLAG PROPERTIES); PRODUCE A SYNTHESIS GAS FREE FROM TARS AND PHENOLS, WHICH SHALL BE CAPABLE OF PURIFICATION BY EXISTING CONVENTIONAL MEANS AND AT REASONABLE COST; ACHIEVE A HIGH CARBON CONVERSION FACTOR YIELDING GOOD THERMAL EFFICIENCY AND HIGH CONTENT OF H$SUB 2$ AND CO IN THE SYNTHESIS GAS; PRODUCE AN ENVIRONMENTALLY ACCEPTABLE SLAG FOR DISPOSAL AS LANDFILL; HAVE BEEN DEMONSTRATED SATISFACTORILY AT LEAST ON A PILOT PLANT SCALE; GASIFY COAL HAVING HIGH SULFUR CONTENT, LOW HEATING VALUE AND HIGH SWELLING INDEX (I.E. COAL OF RELATIVELY LOW COST AND HIGH AVAILABILITY); AND BE CAPABLE OF DEVELOPMENT INTO LARGE SCALE SINGLE STREAM UNITS. THE TEXACO COAL GASIFICATION PROCESS, WHICH INCLUDES THE REMOVAL AND SUBSEQUENT SEPARATION AND RECYCLE OF ASH AND UNCONVERTED CARBON CHAR, SATISFACTORILY FULFILLS THE MINIMUM REQUIREMENTS ENUMERATED ABOVE AND WAS SELECTED FOR THE DEMONSTRATION PLANT. THE PLANT DESIGN IS DESCRIBED AND SHOWN IN DIAGRAMS. THE VARIOUS PLANT SYSTEMS ARE DESCRIBED AND AN ESTIMATE IS MADE OF THE TECHNICAL AND ECONOMIC RISKS INVOLVED.

330

U.S. Department of Energy
Development of the Steam-Iron Process for Hydrogen Production. Final Report, July 1, 1976 through September 30, 1978, FE-2435-38, by Institute of Gas Technology, Springfield, Virginia, NTIS, 459 pgs., July, 1979.

Abstract:

THE OVERALL OBJECTIVE OF THE STEAM-IRON PROGRAM WAS TO DEVELOP AN ECONOMICALLY ATTRACTIVE METHOD FOR PRODUCING HYDROGEN FROM COAL. A PILOT FACILITY TO PROVE THE FEASIBILITY OF THE STEAM-IRON PROCESS WAS CONSTRUCTED, AND AN OPERATIONAL EVALUATION WAS INITIATED. THE FEASIBILITY OF PRODUCING HYDROGEN FROM COAL BY THE STEAM-IRON PROCESS WAS PROVED, AND ECONOMIC EVALUATIONS CONDUCTED BY TWO MAJOR ENGINEERING FIRMS PROJECTED THIS PROCESS TO BE AN ECONOMICALLY ATTRACTIVE HYDROGEN PRODUCER. WHEN THIS PROCESS IS COMBINED WITH A SUBSTITUTE NATURAL GAS (SNG) PROCESS, SUCH AS HYGAS, AND BY-PRODUCT ELECTRIC POWER PRODUCTION IS CREDITED AT 25 MILLS/KWHR (1976 COSTS), IT HAS THE LOWEST PROJECTED GAS COST, COMPARED WITH SNG FROM THE OTHER COAL PRODUCERS. THE PILOT PLANT EVALUATION WAS INTERRUPTED EARLY IN THE PROGRAM BY THE US DEPARTMENT OF ENERGY (DOE) FOR PROGRAMMATIC REASONS, AND THE FACILITY HAS BEEN INACTIVATED FOR AN INDEFINITE PERIOD. ADDITIONAL DEVELOPMENTAL WORK IS NECESSARY IN THE PILOT FACILITY TO GATHER SUFFICIENT DATA TO DESIGN AN INTEGRATED, COMMERCIAL SCALE, STEAM-IRON PLANT. CONSTRUCTION OF THE PILOT PLANT BEGAN IN SEPTEMBER 1974, AND MECHANICAL COMPLETION OF THE 20 MILLION DOLLAR FACILITY WAS ACHIEVED IN JULY 1976. THE STEAM-IRON FACILITY INCLUDES EQUIPMENT TO PREPARE AND FEED CHAR TO THE HIGH-PRESSURE REACTOR SYSTEM AND TO PROCESS AND CLEAN PRODUCTS AND WASTES. THE REACTOR SYSTEM COMPRISES TWO PRINCIPAL VESSELS: (1) A PRODUCER REACTOR TO MAKE THE REDUCING GAS BY REACTING CHAR WITH STEAM AND AIR AND (2) A STEAM-IRON REACTOR IN WHICH ORE IS CONTINUOUSLY AND CYCLICALLY REDUCED BY THE PRODUCER GAS AND IS OXIDIZED WITH STEAM TO PRODUCE HYDROGEN. THIS REPORT COVERS THE INITIAL OPERATING PERIOD IN THE PILOT PLANT FACILITY FROM OCTOBER 1976 THROUGH SEPTEMBER 1978.

331

U.S. Department of Energy
Environmental Assessment of the HYGAS Process by Institute of Gas Technology, Springfield, Virginia, NTIS, 51 pgs., 1978.

Abstract:

Abstract: The U.S. Department of Energy is charged with the responsibility of demonstrating the technical feasibility of new energy systems, which includes an assessment of expected environmental effects associated with their operation. To aid DOE in evaluating coal gasification as a viable energy alternative, the Institute of Gas Technology has developed the present comprehensive Test Plan for estimating the production of potential pollutants in large scale HYGAS plants. The HYGAS process is a second-generation, high-pressure, coal gasification process that produces a high-Btu substitute natural gas (mostly methane). The process is currently being developed at the HYGAS pilot plant under funding from DOE and the American Gas Association. The pilot plant has a design capacity of 3 tons coal/hr. to produce a nominal 1.5 MM SCFD of pipeline quality gas at 1000 Btu/cu. ft. The main objective of the HYGAS Environmental Assessment Program is to obtain and interpret experimental data from the HYGAS pilot plant to estimate pollutant production for demonstration and commercial scale HYGAS coal gasification plants. This Test Plan features five sequential objectives in its assessment methodology for environmental data acquisition and interpretation: Identification of potential pollutants in plant effluent streams; development of sampling, preservation, and analytical techniques; process unit, stream, and species selection; quantitative descriptions of significant pollutants; and environmental data interpretation and extrapolation to larger demonstration and commercial plants.

332

U.S. Department of Energy
"Environmental Control: Coal Utilization Program", in Proceedings of the U.S. Department of Energy Environmental Control Symposium-Vol. 1, Plenary Session and Fossil Fuels, DOE/EV--0046 by K.E. Wilzbach, et al., Argonne National Lab., Springfield, Virginia, NTIS, pgs. 149-165, September, 1979.

Abstract:

IN-DEPTH ENGINEERING AND ECONOMIC ASSESSMENTS OF AVAILABLE AND NEAR-TERM CONTROL TECHNOLOGIES HAVE BEEN MADE BY THE ANL STAFF AND SEVERAL SUBCONTRACTORS. THE TOPICS COVERED INCLUDE COAL CLEANING, NO/SUB X/ CONTROL, PARTICULATES COLLECTION, FLUE GAS DESULFURIZATION AND DENITRIFICATION, LOW-BTU GASIFICATION WITH COMBINED-CYCLE GENERATION, AND SOLVENT REFINING OF COAL. THE DEVELOPMENT OF ADVANCED TECHNOLOGIES, SUCH AS MHD AND FUEL CELLS, IS BEING MONITORED IN-HOUSE TOGETHER WITH SUCH OTHER FUEL CYCLE ELEMENTS AS COAL TRANSPORTATION. ANOTHER IMPORTANT ASPECT OF THE PROGRAM IS THE COMPARATIVE EVALUATION OF DIFFERENT CONTROL TECHNOLOGIES. AT PRESENT, THE ANL COMPARATIVE ASSESSMENT MODEL IS ONLY APPLICABLE TO CONVENTIONAL COMBUSTION TECHNIQUES. AS PERFORMANCE AND ECONOMIC DATA BECOME AVAILABLE ON ADVANCED TECHNIQUES SUCH AS FLUIDIZED BED COMBUSTION, MHD, LIQUEFACTION, AND GASIFICATION/COMBINED CYCLE SYSTEMS, THIS INFORMATION WILL BE INCORPORATED INTO THE COMPARATIVE ASSESSMENT MODEL. ONCE THIS INCORPORATION HAS BEEN COMPLETED IT WILL BE POSSIBLE FOR THE DEPARTMENT OF ENERGY, OR OTHER INTERESTED USERS, TO EVALUATE THE EFFECTS OF THESE TECHNOLOGIES ON POWER GENERATION WHILE MEETING ENVIRONMENTAL REGULATIONS ON A SITE-SPECIFIC BASIS.

333

U.S. Department of Energy
"Failure Analysis of Coal Gasification Pilot Plant Components" in 2nd International Coal Utilization Exhibition and Conference, CONF-791169-1, Argonne National Laboratory, Springfield, Virginia, NTIS, 60 pgs., September, 1979.

Abstract:

ARGONNE NATIONAL LABORATORY HAS AN ACTIVE AND ONGOING PROGRAM IN FAILURE ANALYSIS OF COMPONENTS FROM COAL-GASIFICATION PILOT PLANTS AND ENERGY TECHNOLOGY CENTERS. THE ANALYSES CONTRIBUTE TO A KNOWLEDGE BASE WHICH CAN BE USED FOR SPECIFYING PROPER MATERIALS AND DESIGNS TO INCREASE COMPONENT LIFE. DATA HAVE BEEN OBTAINED ON FAILED COMPONENTS FABRICATED FROM A BROAD VARIETY OF MATERIALS AND EXPOSED TO DIVERSE ENVIRONMENTAL CONDITIONS. ALTHOUGH EACH GASIFICATION SYSTEM IS UNIQUE, EACH SCHEME MAY BE SUBDIVIDED INTO FIVE PROCESS LOCATIONS WHICH DIFFER WITH RESPECT TO TEMPERATURE, PRESSURE AND CORROSIVE ENVIRONMENT. THESE ARE THE COAL-HANDLING SYSTEM, TRANSPORT LINES, GASIFIER, HOT GAS-STREAM CLEANUP SYSTEM, AND SOLIDS-DISPOSAL SYSTEM. THE FAILURE MODES ARE GENERALLY MECHANICAL IN COAL-HANDLING REGIONS; MECHANICAL FAILURES, STRESS-CORROSION CRACKING (SCC) AND LOCALIZED CORROSION DOMINATE IN THE TRANSPORT LINES. FAILURES IN GASIFIER COMPONENTS ARE MAINLY DUE TO SULFIDATION, SULFUR GRAIN-BOUNDARY EMBRITTLEMENT, SCC AND EROSION, PROCESSES TO BE EXPECTED IN REGIONS OF HIGH TEMPERATURE AND SOLID-PARTICLE THROUGHPUT. SOLID-PARTICLE EROSION IS THE DOMINANT FAILURE MECHANISM IN HOT GAS-STREAM CLEANUP AREAS, AND CORROSION AND EROSION ARE THE PRINCIPAL FAILURE MODES ASSOCIATED WITH SOLIDS DISPOSAL. TWO SPECIFIC FAILURES FROM THE IGT U-GAS PILOT PLANT, WHICH REPRESENT TYPICAL ANALYSES OF COMPONENTS FROM THE GASIFIERS, ARE DISCUSSED. (LTN)

334

U.S. Department of Energy
Filtration Process and Equipment Studies for Coal Liquefaction Processes, Final Report, FE-2007-T1, by I. Bastidas, et al., Johns-Manville Sales Corporation, Springfield, Virginia, NTIS, 217 pgs., May, 1979.

Abstract:

PRECOAT FILTRATION HAS BEEN USED AS THE LIQUID/SOLID SEPARATION PROCESS AT BOTH THE PITTSBURG AND MIDWAY COAL MINING COMPANY, FORT LEWIS, WASHINGTON, SRC I PILOT PLANT AND THE SRC PILOT PLANT AT WILSONVILLE, ALABAMA. JOHNS-MANVILLE'S EXPERIENCE FROM OTHER PRECOAT FILTRATION APPLICATIONS INDICATED THAT MAJOR IMPROVEMENTS IN FILTRATION RATE AND OPERATING COSTS SHOULD BE POSSIBLE. A ROTARY PRESSURE PRECOAT FILTER TEST LEAF WAS DESIGNED AND CONSTRUCTED WHICH MAKES IT POSSIBLE TO SIMULATE THE OPERATION OF A FULL SCALE ROTARY PRESSURE PRECOAT FILTER. VARIABLES AFFECTING THE OPERATION OF THE ROTARY PRESSURE PRECOAT FILTER WERE INVESTIGATED IN DETAIL. AT OPTIMIZED OPERATING CONDITIONS, THE FILTRATION RATES WERE THREE TO FOUR TIMES THOSE ACHIEVED AT FORT LEWIS AND ALMOST AN ORDER OF MAGNITUDE HIGHER THAN THOSE OBTAINED AT WILSONVILLE ON ANOTHER TYPE OF FILTER. IT NOW APPEARS POSSIBLE TO MARKEDLY REDUCE THE FILTRATION COST IN COAL LIQUEFACTION PLANTS. THIS REPORT INCLUDES A REVIEW OF PRECOAT FILTRATION PRINCIPLES, A DESCRIPTION OF THE TEST EQUIPMENT USED, AND A PRESENTATION OF THE EFFECT OF FILTRATION VARIABLES AS DETERMINED BY STUDIES WITH THE ROTARY PRESSURE PRECOAT FILTER TEST LEAF.

335

U.S. Department of Energy
Fossil Energy Program Progress Report for June 1979 by Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 77 pgs., August, 1979.

Abstract:

Abstract: This report - the fifty-ninth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those of coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment, and chemical research and development.

336

U.S. Department of Energy
Fossil Energy Program. Quarterly Progress Report for the Period Ending June 30, 1979, ORNL--5574, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 433 pgs., October, 1979.

Abstract:

THIS QUARTERLY REPORT COVERS THE PROGRESS MADE DURING THE PERIOD MARCH 1 THROUGH JUNE 30 FOR THE OAK RIDGE NATIONAL LABORATORY RESEARCH AND DEVELOPMENT PROJECTS THAT ARE CARRIED OUT IN SUPPORT OF THE INCREASED UTILIZATION OF COAL AND OTHER FOSSIL FUEL ALTERNATIVES TO OIL AND GAS AS SOURCES OF CLEAN ENERGY. THESE PROJECTS ARE SUPPORTED BY THE DOE DIVISIONS OF FOSSIL FUEL PROCESSING, FOSSIL FUEL UTILIZATION, FOSSIL FUEL EXTRACTION, PLANNING AND SYSTEMS ENGINEERING, BASIC ENERGY SCIENCES, AND HEALTH AND ENVIRONMENTAL RESEARCH, AND BY THE TENNESSEE VALLEY AUTHORITY AND THE EPA OFFICE OF RESEARCH AND DEVELOPMENT THROUGH INTERAGENCY AGREEMENTS WITH THE DOE.

337

U.S. Department of Energy
Gasification of Residual Materials from Coal Liquefaction, Quarterly Report, October-December 1978, FE-2247-22 by A.M. Robin, Texaco, Inc., Springfield, Virginia, NTIS, 13 pgs., March, 1979.

Abstract:

ALMOST ALL COAL LIQUEFACTION PROCESSES, WHICH ARE BEING DEVELOPED TO REDUCE OUR DEPENDENCE ON FOREIGN OIL, REQUIRE HYDROGEN OR SYNTHESIS GAS (A MIXTURE OF HYDROGEN AND CARBON MONOXIDE) TO SOLUBILIZE THE COAL. IN ORDER TO OBTAIN A FAVORABLE PRODUCT YIELD IN SUCH A COAL LIQUEFACTION PLANT, IT IS NECESSARY TO PRODUCE THE NEEDED HYDROGEN OR SYNTHESIS GAS PRIMARILY FROM THE RESIDUAL FRACTION OF THE COAL. THIS MATERIAL, TOGETHER WITH THE INORGANIC ASH AND SOME FRACTION OF THE CONVERTED COAL, MAY BE RECOVERED IN VARIOUS FORMS DEPENDING ON THE PARTICULAR PROCESS. SOME OF THESE WASTE MATERIALS WILL MAKE NONLIQUEFIABLE FEEDSTOCKS FOR GASIFICATION USING THE TEXACO COAL GASIFICATION PROCESS WHICH PRODUCES SYNTHESIS GAS OR HYDROGEN. OTHERS ARE LIQUEFIABLE AND SUITABLE FOR THE TEXACO SYNTHESIS GAS GENERATION PROCESS. ANALYSIS OF THE DATA OBTAINED FROM PILOT PLANT EVALUATION OF SRC II VACUUM FLASH DRUM BOTTOMS FROM THE LIQUEFACTION OF TWO DIFFERENT COALS WAS COMPLETED. THE MATERIAL BALANCES FOR EACH RUN ARE LISTED.

338

U.S. Department of Energy
H_2S Removal Processes for Low-Btu Coal Gas, ORNL/TM-6077 by M.S. Edwards, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 230 pgs., January, 1979.

Abstract:

Abstract: Process descriptions are provided for seven methods of removing H sub 2 S from a low-Btu coal-derived gas. The processes include MDEA, Benfield, Selexol, Sulfinol, Stretford, MERC Iron Oxide, and Molecular Sieve. Each of these processes was selected as representing a particular category of gas treating (e.g., physical solvent systems). The open literature contains over 50 processes for H sub 2 S removal, of which 35 were briefly characterized in the literature survey. Using a technical evaluation of these 35 processes, 21 were eliminated as unsuitable for the required application. The remaining 14 processes represent six categories of gas treating. A seventh category, low-temperature solid sorption, was subsequently added. The processes were qualitatively compared within their respective categories to select a representative process in each of the seven categories.

339

U.S. Department of Energy
Industrial Fuel Gas Demonstration Plant Program. Task III Report, Demonstration Plant Mechanical Design. Volume IV. Gasification: Gas Cooling and Scrubbing; Ash Treatment, FE-2582-1 (Vol. 4), by Memphis Light, Gas and Water Division, Springfield, Virginia, NTIS, 260 pgs., December, 1979.

Abstract:

COAL IS FED WITH RECYCLED RAW GAS USED AS A CARRIER TO THE GASIFICATION SYSTEM, CONSISTING OF FOUR IDENTICAL REACTORS AND ANCILLARY EQUIPMENT. OXYGEN FROM AIR SEPARATION AND EXHAUST STEAM FROM STEAM TURBINE ARE ALSO FED TO THE GASIFICATION SYSTEM. DURING NORMAL OPERATION ONLY STEAM FLOWS THROUGH THE GRID OF THE REACTOR TO CREATE A FLUIDIZED BED WHERE GASIFICATION OF THE COAL TAKES PLACE. FLOW TO THE REACTOR VENTURI WILL BE A MIXTURE OF STEAM AND OXYGEN WITH THE OXYGEN CONCENTRATION LIMITED TO A MAXIMUM OF 21% BY VOLUME. THE FLOW TO THE CENTER JET OF THE REACTOR WILL BE A MIXTURE OF OXYGEN AND STEAM TO INSURE A MINIMUM VELOCITY AT THE OUTLET OF THE JET OF 100 FPS. THE FLUIDIZED BED TEMPERATURE WILL BE CONTROLLED BY VARYING THE FLOW OF STEAM TO THE GRID. FINE PARTICULATES CARRIED OUT OF THE FLUIDIZED BED BY THE RAW GAS ARE SEPARATED FROM THE RAW GAS STREAM AND RETURNED TO THE GASIFIER BY MEANS OF CYCLONES. THE GAS PRODUCED IS COOLED FROM 1860$SUP O$F TO 236$SUP O$F AND THE HEAT RECOVERED TO GENERATE STEAM. THE GAS IS FURTHER SCRUBBED WITH WATER FOR THE REMOVAL OF ENTRAINED FINES. SCRUBBED RAW GAS FROM THE RAW GAS VENTURI SCRUBBER IS COMPRESSED IN GAS COMPRESSION. AGGLOMERATED ASH QUENCHED IN THE GASIFIER QUENCH DRUM IS DISCHARGED BY GRAVITY INTO THE ASH SLURRY LOCK HOPPER. PRESSURE IN THE ASH SLURRY LOCK HOPPER IS VENTED TO ATMOSPHERIC PRESSURE. THE MOTIVE WATER FLOW FOR THE ASH EDUCATOR IS ACTIVATED AND THE ASH SLURRY DISCHARGE VALVE TO THE ASH EDUCATOR IS OPENED. AGGLOMERATES ARE REMOVED FROM THE LOCK HOPPERS IN THE FORM OF A SLURRY AND TRANSPORTED AS SUCH TO ONE OF THE TWO ASH DEWATERING BINS WHERE WATER IS DRAINED FROM THE ASH AGGLOMERATES. THE AGGLOMERATES ARE THEN DISCHARGED INTO TRUCKS FOR TRANSPORT TO THE ASH PILE.

340

U.S. Department of Energy
Industrial Fuel Gas Demonstration Plant Program. Task III Report, Demonstration Plant Mechanical Design. Volume VI. Sour Water Stripping, FE-2582-1 (Vol. 6), by Memphis Light, Gas and Water Division, Springfield, Virginia, NTIS, 86 pgs., December, 1979.

Abstract:

IN THIS SECTION, SOUR CONDENSATE GENERATED WITHIN THE PROCESS IS TREATED FOR THE REMOVAL OF H$SUB 2$S AND NH$SUB 3$. THE TWO DISTINCT FORMS OF SOUR WATER GENERATED - ONE BEING A 6% SLURRY AND THE OTHER SOLIDS-FREE PROCESS CONDENSATE - REQUIRED SPECIAL DESIGN CONSIDERATIONS. SINCE A TRAYED TOWER WOULD PLUG IF USED TO STRIP SLURRY, A BAFFLED TOWER IS USED INSTEAD. SINCE THE CONCENTRATION OF ABSORBED H$SUB 2$S AND NH$SUB 3$ IS RELATIVELY LOW FOR THE SLURRY CASE, THE LOW STRIPPING EFFICIENCY OF BAFFLED TOWERS WAS NOT A PROBLEM. A TRAYED TOWER OF CONVENTIONAL DESIGN IS USED FOR THE SOLIDS-FREE SOUR PROCESS CONDENSATE. SLURRY WATER REPORTING FROM GAS COOLING AND SCRUBBING IS STRIPPED OF H$SUB 2$S AND NH$SUB 3$ BY MEANS OF LIVE STEAM WITHIN SLURRY WATER STRIPPER. STRIPPED SLURRY WATER EXITING THE SLURRY WATER STRIPPER AT A TEMPERATURE OF 271$SUP 0$F IS COOLED TO 95$SUP 0$F BY MEANS OF SLURRY SOUR WATER EXCHANGER AND SLURRY WATER COOLER, AFTER WHICH IT PASSES TO THE CLARIFIER IN THE UTILITY AREA. OVERHEAD STRIPPING STEAM FROM THE SLURRY WATER STRIPPER IS INTRODUCED AT AN INTERMEDIATE FEED POINT TO THE SOUR WATER STRIPPER. THIS DOUBLE USE OF LIVE-STRIPPING STEAM PROVIDES FOR AN ECONOMICAL USE OF STRIPPING STEAM OVERALL. THE SOUR WATER STRIPPER OVERHEAD VAPORS ARE COOLED AND PARTIALLY CONDENSED TO A TEMPERATURE OF 220$SUP 0$F IN STRIPPER OVERHEAD CONDENSER. THE VAPOR PORTION OF THE FLOW BEING SEPARATEDFROM THE CONDENSATE FLOWS TO SULFUR RECOVERY AND THE CONDENSATE RETURNED TO THE SOUR WATER STRIPPER AS REFLUX. STRIPPED WATER PUMPED FROM THE BOTTOM OF THE SOUR WATER STRIPPER BY MEANS OF STRIPPER WATER PUMP IS COOLED FROM A TEMPERATURE OF 268$SUP 0$F TO 95$SUP 0$F IN THE SOUR WATER PREHEATER AND STRIPPED WATER COOLER. THE COOLED STRIPPED WATER IS SENT TO THE WASTE WATER TREATMENT SECTION.

341

U.S. Department of Energy
Industrial Fuel Gas Demonstration Plant Program. Task III Report, Demonstration Plant Mechanical Design. Volume VII. Sulfur Recovery; Tail Gas Treating, FE-2582-1 (Vol. VII), by Memphis Light, Gas and Water Division, Springfield, Virginia, NTIS, 37 pgs., December, 1979.

Abstract:

THIS SECTION CONSISTS OF A CLAUS TYPE SULFUR RECOVERY UNIT EMPLOYING A THERMAL REACTION STEP WITH SULFUR DIOXIDE GENERATION BY OXIDATION OF HYDROGEN SULFIDE FOLLOWED BY THREE STAGES OF CATALYTIC REACTION IN ORDER TO AFFECT RECOVERY OF SULFUR IN EXCESS OF 96% OF THE SULFUR CONTENT OF THE PROCESS GAS STREAMS FED TO THE UNIT. PRIOR TO THE REACTION STEPS, ACID GAS FROM GAS TREATING IS PREHEATED TO 450$SUP 0$F IN THE ACID GAS PREHEATER USING HIGH PRESSURE STEAM. IN ADDITION, COMBUSTION AIR IS PREHEATED TO 460$SUP 0$F IN THE PROCESS AIR PREHEATER USING HIGH PRESSURE STEAM. THE ACID GAS IS COMBUSTED AT THE BURNER RESULTING IN THE GENERATION OF SO$SUB 2$. THE CLAUS REACTION PROCEEDS IN THE SECOND ZONE OF THE MUFFLE FURNACE TO FORM SULFUR VAPORS. THE HOT PROCESS GAS LEAVING THE MUFFLE FURNACE PASSES THROUGH THE WASTE HEAT BOILER WHERE IT IS COOLED TO A TEMPERATURE OF 500$SUP 0$F GENERATING STEAM AT 120 PSIG. THE PROCESS GAS IS THEN FURTHER COOLED IN THE FIRST SULFUR CONDENSER TO A TEMPERATURE OF 350$SUP 0$F WHERE SULFUR IS CONDENSED AND FLOWS BY GRAVITY THROUGH A SULFUR SEAL TO THE SULFUR RUNDOWN PIT. THIS STEP IS ESSENTIALLY REPEATED TWO MORE TIMES WITH REHEATED VAPOR FOR FURTHER REMOVAL OF SULFUR BY THE CLAUS PROCESS. THE GAS LEAVING THE FINAL SULFUR CONDENSER OF THE CLAUS UNIT FLOWS TO THE TAIL GAS TREATING UNIT AT A TEMPERATURE OF 280$SUP 0$F AND A PRESSURE OF 3.0 PSIG FOR REMOVAL OF THE RESIDUAL SULFUR. THE TAIL GAS FROM THE (CLAUS PROCESS) SULFUR RECOVERY UNIT IS TREATED TO REMOVE ESSENTIALLY ALL OF THE REMAINING SULFUR COMPOUNDS BEFORE DISCHARGE TO THE ATMOSPHERE. THE TAIL GAS TREATING UNIT CONSISTS OF A HYDROGENATION/HYDROLYSIS SECTION FOLLOWED BY A STRETFORD ABSORBER SECTION AND STRETFORD SOLUTION OXIDIZER/SULFUR RECOVERY SECTION.

342

U.S. Department of Energy
Industrial Fuel Gas Demonstration Plant Program. Task III Report, Demonstration Plant Mechanical Design. Volume X. Waste Water Treatment, FE-2582-1 (Vol. X) by Memphis Light, Gas and Water Division, Springfield, Virginia, NTIS, 296 pgs., December, 1979.

Abstract:

NONE

343

U.S. Department of Energy
"Leaching Studies on Coal and Coal Conversion Wastes", in <u>6th National Conference on Energy and the Environment</u>, CONF-790671-1 by C.R. Boston and W.J. Boegly, Jr., Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 8 pgs., 1979.

Abstract:

IN SUPPORT OF THE DEPARTMENT OF ENERGY'S DEMONSTRATION PROGRAM, THE OAK RIDGE NATIONAL LABORATORY HAS CONDUCTED LEACHING STUDIES ON REPRESENTATIVE SOLID WASTES FROM PILOT COAL CONVERSION PLANTS. LEACHING STUDIES HAVE ALSO BEEN CARRIED OUT ON VARIOUS COALS REPRESENTATIVE OF THOSE TO BE USED AT THE DEMONSTRATION PLANTS. THE PROGRAM IS DESIGNED TO BE RESPONSIVE TO BOTH THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) AND THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA); THIS PAPER SUMMARIZES THE RESULTS FROM A COMPLIANCE POINT OF VIEW. PRELIMINARY RESULTS FOR LEACHING STUDIES ON COAL CONVERSION ASH/SLAGS INDICATE THAT MOST OF THE ASH/SLAGS STUDIED WOULD BE CLASSIFIED AS NON-HAZARDOUS UNDER CURRENTLY PROPOSED RCRA CRITERIA. SOIL ATTENUATION EXPERIMENTS NOW UNDERWAY WILL PERMIT A BETTER ASSESSMENT OF IMPACTS TO AFFECTED GROUND AND SURFACE WATER SYSTEMS. COAL LEACHATES SHOW WIDE VARIATIONS IN QUALITY DEPENDING ON COAL TYPE, PARTICLE SIZE, AND STORAGE CONDITIONS. SOME DEGREE OF RUNOFF TREATMENT WILL PROBABLY BE REQUIRED FOR MOST COALS.

344

U.S. Department of Energy
<u>Liquefaction Technology Assessment, Final Report</u>, ORNL/SUB-7186-30, by R.M. Parsons Co., Springfield, Virginia, NTIS, 198 pgs., May, 1979.

Abstract:

A SURVEY OF COAL LIQUEFACTION TECHNOLOGY AND ANALYSIS OF PROJECTED RELATIVE PERFORMANCE OF HIGH POTENTIAL CANDIDATES HAS BEEN COMPLETED AND THE RESULTS ARE REPORTED HERE. THE KEY OBJECTIVES OF THE STUDY INCLUDED PREPARATION OF A BROAD SURVEY OF THE STATUS OF LIQUEFACTION PROCESSES UNDER DEVELOPMENT, SELECTION OF A LIMITED NUMBER OF HIGH POTENTIAL PROCESS CANDIDATES FOR FURTHER STUDY, AND AN ANALYSIS OF THE RELATIVE COMMERCIAL POTENTIAL OF THESE CANDIDATES. PROCEDURES WHICH CONTRIBUTED TO THS ACHIEVEMENT OF THE ABOVE KEY GOALS INCLUDED DEFINITION OF THE CHARACTERISTICS AND DEVELOPMENT STATUS OF KNOWN MAJOR LIQUEFACTION PROCESS CANDIDATES, DEVELOPMENT OF STANDARDIZED PROCEDURES FOR ASSESSING TECHNICAL, ENVIRONMENTAL, ECONOMIC AND PRODUCT CHARACTERISTICS FOR THE SEPARATE CANDIDATES, AND DEVELOPMENT OF PROCEDURES FOR SELECTING AND COMPARING HIGH POTENTIAL PROCESSES. THE COMPARISONS WERE MADE FOR THREE PRODUCTION AREAS AND FOUR MARKETING AREAS OF THE US. IN VIEW OF THE BROAD SCOPE OF THE OBJECTIVES THE SURVEY WAS A LIMITED EFFORT. IT USED THE EXPERIENCE GAINED DURING PREPARATION OF SEVEN COMPREHENSIVE CONCEPTUAL DESIGNS/ECONOMIC EVALUATIONS PLUS COMPREHENSIVE REVIEWS OF THE DESIGNS, CONSTRUCTION AND OPERATION OF SEVERAL PILOT PLANTS. RESULTS AND CONCLUSIONS MUST BE VIEWED IN THE PERSPECTIVE OF THE INFORMATION AVAILABLE, HOW THIS INFORMATION WAS TREATED, AND THE FULL CONTEXT OF THE ECONOMIC COMPARISON RESULTS. COMPARATIVE ECONOMICS ARE PRESENTED AS RATIOS; THEY ARE NOT INTENDED TO BE PREDICTORS OF ABSOLUTE VALUES, BECAUSE THE TRUE COST OF CONSTRUCTING AND OPERATING LARGE COAL CONVERSION FACILITIES WILL BE KNOWN ONLY AFTER COMMERCIALIZATION. RELATIVE VALUES ARE CONSIDERED MORE APPROPRIATE. (LTN)

345

U.S. Department of Energy
Occupational Health Issues and Fossil-Energy Development, by E.L. Husting, et al., Flow Resources Corporation, Springfield, Virginia, NTIS, 160 pgs., March 14, 1977.

Abstract:

Abstract: Results of extensive literature surveys on coal, coal conversion, occupational health and safety, and carcinogenesis are summarized. The limited occupational health studies which have been conducted on coal conversion are also discussed. Using published literature and data, a brief characterization of potential health effects is developed for one gasification and one liquefaction process. The limitations of the existing data, and consequently of the characterization are discussed. A summary of occupational health studies planned or in progress at the time of the report is provided. It was found that there was wide variability in the type and extent of health and safety programs available. A review of recordkeeping practices and of sample records was conducted to evaluate their potential usefulness in conducting epidemiological studies. Recommendations are made for improving or starting health and safety programs. Recommendations are also made regarding bioassay and other screening methods which should be used to further define potential hazards. It was concluded that published studies relating to occupational health aspects of coal conversion, characterization of hazardous substances possibly present in coal conversion processes, and existing sample records are probably not adequate for epidemiological assessment. Additional information in these areas is essential as are medical surveillance and epidemiological assessment. Existing DOE Manual Chapters relevant to health and safety are summarized in an Appendix. (ERA citation 03:046538)

346

U.S. Department of Energy
Phase I: The Pipeline Gas Demonstration Plant. Analysis of Coal, By-products and Waste Waters From the Technical Support Program, FE-2542-23, by G.W. Heunisch and G.J. Leaman, Conoco, Inc., Springfield, Virginia, NTIS, 55 pgs., August, 1979.

Abstract:

THE DATA REPORTED HEREIN WILL ASSIST IN THE DESIGN OF THE DEMONSTRATION PLANT AND IN THE MARKETING OF THE BY-PRODUCTS. THE LEACHING STUDIES OF COAL AND SLAG WILL ASSIST IN DETERMINING THE APPLICABLE ENVIRONMENTAL HANDLING OF THESE MATERIALS. COMPLETE ANALYSIS OF TWO OF THE FEED COALS FOR THE DEMONSTRATION PLANT -- PITTSBURGH NO. 8 COAL AND OHIO NO. 9 COAL -- ARE REPORTED. THESE ANALYSES WILL ASSIST IN SETTING SPECIFICATIONS FOR COAL FEEDSTOCK PROCUREMENT. BOTH OF THESE COALS WERE EVALUATED IN THE PILOT PLANT PROGRAM.CONOCO COAL DEVELOPMENT COMPANY INVESTIGATED THE LEACHING OF RUN-OF-MINE OHIO NO. 9 COAL. CLEANED OHIO NO. 9 COAL. AND THE REFUSE FROM THE WASHING. THIS SIMULATION OF RAINFALL WEATHERING OF UNPROTECTED PILES OF THE MATERIALS SHOWS THAT THE COMPONENTS WHICH ARE LEACHED DO NOT EXCEED THE RESOURCE CONSERVATION AND RECOVERY ACT PROPOSED GUIDELINES. ANALYSES OF VARIOUS SAMPLES INDICATES ALL THE SLAGS ARE SIMILAR IN COMPOSITION. BOTH CONOCO COAL DEVELOPMENT COMPANY AND OAK RIDGE NATIONAL LABORATORY INVESTIGATED THE LEACHABILITY OF THE SLAG. THE RESULTS SHOW THAT ONLY TRACE CONCENTRATIONS OF THE EPA PRIORITY POLLUTANTS ARE LEACHED FROM THE SLAG. ANALYSES OF THE SLAG QUENCH WATER, OIL SEPARATOR WATER, AND TAR SEPARATOR WATER PROVIDES INFORMATION FOR DESIGN OF THE TREATMENT FACILITIES AND THE POTENTIAL FOR REUSE OF THE TREATED WATER IN THE DEMONSTRATION PLANT. NAPHTHA, TAR OIL AND RECYCLE TAR WERE CHARACTERIZED IN DETAIL AND BASED ON THESE RESULTS. THE MATERIALS WERE CLASSIFIED AS POSSIBLE OIL REFINERY FEEDSTOCKS.

347

U.S. Department of Energy
Pipeline Demonstration Plant. Phase I. Quarterly Technical Progress Report, June-August 1979, FE-2012-075, by R.J. Eby, Illinois Coal Gasification Group, Springfield, Virginia, NTIS, 61 pgs., September, 1979.

Abstract:

WORK HAS CONTINUED ON THE PIPELINE GAS DEMONSTRATION PLANT PROGRAM AS FOLLOWS: DEMONSTRATION PLANT PROCESS DESIGN, SITE EVALUATION AND SELECTION, DEMONSTRATION PLANT ENVIRONMENTAL ANALYSIS, TECHNICAL SUPPORT, AND PROJECT MANAGEMENT. WORK WAS INITIATED ON A LONG LEAD PROCUREMENT LIST. THE FOLLOWING MAJOR CONTRACT DELIVERABLES HAVE BEEN SUBMITTED TO DOE: DRAFT ENVIRONMENTAL ANALYSIS REPORT, TENTATIVE LONG LEAD TIME PROCUREMENT LIST, AND A QUALITY ASSURANCE/AVAILABILITY ASSURANCE PLAN. THE MAJOR WORK EFFORT HAS BEEN DIRECTED TOWARD THE COMPLETION OF THE DEFINITIVE PROCESS DESIGN AND THE SUBSEQUENT DEMONSTRATION PLANT PROCESS DESIGN REPORT AND DESIGN ANALYSIS REPORT. WITH DOE APPROVAL OF THE REMAINING PROCESS LICENSOR SUBCONTRACTS, IT APPEARS THAT THIS WORK WILL BE COMPLETED AS PER THE CURRENT SCHEDULE. ACTIVITY DIRECTED TOWARD THE ENVIRONMENTAL IMPACT STATEMENT HAS PROGRESSED WITH THE COMPLETION OF THE DRAFT ENVIRONMENTAL ANALYSIS REPORT AND THE EIS SCOPING MEETING. ALL OTHER AUTHORIZED WORK IS CONTINUING, WITHIN THE CONSTRAINT OF AVAILABLE FUNDS, TOWARD THE COMPLETION OF PHASE I.

348

U.S. Department of Energy
"Post Mortem Assessment--Coal Gasification Plant" in Proc. Annu. Reliab. Maintain. Symp. by S.S. Canja and F.H. O'Donnell, Washington, D.C., DOE, pgs. 291-300, 1979.

Abstract:

THIS PAPER DESCRIBES RECENT WORK OF THE DEPARTMENT OF ENERGY IN COLLECTING, DOCUMENTING AND ANALYZING MATERIALS AND COMPONENTS PERFORMANCE DATA FROM A HIGH BTU COAL GASIFICATION PLANT--THE CARBON DIOXIDE (CO;SUB 2;) ACCEPTOR PILOT PLANT, AT THE END OF ITS OPERATIONAL DEMONSTRATION PHASE AND JUST BEFORE PLANT SHUT-DOWN. THIS WAS THE FIRST SUCH **POST MORTEM** ASSESSMENT PERFORMED ON A FOSSIL ENERGY PLANT. THE PURPOSE OF THE ASSESSMENT WAS TO REVIEW PLANT OPERATIONAL RECORDS TO EXTRACT FAILURE, MAINTENANCE

349

U.S. Department of Energy
"Preliminary Environmental Results of the LETC Hanna III Underground Coal Gasification Experiment" in Environmental Control Symposium, CONF-781109 (Vol. 1) by J.E. Virgona, et al., Springfield, Virginia, NTIS, pgs. 393-408, September, 1979.

Abstract:

CHANGES IN GROUND-WATER QUALITY AND THE POSSIBLE EFFECTS OF SUBSIDENCE AND GROUND MOVEMENT INDUCED BY THE UNDERGROUND GASIFICATION CAVITY REPRESENT SIGNIFICANT ENVIRONMENTAL CONCERNS ASSOCIATED WITH UNDERGROUND COAL GASIFICATION (UCG). PARALLEL ENVIRONMENTAL STUDIES ARE BEING CONDUCTED BY THE LARAMIE ENERGY TECHNOLOGY CENTER (LETC) AND THE LAWRENCE LIVERMORE LABORATORY (LLL) NEAR HANNA AND GILLETTE, WYOMING, RESPECTIVELY, TO CHARACTERIZE THESE ENVIRONMENTAL EFFECTS AND TO DEVELOP THE CONTROLS NECESSARY TO MEET STATE AND FEDERAL ENVIRONMENTAL REGULATIONS AND TO INSURE ENVIRONMENTALLY SOUND COMMERCIALIZATION. GROUND-WATER STUDIES ARE IN THE CHARACTERIZATION PHASE, WITH CONTROL TECHNOLOGY DEVELOPMENT TO FOLLOW ONCE THE TYPE AND QUANTITY OF POTENTIAL GROUND-WATER CONTAMINANTS AND OVERBURDEN EFFECTS ARE DETERMINED. THE PAPER DISCUSSES THE LETC HANNA III ENVIRONMENTAL STUDIES. THE HANNA III EXPERIMENT (JUNE-JULY, 1977) WAS DESIGNED PRIMARILY TO PROVIDE INFORMATION ON THE POTENTIAL IMPACTS OF UCG ON GROUND-WATER QUALITY AND THE ENVIRONMENTAL CONTROL TECHNOLOGY IMPLICATIONS OF THOSE IMPACTS. IN ADDITION, PARAMETERS CRITICAL TO THE PROCESS ITSELF WERE EXAMINED. PRELIMINARY RESULTS OF THE GROUND-WATER MONITORING DURING THE PRE-OPERATIONAL, OPERATIONAL, AND EARLY PORTION OF THE POST-OPERATIONAL PHASES WILL BE PRESENTED.

350

U.S. Department of Energy
Problems Associated with Controlling Sulfur Emissions from High-Btu Coal Gasification Plants. Interim Report, by W.T. Adkins and H.J. Takach, C.F. Braun and Co., Springfield, Virginia, NTIS, 46 pgs., August, 1978.

Abstract:

Abstract: The control of sulfur emissions from coal gasification plants is a complex problem. At some point more stringent sulfur emission standards for high Btu coal gasification process streams may result in a net increase in sulfur emissions from the entire complex. The benefit of sulfur control on process streams can only be evaluated after a thorough study of the effects of trace components on sulfur recovery plant performance and the calculation of total sulfur emissions from all sources. To impose treatment standards based solely on technical accomplishments in a parallel industry without regard to net environmental benefit or the associated energy or economic penalty or without complete understanding of the role of trace components on performance could adversely affect the emerging coal gasification industry and ambient air quality. (ERA citation 04:042225)

351

U.S. Department of Energy
Refining and Upgrading of Synfuels from Coal and Oil Shales by Advanced Catalytic Processes. Quarterly Report, October-December 1978, FE-2315-34, by R.F. Sullivan, Chevron Research Co., Springfield, Virginia, NTIS, 42 pgs., January, 1979.

Abstract:

PILOT PLANT TESTS ON THE HYDROTREATING OF SRC-II PROCESS PRODUCT INDICATE THAT THIS COAL-DERIVED FEED IS A SUITABLE FEED FOR REFINING USING ADVANCED COMMERCIAL PETROLEUM PROCESSING TECHNOLOGY. EXPERIMENTS ARE IN PROGRESS TO EVALUATE SEVERAL DIFFERENT COMBINATIONS OF REFINERY PROCESSES FOR CONVERSION OF SRC-II TO TRANSPORTATION FUELS. NITROGEN IN THE WHOLE SRC-II PROCESS PRODUCT CAN BE REDUCED TO A CONCENTRATION OF LESS THAN 0.5 PPM IN A SINGLE CATALYTIC STAGE. SULFUR AND OXYGEN CAN ALSO BE REDUCED TO LOW LEVELS; AND AT HIGH SEVERITY, MOST OF THE AROMATIC COMPOUNDS ARE CONVERTED TO NAPHTHENES. THE NAPHTHA APPEARS TO BE AN EXCELLENT CATALYTIC REFORMER FEED, AND THE MIDDLE DISTILLATE MEETS THE SMOKE POINT AND STABILITY SPECIFICATIONS FOR JET FUEL. AS THE PROCESSING SEVERITY IS DECREASED, PRODUCT NITROGEN INCREASES; AND THE PRODUCT BECOMES MORE AROMATIC.

352

U.S. Department of Energy
Research and Development of an Advanced Process for Conversion of Coal to Synthetic Gasoline and Other Distillate Motor Fuels, Annual Report, June 1978 - May 1979, FE-1800-39 (Vol. 1), by D.C. Succop and F.E. Wynne, Gulf Research and Development Co., Springfield, Virginia, NTIS, 120 pages, July 1979.

Abstract:

THIS PROGRAM WAS REDIRECTED TO A STUDY OF MORE URGENTLY NEEDED DESIGN CRITERIA FOR HYDROLIQUEFACTION SLURRY HEATING. A REVIEW OF HEATER DESIGN CRITERIA INDICATED THAT DATA WERE NEEDED ON HEAT TRANSFER COEFFICIENTS, TUBE WALL TEMPERATURES, SLURRY VISCOSITIES, SLURRY RESIDENCE TIMES AND SOLVENT CHARACTERISTICS. IN ADDITION, IT IS KNOWN THAT REACTIONS OCCUR WITHIN THE SLURRY HEATERS BUT THE EXTENT OF THESE REACTIONS AND THE EFFECT OF HEATER DESIGN ON THE REACTIONS IS NOT CLEARLY DEFINED IN TERMS OF HEAT REQUIREMENTS, PHYSICAL PROPERTY CHANGES AND THE EFFECT OF HEATER DESIGN ON SUBSEQUENT REACTION IN THE DOWNSTREAM REACTORS AND THEIR DESIGN. ALSO, HEATER OPERATING LIMITS RELATED TO FOULING ARE NEEDED AND FOULING TESTS CONDUCTED WITH COAL/PETROLEUM RESID SLURRIES INDICATED THAT THESE LIMITING FACTORS COULD BE EXAMINED BY SIMILAR TESTS. IN REVIEWING THE DESIGN AND OPERATION OF COAL HYDROLIQUEFACTION SLURRY HEATERS, THE FIRST THING THAT BECAME APPARENT WAS THAT ALMOST ALL SLURRIES ARE MADE WITH RECYCLE SOLVENT. A SECOND FEATURE COMMON TO MOST PROCESSES IS THE ADDITION OF HYDROGEN TO THE COAL/SOLVENT SLURRY DURING PREHEATING. A THIRD FEATURE COMMON TO THREE WIDELY DIFFERENT PROCESSES APPEARED TO BE A CRITICAL HEATER TUBE IN-WALL TEMPERATURE OF 450 TO 460$SUP 0$C (840 TO 860$SUP 0$F) BEYOND WHICH SERIOUS FOULING OCCURS. AN INDEPENDENT EXPERIMENTAL HEATER STUDY TO EXAMINE DESIGN LIMITS APPEARED TO BE NEEDED AND WAS UNDERTAKEN. THE EFFECTS OF CHANGING HEATER TUBE DIAMETER, OPERATING PRESSURE, OUTLET TEMPERATURE, HYDROGEN:SLURRY RATIO AND VELOCITY WERE GENERALLY IN THE DIRECTIONS EXPECTED. THE EFFECT OF REDUCING THE SLURRY COAL CONCENTRATION FROM 30.1 TO 19.5 WEIGHT PERCENT WAS SLIGHT. HEAT TRANSFER WAS STUDIED BY EXAMINING THE EFFECTS OF HEATER OPERATING VARIABLES ON THE OVERALL HEAT TRANSFER COEFFICIENT, HEAT FLUX, INSIDE WALL COEFFICIENT AND INSIDE WALL TEMPERATURE.

353

U.S. Department of Energy
Sulfur Recovery in a Coal Gasification Plant by W. Chia and F. Todd, C.F. Braun and Co., Springfield, Virginia, NTIS, 66 pgs., August, 1978.

Abstract:

Abstract: For the western coal feed, the combination of a non-selective Selexol process for acid gas removal, FMC Double Alkali process for flue gas cleanup, and a Stretford process for sulfur recovery, was the most economical among the cases studied. For the eastern coal case, a selective Selexol unit with a Claus unit for sulfur recovery and FMC Double Alkali process flue gas treating was the most economical. The combination of a Claus unit with Beavon mark I, selective Selexol, and FMC Double Alkali flue gas processes was also found economically competitive on eastern coal feed. The FMC Double Alkali process was used in this study. The selection of this process was the result of another Braun study. The conclusions of this study would not be greatly affected by choice of flue gas treatment by any of the lime or limestone scrubbing processes considered in that study. The conclusions in this report are based on the BCR BI-GAS process as prepared by Braun for the commercial concept factored estimates. They may be extended to the other high pressure processes in those reports. For the CO sub 2 Acceptor, Lurgi ad Steam Iron HYGAS processes, the raw gas pressure, composition or distribution may be sufficiently different to require another choice of process schemes. (ERA citation 04:044247)

354

U.S. Department of Energy
Survey of Industrial Coal Conversion Equipment Capabilities: Executive Summary, ORNL-TM-6810, by W.R. Williams, Oak Ridge National Laboratory, Springfield, Virginia, NTIS, 96 pgs., January, 1980.

Abstract:

A SURVEY OF INDUSTRIAL COAL CONVERSION EQUIPMENT CAPABILITIES WAS CONDUCTED TO DETERMINE THE PRESENT CAPABILITIES OF US INDUSTRY TO SUPPPLY EQUIPMENT FOR FUTURE DEMONSTRATION AND COMMERCIAL COAL CONVERSION FACILITIES. EQUIPMENT OPERATING EXPERIENCE, PRICES, DEVELOPMENT NEEDS, AND MARKET DEMAND HAVE ALSO BEEN CONSIDERED. THIS REPORT SUMMARIZES SURVEY ACTIVITIES AND COVERS ROTATING COMPONENTS (PUMPS, COMPRESSORS, HYDRAULIC TURBINES, AND GAS EXPANDERS), VALVES, LETDOWN VALVES, HEAT-TRANSFER EQUIPMENT, GAS-PURIFICATION EQUIPMENT, MECHANICAL PIPING CONNECTORS, AND EXPANSION JOINTS. A RELATED SURVEY ON COAL-HANDLING AND -PREPARATION AND ASH/SLAG-REMOVAL EQUIPMENT IS ALSO DISCUSSED. EQUIPMENT SHOULD BE AVAILABLE FOR ALL CLEAN-STREAM APPPLICATIONS, EXCEPT PERHAPS OXYGEN COMPRESSION. ROTATING COMPONENTS HANDLING SOLIDS (SLURRIES OR ENTRAINED SOLIDS IN GAS STREAMS) MUST BE CAREFULLY SPECIFIED AND FOR MANY APPLICATIONS WILL NEED SIGNIFICANT UPGRADING. HEAT-RECOVERY EQUIPMENT MUST BE DEVELOPED DURING THE DEMONSTRATION PHASE. PROVEN HIGH-TEMPERATURE, HIGH-PRESSURE GAS PURIFICATION EQUIPMENT, EXCEPT CYCLONES, IS ESSENTIALLY NONEXISTENT. MECHANICAL CONNECTORS AND EXPANSION JOINTS ARE CONSIDERED

355

U.S. Department of Energy
A Synopsis of C-Mu Technical Contributions to the DOE Coal Gasification Environmental Assessment Program: Second Annual Report for July 1977-July 1978, FE-2496-39 by M.J. Massey, R. G. Luthy, and M.J. Pochan, Carnegie-Mellon University, Springfield, Virginia, NTIS, 234 pgs., December, 1978.

Abstract:

Abstract: The Department of Energy/Division of Fossil Energy's comprehensive field program for environmental assessment of its high- and low-Btu coal gasification pilot plant installations was initiated to develop the methodology and data base necessary for meaningful assessment of the environmental impact of the processes. Environmental characterization efforts at each pilot plant involve a detailed process engineering analysis of scalable pilot plant environmental characteristics with the goal of establishing strategy and a basis for scale-up to commerical-size installations. Carnegie-Mellon University, the program's assistance, coordination, and evaluation contractor, has performed four basic tasks: strategic development of an effluent data base; analysis of process-related environmental engineering problems; coordination of industrial hygiene sampling and analysis efforts; and environmental assessment support activities. To date, activities have encompassed work with five high-Btu pilot plants (Hygas in Chicago, Ill., Bi-Gas in Homer City, Pa., CO sub 2 -Acceptor in Rapid City, S.D., the slagging fixed bed gasifier in Grand Forks, N.D., and Synthane in Bruceton, Pa.) and two low-Btu facilities (the Wellman-Galusha gasifier at the Glen Gery Brick Co. in York, Pa. and Combustion Engineering in Windsor, Conn.). (ERA citation 04:040177)

356

U.S. Department of Energy
Synthane Pilot Plant, South Park Township, Pennsylvania. Final Report, by C-E Lummus, Springfield, Virginia, NTIS, 548 pages, 1979.

Abstract:
THE SYNTHANE PILOT PLANT WAS OPERATED BY THE LUMMUS COMPANY FOR THE US DEPARTMENT OF ENERGY DURING THE PERIOD 1975-1978 TO TEST THE FEASIBILITY OF THE SYNTHANE PROCESS TO PRODUCE PIPELINE QUALITY GAS FROM COAL. THE SYNTHANE PROCESS WAS DEVELOPED BY THE US BUREAU OF MINES AT BRUCETON, PA., NOW THE PITTSBURGH ENERGY TECHNICAL CENTER. THE OPERATIONS OF THE SYNTHANE PILOT PLANT WERE SUSPENDED IN SEPTEMBER, 1978. THE UNIT HAS BEEN MOTHBALLED AND IS PRESENTLY BEING MAINTAINED IN A STANDBY MODE. THE FINAL REPORT OF THE OPERATION OF THE SYNTHANE PILOT PLANT REPRESENTS A SUMMARY OF VARIOUS ASPECTS OF THIS PROJECT. IT CONTAINS REPORTS WHICH COVER THE OPERATION, TECHNICAL EVALUATION, AND ENGINEERING FOR THE PERIOD 1976-1978. ADDITIONAL DATA ON THE OPERATION OF THE SYNTHANE PILOT PLANT HAVE PREVIOUSLY BEEN RECORDED IN VARIOUS RUN REPORTS SUBMITTED TO THE DEPARTMENT OF ENERGY AND ARE AVAILABLE FROM THE NATIONAL TECHNICAL INFORMATION SERVICES (NTIS). THIS FINAL REPORT INCLUDES AN APPENDIX WHICH SUPPLEMENTS THE INDIVIDUAL SECTIONS AND AN INDEX TO THE LIBRARY THAT IS PART OF THE SYNTHANE PILOT PLANT IN BRUCETON, PA. WHERE ALL DOCUMENTS PREPARED FOR THE DESIGN, ENGINEERING, AND OPERATION OF THIS FACILITY ARE FILED.

357

U.S. Department of Energy
Technology Characterization: Lurgi Coal Gasification Process for Production of High BTU Synthetic Natural Gas, ANL/EES-TM-16, Argonne National Laboratory, Springfield, Virginia, NTIS, 76 pgs., August, 1976.

Abstract:
ARGONNE NATIONAL LABORATORY (ANL) REQUESTED THAT SARGENT AND LUNDY PREPARE A TECHNOLOGY CHARACTERIZATION FOR THE PRODUCTION OF HIGH BTU SYNTHETIC NATURAL GAS FROM COAL BY THE LURGI PROCESS. THE SCOPE OF WORK WAS TO BE CONFINED TO A LITERATURE REVIEW OF THE COAL GASIFICATION PROCESS INCLUDING THE PROCESSES FROM THE COAL MINE TO THE FINAL PRODUCTION OF HIGH BTU SYNTHETIC GAS. THE FOLLOWING FACTORS WERE IDENTIFIED BY ANL FOR INCLUSION IN THE REPORT: ENERGY AND MATERIAL BALANCES. DESCRIPTION OF THE PROCESS STEPS AND PROCESS FLOW DIAGRAMS. LISTING OF INPUTS AND OUTPUTS INCLUDING EFFLUENTS AND RESIDUALS. DESCRIPTION OF PLANT CONSTRUCTION, DESCRIPTION OF PLANT OPERATION AND ESTIMATION OF THE MANPOWER REQUIRED TO OPERATE THE PLANT. SHORT DESCRIPTION OF PLANT DECOMMISSIONING. IDENTIFICATION OF ANY EQUIPMENT IMPEDIMENTS FOR CONSTRUCTION AND OPERATION, AND IDENTIFICATION OF ANY PROBLEMS RESULTING FROM THE MINING OF COAL FOR THE PLANT. THE REPORT WAS TO INCLUDE A SENSITIVITY ANALYSIS FOR THE USE OF ILLINOIS COAL VERSUS NORTH DAKOTA LIGNITE. THE SIZE OF THE PLANT CONSIDERED WAS TO BE IN THE 250-MMSCFD (MILLION STANDARD CUBIC FEET PER DAY) RANGE. THE REPORT DOES NOT INCLUDE AN ASSESSMENT OF THE MARKET POTENTIAL FOR THE PRODUCT GAS. ITS END USE, OR INFORMATION CONCERNING PIPELINE REQUIREMENTS FOR TRANSPORT OF THE GAS. PUBLISHED COST ESTIMATES IN THE LITERATURE HAVE BEEN IDENTIFIED BUT ORIGINAL COST ESTIMATES HAVE NOT BEEN PROVIDED. PLANT LAYOUTS, CONCEPTUAL DESIGNS, AND SOCIOECONOMIC ANALYSES ARE NOT PROVIDED.

358

U.S. Department of Energy
Test and Evaluate the Tri-Gas Low-Btu Coal Gasification Process. Quarterly Report, October-December 1979, FE-2798-74, by Bituminous Coal Research, Inc., Springfield, Virginia, NTIS, 20 pgs., January, 1980.

Abstract:
THREE TESTS WERE CONDUCTED IN THE TRI-GAS PEDU, EACH IN THE PROCESS DESIGN MODE. SMOOTH TRANSFER OF BOTH CHAR AND GAS BETWEEN REACTORS WAS ACCOMPLISHED. SEVERAL MINOR EQUIPMENT PROBLEMS WERE ENCOUNTERED WHICH HAVE BEEN ALLEVIATED THROUGH MODIFICATIONS. DURING THE LAST TEST, HOWEVER, ALL THREE REACTOR HEATERS FAILED. THE DAMAGE WAS SUCH THAT THE HEATERS HAVE TO BE COMPLETELY REBUILT. WORK ON THE BENCH-SCALE EQUIPMENT CONTINUED.

359

U.S. Department of Energy
Two-Step Coal Liquefaction is a Hydrogen Efficient Route to Distillate Fuels, CONF-790961-1, by T.C. Carson, et al., Cities Service Co., Springfield, Virginia, NTIS, 26 pgs., 1979.

Abstract:

CITIES SERVICE'S EFFORTS IN CATALYTIC HYDROGENATION AND IN THE UPGRADING OF SOLVENT REFINED COAL HAVE LED TO THE DEVELOPMENT OF A NEW COAL LIQUEFACTION TECHNOLOGY CALLED TWO-STEP COAL LIQUEFACTION, TSL. THE PROCESS IS COMPOSED OF A SOLVENT REFINED COAL UNIT OPERATING IN TANDEM WITH AN LC-FINING UNIT. LC-FINING (LUMMUS/CITIES FINING) IS A PROPRIETARY CATAYLTIC HYDROGENATION PROCESS FOR UPGRADING HEAVY OIL FEEDSTOCKS. IN TWO-STEP LIQUEFACTION, COAL IS DISSOLVED IN A PROCESS-DERIVED SOLVENT, PARTIALLY HYDROGENATED, AND CATALYTICALLY HYDROCRACKED. COAL DISSOLUTION AND CATALYTIC UPGRADING ARE CONDUCTED IN SEPARATE REACTORS, ALLOWING EACH STEP TO BE PERFORMED AT OPTIMUM CONDITIONS. HYDROGEN GENERATION INEFFICIENCIES REPRESENT THE MAJOR ENERGY LOSS FROM THE LIQUEFACTION FACILITY. AN ESTIMATE OF THE MAGNITUDE OF THESE LOSSES IS GIVEN FOR THE TWO-STEP COAL LIQUEFACTION AND FOR AN SRC-II LIQUEFACTION PLANT. THE TSL PROCESS ACHIEVES A SIGNIFICANT REDUCTION IN HYDROGEN CONSUMPTION RELATIVE TO SRC-II. THE IMPACT OF THIS REDUCTION IN HYDROGEN PLANT OPERATING EXPENSES IS SUBSTANTIAL AND REPRESENTS A PRETAX SAVING OF APPROXIMATELY $20,000/D. THE MAGNITUDE OF THIS SAVING IS DIRECTLY LINKED TO THE COST OF ENERGY AND IS, THUS, LIKELY TO INCREASE IN THE FUTURE.

360

U.S. Department of Energy
Upgrading of Coal Liquids. Hydrotreating and Fluid Catalytic Cracking of EDS Process Derived Gas Oils. Interim Report, FE-2566-30, by F.J. Riedl and A.J. Derosset, UOP, Inc., Springfield, Virginia, NTIS, 54 pgs., August, 1979.

Abstract:

THE OBJECTIVE OF THIS WORK WAS TO EVALUATE THE APPLICABILITY OF COMMERCIAL UOP HYDROTREATING AND FLUID CATALYTIC CRACKING (FCC) PROCESSES TO DISTILLATE LIQUIDS DERIVED FROM THE EXXON DONOR SOLVENT (EDS) PROCESS. FEEDSTOCKS WERE DERIVED FROM THE 400 TO 1000$SUP 0$F (204-538$SUP 0$C) FRACTION OF THE NEW EDS PRODUCT. FIVE DIFFERENT FEEDSTOCKS, RANGING IN HYDROGEN CONTENT FROM 7.41 TO 11.95 WT % WERE PREPARED BY BATCH VACUUM FLASH DISTILLATION OR BY CATALYTIC HYDROTREATING IN RESEARCH PILOT PLANTS. RERUNNING THE RAW FEED TO REMOVE 16.7 WT % BOTTOMS FAILED TO ELIMINATE HEPTANE INSOLUBLES. THEREFORE, A UOP BLACK OIL CONVERSION CATALYST, KNOWN TO BE EFFECTIVE IN REDUCING HEPTANE INSOLUBLES, WAS SELECTED FOR HYDROTREATING THE RAW STOCK. RESULTS OF FLUID CATALYTIC CRACKING IN A RESEARCH SCALE RISER CRACKER UNIT SHOWED THAT FEED HYDROGEN CONTENT IS A DOMINANT FACTOR IN CONVERSION AND YIELD STRUCTURE. HYDROTREATING SUBSTANTIALLY IMPROVED THE CRACKING CHARACTERISTICS OF THE EDS LIQUID PRODUCT. AS MORE HYDROGEN WAS ADDED, CONVERSION AND GASOLINE YIELD INCREASED AND CARBON DEPOSITION DECREASED. GASOLINE RESEARCH OCTANE NUMBERS OF 95-101 WERE OBTAINED. CYCLE OILS CONTAINING 650$SUP 0$F$SUP -$ DISTILLATE AS HIGH AS 85 VOL % WERE GENERATED. THE LIGHTER PORTIONS OF THE CYCLE OIL, BOILING BETWEEN 400 TO 650$SUP 0$F, ARE VALUABLE COMPONENTS OF DISTILLATE FUELS AND HEATING OILS. IT IS CONCLUDED THAT, WITH AN APPROPRIATE DEGREE OF HYDROTREATMENT, THE EDS PROCESS DERIVED GAS OIL, OR ANY OTHER COAL DERIVED DISTILLATE OF SIMILAR QUALITY, CAN BE READILY PROCESSED INTO HIGH QUALITY GASOLINES BY APPLYING ADVANCED COMMERCIAL FLUID CATALYTIC CRACKING TECHNOLOGY. THE FLUID CATALYTIC CRACKER, IN CONJUNCTION WITH A HYDROTREATER, HAS A POTENTIAL TO PLAY A MAJOR ROLE IN FUTURE COMMERCIAL REFINING OF COAL DERIV[illegible]

361

U.S. Energy and Research Development Administration
Characterization and Combustion of SRC II Fuel Oil. Final Report, by W. Downs, and A.J. Kubasco, Babcock and Wilcox Co., Springfield, Virginia, NTIS, 131 pgs., June, 1979.

Abstract:

Abstract: This report deals with an experimental evaluation of the SRC II process's principal product, solvent refined coal fuel oil (SRC fuel oil), for use with commercial scale steam generating equipment. The purpose was to identify problems, if any, associated with handling, storing, pumping, and burning SRC fuel oil. Detailed fuels characterization analyses were performed and compared to petroleum distillate products. An industrial boiler rated at a steam flow of 45,000 lbs/hr was utilized for combustion tests. Modifications made to the boiler facility included connection of an existing air heater to supply combustion air at 400 exp 0 F, revamping of the boiler controls to permit biasing of the fuel/air ratio, installation of a high pressure mechanical return flow pumping and atomization system, various piping and pump modifications, and installation of various gas and particulate analysis instrumentation. Combustion tests were performed with SRC fuel oil, No. 2 fuel oil, and No. 5 fuel oil. Operating variables included load, excess air, and burner register settings. The laboratory fuel analyses indicated that in most respects this SRC fuel oil sample behaved similarly to No. 2 fuel oil. The combustion test confirmed that SRC fuel oil burns similarly to No. 2 fuel oil with one notable exception, NO/sub x/ emissions were substantially higher than for either the No. 2 or No. 5 fuel oils. It was concluded that SRC fuel oil will require the application of NO/sub x/ combustion control techniques to meet the proposed New Source Performance Standards of 0.5 pound NO sub 2 /million Btu when burned in power boilers equipped with wall-mounted burners. (ERA citation 04:049456)

U.S. Energy Research and Development Administration
Environmental Assessment of the HYGAS Process. Monthly Progress Report, April 1-30, 1977, by Institute of Gas Technology, Springfield, Virginia, NTIS, 25 pages, August 1977.

Abstract:

Abstract: Hygas tests were carried out with Montana subbituminous nonagglomerating coal and with Illinois bituminous coal. Sulfur-by-species determinations were completed on reactor solids for some tests, and concentrations of selected pollutants in Hygas aqueous streams are also reported for one test. Final data from one test indicated that Be, V, Mn, Zn, Li, Cr, and Pb essentially remained in the ash, and from 50 to 90 percent of the Fe, Ba, As, B, F, Tl, Ni, Cu, and Mo also remained in the ash. The most reactive elements were Cl, Se, Cd, and Hg with less than 50 percent recovery in the ash. An ash balance also implied that Fe, As, Se, Tl, Ni, Cu, Cd, and Mo were primarily released in the steam-oxygen zone; Ba, B, Cl, and Hg were primarily released in the first and second stages of gasification. There is some evidence for the accumulation (by an unknown mechanism) of Fe, Tl, Ni, Cu, Cd, Pb, Mo, and Cr in the upper, cooler sections of the gasifier. A comparison of trace element analyses with earlier tests with lignite shows that they agree for Li and Mn but that substantial differences are evident for the remaining comparable trace elements. The production of selected pollutants in Hygas water effluents is presented on a normalized basis. Rudimentary S material balances around the pretreater and around the gasifier are presented as an aid in ascertaining the ultimate fate of S during gasification. (ERA citation 03:005794)

363

U.S. Energy Research and Development Administration
Environmental Assessment of the HYGAS Process. Monthly Progress Report, May 1-May 31, 1977 by Institute of Gas Technology, Springfield, Virginia, NTIS, 21 pgs., September, 1977.

Abstract:

Abstract: The environmental assessment program for the HYGAS Process was started with HYGAS Tests 55 through 58, which utilized Montana subbituminous coal (nonagglomerating) from the Rosebud seam. Beginning with HYGAS Test 59, pilot plant studies were started with Illinois No. 6 bituminous coal from the Peabody No. 10 Mine. In the HYGAS tests with subbituminous coals, light-oil samples recovered from the steam stripper were analyzed for organic constituents by gas chromatography-mass spectrometer (GCMS) techniques. Phenols were not detected in the stripped oil samples; consequently, samples of the coal feed oil slurry were recovered and analyzed primarily for phenols. These samples showed detectable and significant levels of phenols (0.8 to 3.8 wt. percent). Compared with the stripped oil, these samples also showed higher levels for 2- and 3-ring compounds and detectable levels of additional 4- and 5-ring compounds. The phenols were characterized and compared with phenols found in Test 37 with lignite coal, which showed major fractions of C sub 1 - and C sub 2 -phenols (approximately 40 percent each) with minor fractions of phenol and C sub 3 -phenols. For subbituminous coals, the major fractions consisted of C sub 1 -, C sub 2 -, and C sub 3 -phenols (approximately 30 percent each); minor fractions of phenol and C sub 4 -phenol (approximately 10 percent each); and approximately 1 percent C sub 5 -phenol. Support studies continue with simulated process gas mixtures to determine catalytic contaminant alterations that occur during water-gas shift reactions. The catalyst being studied is sulfur-active BASF K8-11. In recent tests, the feed gas contained low-level concentrations of NH sub 3, COS, and low molecular weight unsaturated alkenes. Test 4 is reported with about 75 percent COS conversion to H sub 2 S and 66 percent hydrogenation of butene to butane. (ERA citation 03:007825)

U.S. Energy Research and Development Administration
Environmental Assessment of the HYGAS Process. Quarterly Progress Report No. 3, January 1-March 31, 1977, by Institute of Gas Technology, Springfield, Virginia, NTIS, 32 pgs., October, 1977.

Abstract:

Abstract: A revised and enlarged test plan for the environmental assessment program was developed and a draft was circulated to interested parties for review and comment. The compositions of water streams during Test 59 with bituminous coal were obtained for 3 days of plant operation; large fluctuations in contaminant levels reflected operating difficulties encountered during this test. The bituminous coal feed for test 59, with 4.5 weight percent sulfur, had the highest level of sulfur yet encountered. Some sulfur was released during the oxidative coal pretreatment step, primarily from the organic sulfur species. Trace element data were obtained during Test 55 and compared with earlier IGT work performed in a process development unit with lignite coal. Data from the two units show substantial differences for iron, barium, molybdenum, nickel, zinc, chromium, lead, and mercury. Relatively good agreement was obtained for manganese, lithium, boron, and cadmium. The expected trace element compounds in the HYGAS reactor are reported from preliminary thermodynamic analyses performed in the PDU study. Relationships were sought between sets of two aromatic components in the coal feed oil slurry and in oil recovered from the steam stripper. Several trial runs were made in the laboratory to determine the effects of shift catalysts on pollutant levels in simulated process gas mixtures. The results of a time-series sampling of the product-gas quench condensate carried out during Test 57 were analyzed statistically and used to predict the expected error in the HYGAS batch-sampling scheme for quench condensate. Based on these results, the current HYGAS sampling scheme seems reasonable, because longer time periods increase the risk of encountering unsteady-state periods, and shorter time periods are operationally and economically prohibitive. (ERA citation 03:009531)

365

U.S. Energy Research and Development Administration
Evaluation of Regenerable Flue Gas Desulfurization Processes. Volume I. Final Report, by E.F. Aul, et al., Radian Corp., Springfield, Virginia, NTIS, 113 pgs., July 30, 1976.

Abstract:

Abstract: Eleven regenerable flue gas desulfurization (FGD) processes have been evaluated on a common design and cost basis to assess their future potential and make recommendations regarding the level of additional developmental activities. One throwaway FGD process, lime/limestone wet scrubbing, was also considered to provide a base-line for process comparisons. Because of the preliminary development status of many of the processes, capital investment costs were not estimated in this study. Additional topics considered in the study were reducing gas production, lime/limestone sludge regeneration, and sulfur versus sulfuric acid production. Four major conclusions can be drawn from this study. First, although capital costs were not estimated during this study, it is clear that they will represent a major factor in the total annualized cost of these processes and will become the key to selecting one process over another. Second, designs and operating data currently available for most second-generation FGD processes do not appear adequate for scale-up to commercial sized (100 MW) units. Third, the choice of sulfur or sulfuric acid production is a criterion which will have a major impact on the cost of an FGD system and will have to be evaluated on a site-specific basis. Finally, the use of reducing gas produced from coal or heavy fuel oil results in technical and economic penalties when compared to the use of methane as a reductant. (ERA citation 02:031767)

366

U.S. Energy Research and Development Administration
Evaluation of Regenerable Flue Gas Desulfurization Processes. Volume II. Final Report, by E.F. Aul, et al., Radian Corp., Springfield, Virginia, NTIS, 516 pgs., July 30, 1976.

Abstract:

Abstract: Detailed process descriptions and technical evaluations are given for the following twelve flue-gas desulfurization processes: (1) Westvaco Activated Carbon Process, (2) Shell/UOP Copper Oxide Adsorption Process, (3) Bergbau-Forschung/Foster Wheeler Dry Adsorption Process, (4) Atomics International Aqueous Carbonate Process, (5) Catalytic/IFP Ammonia Scrubbing Process, (6) Citrate/Phosphate Buffered Absorption Process, (7) Ammonia--Ammonium Bisulfate (ABS) Process, (8) Ionics Electrolytic Regeneration Process, (9) Wellman-Lord Sulfite Scrubbing Process, (10) Cat-Ox Catalytic Oxidation Process, (11) Magnesia Slurry Scrubbing Process and (12) Lime/Limestone Wet Scrubbing Process. Since several of the processes require an H sub 2 /CO reducing gas, a section includes various technical and economic considerations relating to four methods of H sub 2 /CO production: steam methane reforming, steam-naphtha reforming, coal gasification, and partial oxidation. The study basis specified that the processes be designed for sulfur production. However, it was felt that recent developments indicate a strong potential market for sulfuric acid exists in some areas which may result in sulfuric acid being the desired by-product although more difficult to store and ship. Therefore, a section discussing sulfur and sulfuric acid production was prepared. Technical and economic evaluation of calcium sulfite/sulfate regeneration for the Lime/Limestone Process is presented. (ERA citation 02:031768)

367

U.S. Environmental Protection Agency
Alternatives for High-Temperature/High Pressure Particulate Control. Final Report, October 1977-October 1978 by R. Parker & S. Calvert, Air Pollution Technology, Inc., Springfield, Virginia, NTIS, 137 pgs., January, 1979.

Abstract:

THE REPORT GIVES THE STATUS OF THE MOST PROMISING HIGH-TEMPERATURE/HIGH-PRESSURE (HTP) PARTICULATE CONTROL DEVICES BEING DEVELOPED. DATA ARE PRESENTED AND ANTICIPATED PERFORMANCE AND DEVELOPMENT PROBLEMS ARE DISCUSSED. HTP PARTICULATE CONTROL OFFERS EFFICIENCY AND POTENTIAL ECONOMIC ADVANTAGES OVER COLD GAS CLEANUP IN PRESSURIZED FLUIDIZED-BED COMBUSTION (PFBC) AND LOW-BTU COAL GASIFICATION [illegible] COMBINED-CYCLE POWER GENERATION SYSTEMS. HOWEVER, CONSIDERABLY MORE DEVELOPMENT WILL BE NECESSARY IN ORDER TO DEMONSTRATE THE TECHNICAL AND ECONOMIC FEASIBILITY OF HTP GAS CLEANUP COMMERCIALLY. THE ALTERNATIVE OF RECUPERATIVE HEAT EXCHANGE COUPLED WITH LOW-TEMPERATURE/HIGH-PRESSURE PARTICULATE CONTROL IS REVIEWED WITH REGARD TO POWER SYSTEM EFFICIENCY [illegible] OR PFBC AND [illegible] COMBINED-CYCLE PROCESSES. SUCCESSFUL HOT GAS CLEANUP HAS CLEAR EFFICIENCY ADVANTAGES (1-7%) OVER COLD GAS CLEANUP. THE ECONOMICS OF HOT GAS CLEANUP, HOWEVER, ARE VERY SPECULATIVE AT THE CURRENT STATE OF DEVELOPMENT.

368

U.S. Environmental Protection Agency
Characterization of Claus Plant Emissions, EPA-R2-73-188, by D.W. Beers, Process Research Inc., Springfield, Virginia, NTIS, 173 pages, April 1973.

Abstract:

Abstract: The report discusses Claus sulfur plant emissions and control, based on literature, supplemented with data from companies operating or designing Claus plants. It discusses process variations, investment, and operating costs. It lists data for 169 Claus plants in 31 states, with daily sulfur capacities totaling over 15,800 long tons, most based on natural gas or petroleum refining. Total capacity of 66 Canadian plants is 60 percent more than the U.S. total.

369

U.S. Environmental Protection Agency
Control of Emission From Lurgi Coal Gasification Plants, EPA-450/2-78-012, Springfield, Virginia, NTIS, 178 pgs., March, 1978.

Abstract:

Abstract: The purpose of this document is to provide information on Lurgi Coal Gasification Plants, their emissions, control technologies which can be used to control emissions, and the environmental and economic impacts of applying these control technologies. This document is being issued to assist State, local, and Regional EPA enforcement personnel in the determination (on a case-by-case basis) of the best available control technology for Lurgi Coal Gasification Plants.

370

U.S. Environmental Protection Agency
Engineering Evaluation of Control Technology for H-Coal and Exxon Donor Solvent Processes, EPA-600/7-79-168, by K.R. Sarna and D.T. O'Leary, Dynalectron Corp., Springfield, Virginia, NTIS, 125 pgs., July, 1979.

Abstract:

Abstract: The report gives results of an evaluation of the control technology of two coal liquefaction processes, H-Coal and Exxon Donor Solvent. The effluent streams were characterized and quantified for both processes and plants (pilot and conceptualized commercial). The gaseous-, liquid-, and solid-stream emissions were analyzed for their controllability, process complexity, and efficiency. Extrapolations to the larger commercial size were based partly on pilot plant data and (where such data was unavailable) engineering judgment. Several information gaps were encountered for liquid and solid effluent streams, especially as to composition. These deficiencies were pointed out and recommendations were outlined. Present control technology for the H-Coal process seems to be barely adequate: present designs are inadequate for zero discharge criteria. Control technology for the EDS process depends on being able to rely on the facilities of an adjacent refinery's controls: the scalability of present control technologies, especially in the case of the bag filter operation, is not confirmed.

371

U.S. Environmental Protection Agency
Evaluation of Pollution Control in Fossil Fuel Conversion Processes, EPA-600/2-76-101, by E.M. Magee, Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 306 pgs., April, 1976.

Abstract:

Abstract: The review gives an overview of work, between June 1972 and January 1976, on various environmental aspects of fossil fuels. Details of this work is presented in 14 reports published during this same period. The details include potential pollutants in fossil fuels: quantities of solid, liquid, and gaseous effluents from coal treatment and conversion to gaseous and liquid fuels; and an analytical test plan for coal conversion systems. The overview report discusses commonality and differences in the reviewed processes with emphasis on factors which might affect the environment when the processes are in commercial use. Due to the lack of a sufficient data base, data and research and development needs are also addressed.

372

U.S. Environmental Protection Agency
Evaluation of Pollution Control in Fossil Fuel Conversion Processes. Analytical Test Plan, EPA-650/2-74-009/1, by C.D. Kalfadelis, et al., Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 186 pgs., October, 1975.

Abstract:

Abstract: The report gives results of a preliminary definition of those streams which require analysis to permit an assessment of the pollution potential of the processes in the light of current environmental standards, using a coal gasification process (Lurgi) and a coal liquefaction process (COED) as a basis. It defines methods for sampling indicated streams and analytical procedures which are required to obtain the data. These summaries may be readily modified or adapted to other processes, and expanded to include additional polluting constituents or improvements in analytical procedures. The report also contains the industrial set up of the processes for gasification and liquefaction of coal.

373

U.S. Environmental Protection Agency
Evaluation of Pollution Control in Fossil Fuel Conversion Processes. Gasification: Section I. Koppers-Totzek Process, EPA-650/2-74-009a, by E.M. Magee, C.E. Jahnig, and H. Shaw, Esso Research and Engineering Co., Springfield, Virginia, NTIS, 53 pgs., January, 1974.

Abstract:

Abstract: The report gives results of a study of pollution control and thermal efficiency of the Koppers-Totzek process for producing clean, low-Btu (303 Btu/cu ft) gas from coal. It estimates quantities of potential pollutant streams and gives a preliminary design that ensures clean up of these streams where appropriate pollution control techniques are available. The report points out information gaps and research needs, and discusses process alternatives and potential process improvements.

374

U.S. Environmental Protection Agency
Evaluation of Pollution Control in Fossil Fuel Conversion Processes. Liquefaction: Section I., COED Process, EPA-650/2-74-009, by C.D. Kalfadelis and E.M. Magee, Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 72 pgs., January, 1975.

Abstract:

Abstract: The report gives results of a review of the FMC Corporation's COED coal conversion process, from the standpoint of its potential for affecting the environment. It includes estimates of the quantities of solid, liquid, and gaseous effluents, where possible, as well as the thermal efficiency of the process. It proposes a number of possible process modifications or alternatives, and points out new technology needs, aimed at lessening adverse environmental impact.

375

U.S. Environmental Protection Agency
Evaluation of Pollution Control in Fossil Fuel Conversion Processes. Liquefaction: Section 3. H-Coal Process, EPA-650/2-74-009m, by C.E. Jahnig, Exxon Research and Engineering Co., Springfield, Virginia, NTIS, 69 pgs., October, 1975.

Abstract:

Abstract The report gives results of a review of the H-Coal Process of Hydrocarbon Research, Inc., from the standpoint of its effect on the environment. Quantities of solid, liquid, and gaseous effluents are specified, where possible, as well as the thermal efficiency of the process. Techniques for controlling pollution are outlined and discussed. For the purpose of reducing environmental impact, a number of possible modifications or alternatives are presented for consideration. In some areas existing information or control systems are inadequate; therefore, technology needs are pointed out covering such areas, together with approaches to improve efficiency and conservation of energy or water.

376

U.S. Environmental Protection Agency
Fate of Trace and Minor Constituents of Coal During Gasification, EPA-600/2-76-258, by A. Attari, J. Pau, and M. Mensinger, Institute of Gas Technology, Springfield, Virginia, NTIS, 46 pgs., September, 1976.

Abstract:

Abstract: The report gives results of a study of the fate of selected minor and trace elements of Montana lignite and Illinois No. 6 bituminous coals during development of the HYGAS process. Solid residue samples from various development stages were analyzed. The data indicate that certain volatile trace elements are removed from the coal during gasification. Removed from the solids during processing were such elements as antimony, arsenic, bismuth, cadmium, chlorine, fluorine, mercury, lead, selenium, and tellurium. It is estimated that, in a full scale operation, these will appear in the quench water system.

377

U.S. Environmental Protection Agency
Potentially Hazardous Emissions from the Extraction and Processing of Coal and Oil, EPA-650/2-75-038, by H.E. Lebowitz, et al., Battelle Columbus Labs., Springfield, Virginia, NTIS, 162 pgs., April, 1975.

Abstract:

Abstract: The report lists potentially hazardous materials which may be associated with the air, water, and solid waste from a refinery, a coke plant, a Lurgi high-Btu gas process, and the solvent refined coal process. Fugitive loss was identified as the major emissions source in the refinery, although its composition is difficult to quantify. Coking is the most offensive of the four processes assessed. Coal gasification may produce materials as dangerous as those from the coke plant, but the former will probably be more contained than coke oven emissions. The environmental impact of coal liquefaction is not well defined; however, liquefaction products will probably be more hazardous than crude oil products, and their refining and utilization will be worse offenders than corresponding petroleum operations.

378

U.S. Environmental Protection Agency
Symposium on Environmental Aspects of Fuel Conversion Technology, CONF-7709162, EPA-600/7-78-063 by F.A. Ayer and M.F. Massoglia, eds., Springfield, Virginia, NTIS, April 19, 1978.

Abstract:

THE TREATMENT OF PHENOLIC COMPOUNDS FROM COAL GASIFICATION PLANTS USING ULTRAFILTRATION AND HYPERFILTRATION IS PRESENTED. DYNAMICALLY FORMED HYDROUS ZIRCONIUM(IV) OXIDE MEMBRANES ON SEVERAL TYPES OF SUPPORTS WERE THE FOCUS OF THE INVESTIGATION. THE PH VARIATIONS OF 6.5 TO 11, PRESSURE VARIATIONS OF 250 TO 1000 PSIG (1724 TO 6895 KPA) AND CONCENTRATION VARIATIONS OF 1 TO 400 MG/L WERE EXAMINED. PHENOL REDUCTIONS GREATER THAN 95% WERE OBTAINED WITH SEVERAL MEMBRANES. AND FLUX RATES WERE GREATER THAN 100 GPD/SQ FT (4.08 CU M/DAY/SQ M).

379

U.S. Federal Energy Administration
Siting Energy Facilities at Glasgow Air Force Base, Volume III., FEA/G-75-421, by Montana Energy and MHD Research and Development Institute, Inc., Springfield, Virginia, NTIS, 156 pgs., November, 1975.

Abstract:

Abstract: The feasibility of establishing an energy center at Glasgow Air Force Base, near Glasgow, Montana is studied. Volume III presents a discussion and analysis of the environmental effects of coal conversion and energy facilities siting, including socio-economic impact projections for a conceptual energy center at Glasgow AFB.

380

Verhoff, F.H., M.K. Choi, West Virginia University
Sour Water Stripping of Coal Gasification Waste Water, METC/CR-79/23, Springfield, Virginia, NTIS, 108 pgs., May, 1979.

Abstract:

THIS VAPOR--LIQUID EQUILIBRIUM MODEL FOR CARBON DIOXIDE--AMMONIA--WATER--HYDROGEN SULFIDE--ORGANICS AND ALL THE IONIC SPECIES WAS USED FOR THE PRELIMINARY DESIGN OF THE STRIPPING COLUMN. A SIMPLE DESIGN PROCEDURE WAS SELECTED AND USED TO INVESTIGATE THE INFLUENCE OF VARIOUS PARAMETERS ON THE PROCESS. THESE PARAMETERS INCLUDE STEAM TO SOUR WATER FLOW RATIOS, THE NUMBER OF THEORETICAL PLATES, AND VARIOUS OTHER PARAMETERS. THERE ARE TWO BASIC CONCLUSIONS TO THE STUDY. FIRST, A SIGNIFICANT FRACTION OF THE ORGANICS (IN THE RANGE OF 50%) WILL BE REMOVED IN THE STEAM. THIS ORGANIC LOSS IN THE STEAM SEVERELY LIMITS THE UTILITY OF THE STRIPPING COLUMN. THERE ARE TWO POSSIBLE MEANS OF OVER-COMING THIS DIFFICULTY: A DISTILLATION COLUMN COULD BE INSTALLED INSTEAD OF THE STRIPPING COLUMN OR VALUABLE COMPOUNDS COULD BE RECOVERED FROM THE STEAM. ONLY THE LATTER ALTERNATIVE HAS ANY CHANCE FOR ECONOMIC VIABILITY. THE SECOND IMPORTANT CONCLUSION IS THAT IN ANY PROCESS FOR THE REMOVAL OF AMMONIA AND HYDROGEN SULFIDE, THE SOUR WATER SHOULD FIRST BE PASSED THROUGH A FLASH DRUM TO REMOVE THE MAJORITY OF THE CARBON DIOXIDE BEFORE ENTERING THE STRIPPING COLUMN. THE VARIOUS UNEXPECTED PROBLEMS ENCOUNTERED AS THE WORK DEVELOPED ARE DISCUSSED IN DETAIL. (LTN)

381

Voss, W.C., Ashland Oil, Inc.
"H-Coal Process: A Status Report", in Proceedings of the Conference on Coal Use for California, CONF-7805183, Springfield, Virginia, NTIS, pgs. 262-267, August 15, 1978.

Abstract:

H-COAL IS A CATALYTIC PROCESS INVOLVING THE DIRECT HYDROGENATION OF COAL TO PRODUCE HYDROCARBON LIQUIDS. ITS DEVELOPMENT WAS STARTED IN 1963 BY HYDROCARBON RESEARCH, INC., A SUBSIDIARY OF DYNALECTRON. THE PROCESS HAS OPERATED AT THE BENCH SCALE LEVEL ON A WIDE VARIETY OF COALS INCLUDING EASTERN US, WESTERN SUBBITUMINOUS AND LIGNITES FROM TEXAS AND NORTH DAKOTA AS WELL AS FOREIGN COALS. A THREE-TON PER DAY PROCESS DEVELOPMENT UNIT HAS ALSO BEEN OPERATED EXTENSIVELY, CONFIRMING BENCH SCALE RESULTS AND ADDING SUBSTANTIALLY TO THE TECHNICAL DATA BASE. THE PROCESS AFFORDS WIDE FLEXIBILITY OF OPERATION FROM FUEL OIL TO SYNCRUDE MODES. A PILOT PLANT NOW UNDER CONSTRUCTION AT CATLETTSBURG, KENTUCKY IS SCHEDULED FOR COMPLETION MARCH 31, 1979. IT WILL BE THE LARGEST COAL LIQUEFACTION PLANT ON-LINE IN THE US, PROCESSING UP TO 600 TPD OF COAL. CONCURRENT WITH THE PILOT PLANT, OTHER DEVELOPMENT ACTIVITIES ARE BEING UNDERTAKEN TO PROVIDE TIMELY INITIATION OF A COMMERCIAL PROJECT. ASSUMING SUCCESSFUL OPERATION OF THE PILOT PLANT IN 1979, ENGINEERING ON A 50,000 BPD PLANT IS SCHEDULED TO START IN EARLY 1980, CONSTRUCTION IN MID-1981 AND OPERATIONS BEGINNING IN LATE 1984.

382

Waitzman, D.A., Tennessee Valley Authority
"Ammonia From Coal: A Technical/Economic Review", Chem. Eng.,
Vol. 85, No. 3, pgs. 69-71, 1978.

Abstract:

CONCERN OVER MEETING U.S. FERTILIZER NEEDS--BECAUSE OF THE NATURAL GAS SHORTAGE--HAS SPURRED PROJECTS
TO PRODUCE AMMONIA FROM ALTERNATIVE FEEDSTOCKS. MAINLY COAL. THIS ARTICLE LOOKS AT EFFORTS BEING MADE
IN THE UNITED STATES AND OVERSEAS. AT LEAST ONE THIRD OF THE FOOD AND FIBER PRODUCED IN THE UNITED
STATES CAN BE CREDITED TO THE USE OF FERTILIZERS. WITH NITROGEN BEING THE NUTRIENT OF MAJOR IMPORTANCE.
PRACTICALLY ALL NITROGEN FERTILIZER IS MADE FROM AMMONIA. WHICH. IN TURN. IS MADE FROM NATURAL GAS. THE
EXISTING AMMONIA PLANTS BASED ON COAL GASIFICATION (ALL OVERSEAS) AS WELL AS DOMESTIC PILOT PLANTS ARE
CRITICALLY EVALUATED FROM TECHNOLOGICAL AND ECONOMIC POINTS OF VIEW.

383

Weiss, L.H.
"Clean Fuel and Scrubbing Compared," Electric World, Vol. 186,
No. 7, pgs. 70-73, October 1, 1976.

Abstract:

THE COMBUSTION OF COAL PRODUCES AIR-BORNE EMISSIONS OF PARTICULATES. NITROGEN (NO/SUB X/). AND SULFUR
OXIDES (SO/SUB X/). IN COAL-FIRED ELECTRICITY-GENERATING PLANTS. PARTICULATES ARE ROUTINELY CONTROLLED
BY WELL-ESTABLISHED TECHNOLOGY. SUCH AS PRECIPITATORS. BAG FILTERS. OR VENTURI SCRUBBERS. AND NO/SUB X/
EMISSIONS CAN USUALLY BE REDUCED TO ACCEPTABLE LEVELS BY CERTAIN COMBUSTION-SYSTEM MODIFICATIONS THAT
ARE NOW ACCEPTED BY THE INDUSTRY. SO/SUB X/ EMISSIONS. HOWEVER. ARE MORE DIFFICULT TO CONTROL. WITH
ONLY TWO ALTERNATIVE APPROACHES CONSIDERED TECHNOLOGICALLY FEASIBLE: COAL CONVERSION TO PRODUCE A CLEAN
FUEL AND FLUE-GAS DESULFURIZATION (FGD). THIS ARTICLE CONTRASTS THESE TWO APPROACHES AND COMPARES THEIR
COSTS AS RELATED TO THE GENERATION OF ELECTRICITY.

384

Weiss, L.H.
"Coal Utilization: The Emissions Control Alternative," in
Eleventh Intersociety Energy Conversion Engineering Conference,
New York, NY, American Institute of Chemical Engineers,
pgs. 309-314, September 12, 1976.

Abstract:

THE DIRECT COMBUSTION OF COAL PRODUCES AIRBORNE EMISSIONS OF SULFUR OXIDES (SO/SUB X/). THE MAIN
ALTERNATIVES FOR LIMITING SO/SUB X/ EMISSIONS ARE CONVERSION OF THE COAL TO A CLEAN FUEL OR FLUE GAS
DESULFURIZATION (FGD). NEITHER IS WELL-ESTABLISHED IN THE U.S.A. THE MOST ECONOMIC COAL CONVERSION
PROCESSES FOR POWER GENERATION ARE LURGI GASIFICATION AND H-COAL LIQUEFACTION. THREE REPRESENTATIVE FGD
PROCESSES WERE SELECTED FOR COMPARISON. THE UNIT COST ESTIMATED FOR ELECTRIC POWER GENERATION USING THE
LIMESTONE SLURRY FGD PROCESS IS 45.9 MIL/KWH. FOR THE WELLMAN-LORD SODIUM-BASED FGD PROCESS IT IS 46.7
MIL/KWH. AND FOR THE ATOMICS INTERNATIONAL ACP FGD PROCESS IT IS 44.6 MIL/KWH IN 1980 COSTS.
INTERMEDIATE BTU GAS FROM A LURGI INSTALLATION GIVES ELECTRICITY AT 62.1 MIL/KWH ON THE SAME BASIS.
SIMILARLY. SYNCRUDE FROM AN H-COAL PLANT HAS A GENERATION COST OF 57.5 MIL/KWH. THE HIGHER CAPITAL
REQUIRED FROM THE COAL CONVERSION PLANTS PLUS THEIR LOW CONVERSION EFFICIENCIES LEAD TO THE HIGHER
COSTS. HOWEVER. SITE-SPECIFIC FACTORS MAY FAVOR PRODUCTION OF CLEAN FUELS OVER THE INSTALLATION OF FGD.
AIR POLLUTION;CAPITAL;COAL: M1;COMBUSTION: Q1;COMPARATIVE EVALUATIONS;COST;DESULFURIZATION: Q2;
ECONOMICS: Q3.Q4.Q5;EFFICIENCY;ELECTRIC POWER;FLUE GAS: M2;H-COAL PROCESS: M5;INTERMEDIATE BTU GAS;
LIMESTONE;LURGI PROCESS: M4;MOLTEN SALT COAL GASIFICATION PROCESS;POWER GENERATION;PRODUCTION;REMOVAL;
Q6;SLURRIES;SULFUR OXIDES: M6;W-L SULFUR DIOXIDE RECOVERY PROCESS: M3

385

Winkler, H.J.S.
Process for the Removal of H_2S and CO_2 from Gaseous Streams,
U.S. Patent Report 4,091,973, Washington, D.C., U.S. Patent Office,
6 pages, May 23, 1978.

Abstract:

A CYCLIC PROCESS FOR THE SIMULTANEOUS REMOVAL OF HYDROGEN SULFIDE AND CARBON DIOXIDE FROM A VARIETY OF GAS STREAMS IS DISCLOSED. THE GAS STREAM CONTAINING THE SOUR GASES IS CONTACTED WITH A SOLUTION OF THE FE(III) CHELATE OF N-(2-HYDROXYETHYL) ETHYLENE DIAMINE TRIACETIC ACID IN A CO$SUB 2$ SELECTIVE SOLVENT. THE HYDROGEN SULFIDE IS CONVERTED TO SULFUR, THE CO$SUB 2$ IS ABSORBED TO PRODUCE A PURIFIED GAS STREAM, AND THE FE(III) CHELATE IS CONVERTED TO THE FE(II) CHELATE. THE PROCESS INCLUDES SULFUR REMOVAL AND SIMULTANEOUS REGENERATION OF THE SOLVENT AND THE FE(III) CHELATE.
AIR POLLUTION CONTROL: Q3,Q4;CARBON DIOXIDE: M4;CHELATES;DECARBONIZATION: Q1.Q2;DESULFURIZATION: Q1.Q2; GASEOUS WASTES: M1;HYDROGEN SULFIDES: M3;INDUSTRIAL WASTES: M2;IRON COMPOUNDS;REMOVAL

386

Yoon, H., et al., University of Delaware
"Analysis of Lurgi Gasification of Two U.S. Coals," Chem. Eng. Sci., Vol. 34, No. 2, pgs. 231-237, 1979.

Abstract:

A MATHEMATICAL MODEL OF MOVING BED COAL GASIFICATION IS USED TO DETERMINE THE PERFORMANCE OF TWO US COALS IN A PRESSURIZED LURGI GASIFIER. AIR AND OXYGEN BLASTS ARE CONSIDERED. OPTIMUM FEED CONDITIONS ARE HIGHLY DEPENDENT ON COAL TYPE AND OXIDANT, WITH HIGH ACTIVITY WYOMING COAL REQUIRING LESS OXYGEN AND LESS STEAM TO GASIFY A GIVEN AMOUNT OF FIXED CARBON THAN LOW ACTIVITY ILLINOIS COAL. THE DIFFERENT STEAM TO OXYGEN RATIOS FOR THE TWO COALS RESULT IN MARKEDLY DIFFERENT H$SUB 2$/CO RATIOS IN THE PRODUCT GAS. OPTIMUM OPERATION REQUIRES THAT THE COMBUSTION ZONE BE MAINTAINED AT A GIVEN DISTANCE ABOVE THE ASH GRATE. CALCULATIONS IN THE NEIGHBORHOOD OF THE OPTIMUM DEFINE PROCESS VARIABLES THAT CAN BE USED TO INFER DEVIATIONS FROM OPTIMUM CONDITIONS. 9 FIGURES, 3 TABLES.

SECTION III

KEY CONTACTS

KEY CONTACTS

Environmental and Health

EPA, Industrial Environmental Research Laboratory (IERL), Research Triangle Park, North Carolina.

Mr. William Rhodes, coordinator of EPA's Environmental Research Programs on Med/High Btu Gasification; useful because of his knowledge about ongoing research and results. (919)-541-2851.

Ms. Gary Kingsbury, A coordinator in EPA's Multimedia Environmental Goal (MEG) Program; working on Pollution Control Guidance Documents; useful because of her knowledge of the entire MEG Program and its implications. (919)-541-5861.

DOE, Office of Health and Environmental Research

Health Effects Division (Germantown, MD.)

Dr. Stapleton, coordinator of DOE's Fossil Energy Research programs on health and the environment, works extensively with other agencies (NIOSH, EPA, OSHA, etc.); useful because helps appropriate money for DOE priority energy projects and related research programs.

Lovelace Center for Health Sciences

Dr. (Ms.) Rogene Henderson, coordinator for major interdisciplinary programs of health effects from synfuel products/by-products. (505)-842-8676.

Oak Ridge National Laboratories

Dr. J.L. Epler, (Biology Division), manager and coordinator of health programs (mutagenicity, etc.). (615)-576-0841.

Dr. Carl W. Gehrs, (Environmental Science Division), manager and coordinator of toxic substances research. (615)-576-7359.

DHEW, (NIOSH), Rockville, Maryland.

Mr. Lynne Harris, program manager for NIOSH's research of gasification and liquefaction; useful because he is working on pilot plant monitoring as well as recommended standards. (301)-443-6377.

Michael Massey, Environmental Research and Technology, Pittsburgh, Pennsylvania; integration of environmental programs for D.O.E., particularly SRC-II, H-Coal, Hygas, Slagging Lurgi.

Water Purification Associates, 238 Main Street, Cambridge, Mass. 02142

Ronald F. Probstein

Harris Gold

D.J. Goldstein

David Yung

J.S. Shen

Socio-Economics

U.S. Department of Energy

E.A. Lloyd, synfuels, Fossil Fuel Division.

Robert I. Hanfling, deputy undersecretary in charge of synfuels.

Dr. Atami P. Siku, director of Fossil Fuels Extraction, Resource Science and Analysis Section.

Office of Management of Budget

W. Bowman Cutter, associate director, put together White House's synfuel legislation proposal.

Dr. Lloyd Bender, U.S. Department of Agriculture/MSU, Bozeman, MT, head of Energy Impact Team; COALTOWN model-projections of employment, population, etc. under various scenarios of coal development, including synfuels.

John Gilmore, Senior Research Fellow, Denver Research Institute, University of Denver; written extensively on socioeconomic impacts of energy development in the west; boom-towns.

F. Larry Leistritz, Professor of Economics, NDSU, Fargo, ND, 58105; has used econometric modeling techniques in several economic impact assessments of energy projects in North Dakota.

Suresh Malhotra and Dianne Manachen, Battelle Human Affairs Research Centers, 4000 NE 41st Street, Seattle, Washington, 98118; have developed a survey of construction workers at nuclear power plant sites, for the USNRC.

Steve H. Murdock, Associate Professor of rural sociology and assistant director of the Center for Energy and Mineral Resources, Texas A and M University, College Station, Texas; worked with Leistritz at NDSU.

Dean C. Coddington, Managing partner in Denver consulting firm of Browne, Bortz, and Coddington, 100 S. Madison, Denver, CO, 80201; worked with Gilmore of Denver Research Institute.

Private Sector

Bruce Gilbert, manager of Bechtel Corporation's coal conversion group; is directly involved in gasification.

R. Keith Dickinson, corporate VP in charge of synfuels for Texas, Eastern, Houston, Texas.

John B. O'Hara, manager of energy department, Ralph M. Parsons, Co., Pasadena, CA; extensive experience in synfuels engineering and assessments.

David S. Tappan, Jr., vice-chariman and key administrator of Fluor Corporation, Irvine, CA; a leading engineering firm with worldwide experience in synfuels (built a plant in South Africa).

Theodore T. Pollaert, manager of synfuels for Lurgi Corp. (NJ), a subsidiary of West Germany's Lurgi Group, gasification engineering experts; involved in many feasibility studies, including plants in North Dakota.

Clark G. Musgrove, Director, environmental science division; Camp, Dresser, and McKee, Denver, CO; community relations consultants.

SECTION IV

APPENDIX

I. Glossary of Terms

II. Technologies

- A. Comparisons - Gasification
  - 1) Near-term Commercial
  - 2) "Promising"
  - 3) Graph--Pressure-Temperature
  - 4) Gas Stream Characteristics
  - 5) Low-Medium Btu Utilization Options
  - 6) Fuel Gas Comparisons
- B. Comparisons - Liquefaction
  - 1) Plant Cost
  - 2) Products & Power Requirement
  - 3) Efficiency-Cost Comparison
  - 4) Efficiency-Cost Graph
- C. Comparisons - Sulfur Removal Systems
  - 1) Acid Gas Removal
    - a. Key Features
    - b. Comparison - Low temperatures
    - c. Written Comparisons
  - 2) Tail Gas Treatment
    - a. Key Features
    - b. General Characteristics
    - c. Summary of Sulfur Recovery & Control Processes
  - 3) General
    - a. Sulfur Removal as Discussed in 141
    - b. Options for Management
    - c. Summary of Data Gaps

D. Other Data

1) Particulate and Tar Loading

2) Graph - Particulate Size Distribution for Fixed Bed Gasifiers

3) Hydrogen for Liquefaction

4) Syncrude Characteristics

E. Data on Specific Technologies

1) Conoco Slagging Lurgi (3 tables)

2) Grand Forks Slagging Lurgi

3) Sasol Water Data

III. Air Pollution - Gasification

A. Estimated Composition of Lurgi Feed - Lockhopper Vent Gas

B. Production Rate and Composition of Lurgi Raw Gas for Montana Subbituminous Coal

C. Composition of Lurgi Tar/Oil Separator

-- Depressurization Gas and

-- Kosovo Operational Data

D. Characteristics of Acid Gases Produced by the Rutisol Process and

-- Emissions of a Lurgi Plant with Alternative Emission Controls and

-- Summary of Estimated Emissions for Air Pollution Control Options and

-- Features of Options

E. Projected Concentrations of Arsine, Hydrogen Selenide and Mercury

F. Incinerator Flue Gas Composition

G. Yearly Estimated Emissions from WESCO Coal Gasification (Lurgi) Plant with Pollution Control and

-- Projected Resource Requirements and Process Residuals of Gasification Processes and

-- Process Requirements and Pollutants Associated with Synfuel Conversion Technologies and

-- Summary of Estimated Controlled Emissions for Porposed Commercial Lurgi SNG Facilities and

-- Variability in Predicted PM/SO_2 Emissions and Ambient Impact Data and

-- Stack-by-Stack Analysis of Estimated Emissions Levels and

-- Summary of Gaseous Effluent Streams from Lurgi Coal Gasification and

-- Summary of Air Effluent Streams from K-T Coal Gasification

IV. Air Pollution - Liquefaction

A. Estimated Separate and Combined Emissions from Acid Gas Removal Unit and Fischer-Tropsch Synthesis Unit

B. Estimated Total Emissions from Fischer-Tropsch Sasol Methanol Plant Using Two Fuel Types

C. Estimated Total Emissions from a Fischer-Tropsch Liquefaction Plant

D. Estimate Composition of Fuel and Flue Gases from Coal Preparation Module (H-Coal)

E. Estimated Composition of Typical Fuel and Flue Gases Emitted from Heaters (H-Coal)

F. Estimated Vent Gas Composition from Solids Separation Unit (H-Coal)

G. Estimated Acid Gas Emissions from H-Coal Before and After Treatment

V. Air Pollution - Atmospheric Dispersion Modeling:

A. WESCO and El Paso Ambient Air Modeling Results - Gasification

B. Summary of Ambient Level Increases - Liquefaction and

-- Summary of Emission Control Requirements - Liquefaction <u>and</u>

-- Graphs on SO_2 and Particulates (four figures) - Liquefaction <u>and</u>

-- Rough Terrain Model Results - Liquefaction <u>and</u>

-- Flat Terrain Model Results - Liquefaction <u>and</u>

-- Model Results Using Modified Impacts - Liquefaction

VI. Problem Areas

A. Environmental Concerns and Research Requirements (In-Situ)

B. Analysis Summary (Risks, Siting, Permitting)

C. Summary on Biological Effects of Coal Liquids

D. Liquefaction Technology Problems

VII. Miscelaneous

A. New Mexico Standards of Performance for Gasification Plants

B. Priority I Pollutants for Coal Cleaning

C. Institute of Gas Technology Suggestion for 1990 Synfuels Plant Deployment

Appendix I

Glossary of Terms

The following glossary has been extracted from ref. 103, by I. Howard-Smith and G.J. Warner.

Acid Gas Removal: A section of a gas plant where hydrogen sulphide and carbon dioxide are removed from the gas stream.

Agglomerate: Assemblage of ash particles rigidly joined together, as by partial fusion (sintering).

Bench Scale Unit: A small-scale laboratory unit for the testing of process concepts and operating criteria as a first step in the evaluation of a process.

Btu: Abbreviation for British Thermal Unit (= 1.05506 kJ.)

B.T.X.: Benzene, toluene, xylene; aromatic hydrocarbons; toluene is methyl-benzene xylene is dimethyl benzene.

Caking coal: Coal which cakes, or agglomerates, or forms coke, when heated.

Carbonization: The destructive distillation of coal in the absence of air accompanied by the formation of char (coke), liquid (tar) and gaseous products.

Catalyst: A substance which accelerates the rate of a chemical reaction without itself undergoing a permanent chemical change.

Char: The solid residue from the carbonization of coal after the volatile matter of the coal has been driven off by heating.

Claus Process: A process for recovering elemental sulphur from hydrogen sulphide gas, utilising a brick-work kiln, at high temperatures with oxygen reacting with the H_2S to yield dry sulphur and steam.

CO Shift Conversion: See Shift Conversion.

Crude Gas: Gas produced in a gasifier containing a wide range of impurities, also known as off-gas.

Demineralization: Removal of mineral matter (ash) from coal by solvent extraction, usually under hydrogen atmosphere.

Devolatilization: The removal of a proportion of the volatile matter from medium-and high-volatile coals to prevent subsequent caking.

Dissolution: The taking up of a substance by a liquid with the formation of a homogenous solution.

Distillation: A process of evaporation and re-condensation used for separating liquids into various fractions according to their boiling points or boiling ranges.

Ebullated Bed: A boiling bed; gas, containing a relatively small proportion of suspended solids, bubbles through a higher density fluidised phase with the result that the system resembles a boiling liquid.

Entrained Bed: A bed in which solid particles are suspended in a moving fluid, and are progressively carried over in the effluent stream.

Extraction-Hydrogenation: Extraction carried out in the presence of hydrogen either as a gas or derived by transfer from H-donor solvents.

Filter Cake: The moist residue remaining from the filtration of a slurry to produce a clean filtrate.

Fixed Bed: A bed through which gases pass at a velocity low enough so as not to blow the solid particles from the bed.

Fluidized Bed: A bed through which a fluid is passed with a velocity high enough for the solid particles to separate and become freely supported in the fluid.

Flue Gas: Gas issuing from a combustor; either exhausted to atmosphere or expanded through a gas-turbine.

Fly Ash: A fine ash from the pulverized coal burned in power station boilers, or entrained ash carried over from a gasifier.

Fuel Gas: Low heating value product generally utilized on-site for power generation or industrial use.

Gasification: Conversion of solid or liquid hydrocarbon substances to a gaseous phase in a gasifier.

Gasifier: A vessel in which gasification occurs usually utilizing fixed bed, fluidized bed or entrained bed units.

High-BTU Gas: Methane-rich gas product with an H.H.V. between 900-1,000 BUT/SCF (See Substitute Natural Gas).

Hydrocracking: A thermal process in which petroleum distillates or coal-derived extracts are broken down into products of lower boiling range with the addition of hydrogen by a catalytic reaction.

Hydrogasification: Gasification that involves the addition of hydrogen to the products of primary gasification to optimise formation of methane.

Hydrogen-Donor Solvent: Solvent such as anthracene oil, tetralin (tetrahydronaphthalene), decalin, etc. which transfer hydrogen to coal constituents causing depolymerisation and consequent evolution of liquid products of lower boiling range which are then taken up by the solvent.

In-Situ: In its original place, e.g. underground gasification of a coal seam.

Intermediate BTU Gas: Synthesis gas product with a H.H.V. between 250-500 BUT/SCF consisting mainly of carbon monoxide and hydrogen.

Liquefaction: Conversion of a solid to a liquid; with coal this invariably involves hydrogenation to depolymerise the coal molecules to simpler molecules.

Low BTU Gas: Nitrogen-rich gas product with an H.H.V. between 100-200 BUT/SCF produced in air-blown gasifiers and air injected "in-situ" gasification. Also known as "Producer Gas".

Methanation: Process for the production of methane by passing carbon monoxide - hydrogen mixtures over nickel catalysts; according to the reaction, $CO+3H_2 \rightarrow CH_4+H_2O$.

Phenols: A group of aromatic compounds having the hydroxyl group directly attached to the benzene ring. They give the reactions of alcohols, forming esters, ethers and thiocompounds; phenols are more reactive than the benzene hydrocarbons; derived from coal tar.

Phenosolvan Process: Process for the dephonolisation of phenolic effluents from coke-oven, carbonisation, gasification, hydrogenation and synthetic phenol and resin producing plants. The phenolic effluents are treated with an oxygen-containing organic solvent (Phenisol or Phenosolvan) in multi-stage counter-current extractors whereby the phenols are absorbed by the solvent. The extract is separated into crude phenols (phenol cresols, xylenols, higher phenols) and solvent by distillation. Developed by Lurgi GmbH.

Pilot Plant: Plant of a scale intermediate between laboratory-scale and large-scale units to evaluate integrated, continuous-operation parameters in the development of a new process, or to provide engineering design data for a commercial-scale plant.

Pipeline Gas: A methane-rich gas that conforms to certain standards and having a H.H.V. between 950-1,050 BTU/SCF. Standards include minimum water content, minimum inert gases, minimum H_2 and CO content and compressed to 1,000 p.s.i.g.

Process Development Unit (PDU): Small-scale plant operated to provide information on the operation of process units, to provide design data for larger-scale plants; similar to pilot plant.

Pyrolysis: The decomposition of coal by heat. See Carbonization.

Quenching: Cooling by immersion in oil or water bath or spray.

Rectisol Process: A process, developed by Lurgi GmbH, for the purification of coal-gasification gas based on the capability of cold methanol to absorb all gas impurities in a single step; gas naphtha, unsaturated hydrocarbons, sulphur, hydrogen sulphide and carbon dioxide are removed from the gas stream by the methanol at temperatures below 0^oC.

Reforming Processes: A group of proprietary processes in which low-grade or low molecular weight hydrocarbons are catalytically reformed to higher-grade or higher molecular weight materials; also applies to the endothermic reforming of methane, for the production of hydrogen by the reaction of methane and steam in the presence of nickel catalysts.

S.C.F.: Standard cubic foot (abbrev. for); (=o.0283168m^3).

Shift Conversion: Process for the production of gas with a desired carbon monoxide content from crude gases derived from coal gasification; a CO-rich gas is saturated with steam and passed through a catalytic reactor where the CO reacts with steam to produce hydrogen and carbon dioxide, the latter being subsequently removed in a wash plant. The ratio of hydrogen to carbon monoxide in the product gas can be changed at will.

Slagging: Operating above the ash-fusion temperature so that the ash is removed from the gasifier as a molten slag.

Solvent Refined Coal: A coal extract derived by solvent extraction; a brittle, vitreous solid (M.P. 300°-400°F) containing about 0.1% ash and about 10% of the sulphur in the original coal feedstock; calorific value is about 16,000 Btu/lb. May be used as a clean fuel for power generation by combustion, utilised for the production of high-grade metallurgical coke, anode carbon and activated carbon by coking, or hydrogenated to produce synthetic crude oil. (abbrev. S.R.C.).

Substitute Natural Gas: A synthetic gas conforming to natural gas standards. (abbrev. S.N.G.)

Syncrude: Synthetic crude oil; oil, produced by the hydrogenation of coal or coal extracts, which is similar to petroleum crude.

Synthesis Gas: Gas consisting of mixtures of carbon monoxide and hydrogen in proportions that allow for synthesis to higher molecular weight products, e.g. methane and Fischer Tropsch products.

Tail Gas: A gas issuing from a gas-treatment unit which may be recycled to the process or exhausted.

Tar: The products of distillation or high-or low-temperature carbonization of coal; coal tar consists of hydrocarbon oils (B.T.X. and higher homologues), phenols, and bases such as pyridine, quinoline pyrrole and their derivatives; gas tar is tar condensed from coal gas and provides, by distillation, ammoniacal liquor, benzole, naphtha and creosote with a residue of pitch which is dehydrated to produce bitumen.

Town gas: Gas product with an H.H.V. of 600 BTU/SCF and conforming to certain standards including prescribed water content, inert gases, H_2, CO, methane content and Wobbe number.

Water Gas: Gas produced by the reaction of carbon and steam to provide carbon monoxide-hydrogen mixtures; similar to synthesis gas.

Appendix II-A-1 COAL GASIFIERS WITH POTENTIAL NEAR-TERM COMMERCIAL APPLICATION IN THE U.S. (226)

Gasifier	Plant/Location[4]	Coal types tested	Part. removal	Quenching/cooling	Acid gas removal	End Use	Status
Lurgi	SASOL Sasolburg, S.A.	Bituminous	Wash cooler	Wash cooler, waste heat boilers, trim	Rectisol	Synthesis gas/fuel gas for domestic consumption	1
Wellman-Galusha	Glen-Gery Brick Co. Reading, PA	Anthracite	Hot cyclone	None	None	Fuel gas for brick kiln	1
	National Lime Co. Carey, OH	Bituminous	Hot cyclone	None	None	Fuel gas for lime kiln	1
Woodall-Duckham/Gas Integrale	Chomutov Tube Works Czechoslovakia	Lignite	Hot cyclone/hot ESP, wash cooler	Wash cooler, trim cooler	None	Fuel gas for metallurgical process	1
Koppers-Totzek	Azot Sanayii T.A.S. Kutahya, Turkey	Lignite	WHB, wash cooler, wet cyclone	WHB, wash cooler, wet cyclone	Sulfinol/Rectisol	Synthesis gas for ammonia production	1
Winkler	Azot Sanayii T.A.S. Kutahya, Turkey	Lignite	WHB, hot cyclone, wash cooler	WHB, wash cooler	Iron oxide, water wash, NaOH wash	Synthesis gas for ammonia production	1
Chapman (Wilputte)	U.S. Army Holston Arsenal Kingsport, TN	Bituminous	Hot cyclone	Water sprays, wash cooler	None	Fuel gas for acetic anhydride process	2
Riley Morgan	Riley Research Center Worcester, MA	Anthracite, bituminous	Hot cyclone	None	None	PDU* - product gas flared	2
Coalex	Inex Resources, Inc. Lakewood, CO	All types except liquids	None	None	Chemical additive to coal feed	Fuel gas to boiler (commercial unit under construction)	2
Pressurized Wellman-Galusha (MERC)	ERDA Morgantown Energy Research Center, Morgantown, WV	Subbituminous, bituminous	Hot cyclone	None	None	PDU* - product gas flared	3
BGC/Lurgi Slagging Gasifier	Westfield Development Centre Westfield, Scotland	Bituminous	Wash cooler	Wash cooler, WHB	Rectisol	PDU* - product gas flared, feed to methanation demonstration plant	3
GFERC Slagging Gasifier	ERDA Grand Forks Energy Research Center Grand Forks, ND	Lignite	Wash cooler	Wash cooler, trim cooler	None	PDU* - product gas flared	3
Texaco	Montebello Research Laboratory Montebello, CA	Lignite, bituminous	Water sprays, quench tank, wash cooler	Water sprays, quench tank, wash cooler	DNA	PDU* - product gas flared	3
Bi-Gas	Bituminous Coal Research, Inc. Homer City, PA	Lignite, subbituminous bituminous	Hot cyclone, wash cooler	Wash cooler	Selexol	PDU* - product gas flared	3
Foster Wheeler/Stoic	University of Minn. Duluth, MN	Subbituminous	Hot ESP, hot cyclone	None	None	Fuel gas steam boiler	3[5]
Wellman Incandescent	York, PA	Bituminous	Hot ESP, cyclone	None	Stratford	Fuel gas	2

[1]Commercially available; significant numbers of units currently operating in the U.S. or in foreign countries.

[2]Commercially available or operating; near-term application possible.

[3]Operating or being constructed as demonstration units; technology is promising

[4]Location of largest operating plant

[5]Under contract

*Process development unit

COMPARISON OF PROMISING COAL GASIFIERS (226)

	Gasifier Type	Development Status	Cold Gas Efficiency (%)[a]	Overall Thermal Efficiency (%)[b]	Feedstock Limitations: Coal Size mm(in)	Maximum Coal Moisture Content (%)	Coal Caking Properties	Coal Ash Content
Wellman-Galusha	Fixed-Bed	Commercial	75	81	8-51(0.3-2.0)	NR	Requires agitator; reduces throughput	Any
Lurgi	Fixed-Bed	Commercial	63-75	76	3-38(0.1-1.5)	<35	Requires agitator; reduces throughput	Any
Woodall-Duckham/ Gas Integrale	Fixed-Bed	Commercial	77	88	6-38(0.25-1.5)	Any	Swelling index <2.5	NR
Chapman(Wilputte)	Fixed-Bed	Commercial	NR	NR	<102(<4.0)	NR	Requires agitator; reduces throughput	Any
Riley Morgan	Fixed-Bed	Commercial Scale Demo. Unit Tested	72	NR	3-51(0.1-2.0)	NR	Requires agitator; reduces throughput	Any
Pressurized Wellman-Galusha Gasifier (MERC)	Fixed-Bed	Demo. Unit Operational	79	NR	50%<13(50%<0.5)	Any	Requires agitator; reduces throughput	Any
GFERC Slagging Gasifier	Fixed-Bed	Demo. Unit Under Const.	NR	NR	6-10(0.25-0.75)	Any	Non-caking coals only	Low ash or refractory type ash may require flux

(continued)

Appendix II-A-2 (cont.)

COMPARISON OF PROMISING COAL GASIFIERS (226) (continued)

	Gasifier Type	Development Status	Cold Gas Efficiency (%)[a]	Overall Thermal Efficiency (%)[b]	Feedstock Limitations: Coal Size mm(in)	Maximum Coal Moisture Content (%)	Coal Caking Properties	Coal Ash Content
BCC/Lurgi Slagging Gasifier	Fixed-Bed	Demo. Unit Operational	NR	NR	13-51(0.5-2.0) Fines may be injected into tuyeres	<20	Requires agitator; reduces throughput	Low ash or refractory type ash may require flux
FW/Stoic Wellman-Incandesc.	Fixed-Bed	Demo. Unit Under Const.	NR	NR	NR	Any	Non-caking coals only	NR
Winkler	Fluidized-Bed	Commercial	55-72	69	<9.5(<0.4)	<30	Swelling index <4.0	Any
Koppers-Totzek	Entrained-Bed	Commercial	65-75	68	70%<0.1(70%<0.04)	2-8	All coals	>40% refactory type ash may require flux
Bi-Gas	Entrained-Bed	Demo. Unit Operational	69	65	70%<0.1(70%<0.04)	Any	All coals	Refractory type ash may require flux
Texaco	Entrained-Bed	Demo. Unit Under Const.	NR	NR	<0.1(<0.04)	Any	All coals	NR
Coalex	Entrained-Bed	Commercial Unit Under Const.	NR	88-93	<0.07(<0.003)	Any	All coals	Any

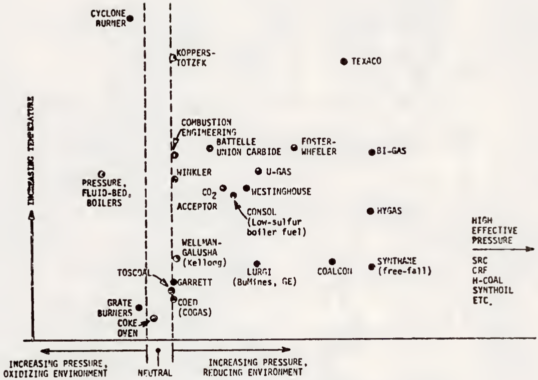
NR: Not reported

[a]Cold gas efficiency = $\frac{\text{[Product gas energy output]}}{\text{[Coal energy input]}} \times 100$

[b]Overall thermal efficiency = $\frac{\text{[Total energy output (product gas + by-products + steam)]}}{\text{[Total energy input (coal + steam + electricity)]}} \times 100$

The useful overall thermal efficiency of a gasifier may vary from the ranges given depending upon the ability of the integrated system to use the energy contained in by-product hydrocarbons and waste steam.

Appendix II-A-3



Comparison of fuel conversion processes (109)

Appendix II-A-4

OPERATING AND RAW PRODUCT GAS STREAM CHARACTERISTICS (213)

Gasifier	Coal Type	Temperature °C	Pressure MPa	Particulate Loading g/nm³	Particulate Composition	Tar Loading g/nm³	Tar Composition
Fixed Bed							
Wellman Galusha(2,3)	anthracite bituminous coke	430-920	0.10			10-50	
Lurgi (2,3,4,5)	"variety of coals"	370-590	2.07-3.21	0.5-6.0	C-75-80% ash-10-25%	tar-13 tar oil 79	tar S-0.77% tar oil S-0.29%
Woodall Duckham(2,3)	lignite bituminous	120-650	0.10			oil & tar 10.3	
Wilputte Chapman(2,3)	all types	540-650	0.10				
Riley Morgan(2)	anthracite bituminous coking bit. bituminous	570-620	0.10	2-4		tar 10-20 tar oil 10-20	
MERC(2,3,4,5,6)	all types	490-650	0.10-2.10	0.5-6.0	C-75-80% ash-10-25%	10	C-92.1 N-7.6 N+O-8.8
GFERC(2,4)	lignite lignite char bit. char	95-370	0.65-2.96			tar-10 tar oil-25	
Fluid Bed							
Winkler(2,3,4)	several coal types	590-730	0.10		C-30% ash-70%	None	
Synthane (3,4,5)	all types	760	6.90	4.8-12	C-80% ash-20%	2.4-17	
CO_2 Acceptor (3,4,5)	lignite sub-bit.	815	1.03-2.06	26	C-8% ash-98%	None	
Hygas(3,4)	all coals	1100	6.90-10.3	120	C-55% ash-40% O_2-5%	None	
CoGas (3)	all types	870	0.21-0.41				
Hydrane (3)	all types	540-815	6.90			4.3	
Union Carbide (3)		870-990	0.69	0.1-1.2		None	
Westinghouse (3)	"variety of coals"		0.90-1.38	8		None	
U-Gas (3)	non-caking, caking req. pretreatmt.	840-1040	0.34-2.41			None	
BCR (3)		-	1.62			None	
Ignifluid (5)		590-715	0.10-0.50	84			
Entrained Bed							
Koppers Totzek (2,3,4)	all types	1450	0.10	30-60	C-10% ash-90%	None	
Bi-Gas (2,3)	lignite sub-bit. bitumin.	745-1180	1.62-10.3	230	char-96-89% ash-12-10% volatiles - 2-1%	None	
Texaco(2,3)	lignite	200-260	2.10-8.27			None	
Combustion Engineering(3)	all types	870	0.10				
B & W (3)	all types	990	0.10-2.10			None	
Coalex (2)	all types	925-950	0.10				
Foster Wheeler (2,3)	non-caking	upper stage 980-1150 lower stage 1370-1540	2.41			None	

Appendix II-A-5

LOW/MEDIUM-BTU GASIFICATION SYSTEM PRODUCT GAS UTILIZATION OPTIONS (226)

Gasifier type Gasifier name	Significant operating characteristics	Utilization option for which each gasifier is best suited
Fixed-Bed (Dry Ash)		
Wellman-Galusha	Atmospheric; air or oxygen blown	On-site combustion
Lurgi	Pressurized; air or oxygen blown	Off-site combustion; combined cycle
Woodall-Duckham/ Gas Integrale	Atmospheric; air or oxygen blown	On-site combustion
Chapman (Wilputte)	Atmospheric; air or oxygen blown	On-site combustion
Riley Morgan	Atmospheric; air or oxygen blown	On-site combustion
Pressurized Wellman-Galusha (MERC)	Pressurized; air or oxygen blown	Off-site combustion; combined cycle
Foster Wheeler/Stoic	Atmospheric; air blown only	On-site combustion
Fixed-Bed (Slagging Ash)		
GFERC Slagging Gasifier	Pressurized; oxygen blown only	Off-site combustion; combined cycle
BGC/Lurgi Slagging Gasifier	Pressurized; oxygen blown only	Off-site combustion; combined cycle
Fluidized-Bed (Dry Ash)		
Winkler	Atmospheric; air or oxygen blown	On-site combustion
Entrained-Bed (Slagging Ash)		
Koppers-Totzek	Atmospheric; oxygen blown only; high CO, low CH_4 in product gas	Synthesis/reductant gas
Texaco Gasifier	Pressurized; air or oxygen blown; high CO, low CH_4 in product gas	Synthesis/reductant gas, combined cycle
Bi-Gas	Pressurized; air or oxygen blown; high CH_4 in product gas	Off-site combustion; combined cycle
Coalex	Atmospheric; air-blown; solid additive for sulfur removal	On-site combustion

Bases for selecting best utilization technology:

1) Atmospheric gasifiers are limited to on-site combustion applications.
2) Pressurized, oxygen-blown gasifiers are best suited to off-site combustion applications.
3) Pressurized gasifiers, both air- and oxygen-blown, are suitable for combined-cycle applications.
4) Product gases which are high in CO and H content, and low in CH and hydrocarbon content are suitable for use as synthesis/reductant gases.

Appendix II-A-6

Fuel Gas Comparisons (050)

INDUSTRIAL FUEL FROM COAL CONVERSION --

	CLEAN LOW BTU	CLEAN MED BTU	SNG
LOCATION	ON-SITE	NEAR	MINE-MOUTH
HEATING VALUE (BTU/SCF)	150	300	1,000
FLAME TEMPERATURE (°F)	3,000	3,500	3,500
FLUE GAS VOLUME (MCF/MIL BTU)	13.9	10.7	11.6
SO_2 EMISSION AT USER (LB/MIL BTU)	0.3	0.3	.0001

FIGURE 2

TYPICAL IFG GASIFIERS (EASTERN COAL) - - - -

	FIXED-BED		ENTRAINED-FLOW	
	W-G, ETC.	LURGI	K-T	TEXACO
SIZE (BILLION BTU/DAY)	2	10+	6+	10+
PRESSURE (PSIG)	ATMOS	300+	ATMOS	300+
COMMERCIALIZATION				
LOW BTU (AIR)	YES	YES	YES	YES
MED BTU (OXYGEN)	?	YES	YES	YES
CRITICAL ISSUES	FINES MED-BTU	FINES?	CARBON CONVERSION?	SCALE-UP

Appendix II-B-1 - PLANT CAPITAL (120)

Major On-Site Plant Cost in Millions of 1978 $

PROCESS

Category	F-T	M	H-Syn	H-FO	EDS	SRC-I	SRC-II
Coal preparation	63	63	84	84	63	63	63
H_2 or gasification	228	228	158	138	190	152	253
O_2 plant	117	175	87	67	-	84	129
(T/D)	(11,070)	(21,000)	(7,200)	(5,400)	-	(6,800)	(13,000)
Gas shift	-	40	35	30	-	-	-
Acid gas & Sulfur plants	57	57	57	57	60	60	60
Reactor section	55	106	210	140	180	160	195
Conversion	100	75	-	-	-	-	-
* Gas plant	25	10	25	30	-	177	30
Flexicoker	-	-	-	-	160	-	-
Pollution systems	40	40	40	40	44	44	44
Solvent Hydro. or catalyst prep.	3	-	-	-	82	-	-
	688	794	696	586	779	740	774

*M includes HF Alkylation; EDS solvent system in Flexicoker; SRC includes filtration

Appendix II-B-2

Products & Power Requirement (120)

Process	Products in BPSD	Electric Power in MW
F-T	19,600 gasoline 20,300 LPG 1,300 No. 2 fuel oil 2,100 No. 6 fuel oil	40
M-Gasoline	47,800 Premium gasoline 5,700 LPG	0
H-Syn	24,700 Naphtha 36,400 Syncrude	(-81.6)
H-FO	15,500 Naphtha 51,300 No. 6 fuel oil	(-4)
EDS	27,500 Naphtha 10,700 LPG 37,200 No. 6 fuel oil	135
SRC - I	13,000 Naphtha 64,400 Solid (equivalent)	0
SRC - II	13,000 Naphtha 6,400 No. 2 fuel oil 52,900 No. 6 fuel oil	0

BPSD = Barrels per stream day (SRC-I equivalent based on 6.2 million Btu/BBL)
MW = Megawatts (negative value indicates export)

Appendix II-B-3 - - - PROCESS COMPARISON (120)

Process	Liquid Products Efficiency	Cost Index 1978	Cost Index 1970
F-T	32	20.5	26.0
M-Gasoline	44	14.0	14.5
H-Syn	56	12.6	14.7
H-FO	66	12.9	18.4
EDS	65	13.6	18.5
SRC - I*	70	13.6	20.1
SRC - II**	77	13.7	20.4

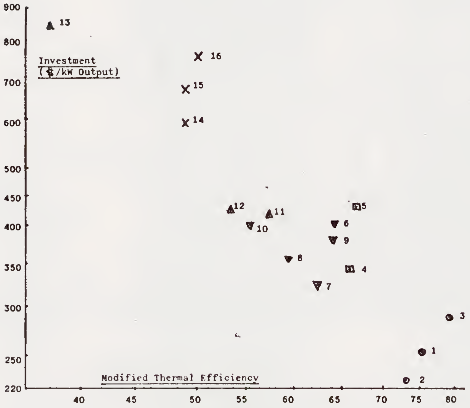
* SRC - I solid treated as a liquid for this purpose.

** SRC Product data is less proven than most of the others shown. Efficiency value shown may be high and cost index low.

Appendix II-B-4

<u>Investment against modified</u>
<u>Thermal Efficiency</u>
<u>'Base' Investment</u>

(050)



KEY

1. SRC (Gulf)
2. SRC (GVV)
3. SRC (Parsons)
4. H-Coal
5. EDS
6. Methanol/Texaco Gasifier
7. Methanol/Slagging Lurgi Gasifier
8. Methanol/FW Gasifier
9. Methanol (Badger)
10. Methanol (Du Pont)
11. Fischer-Tropsch/BiGas Gasifier
12. Fischer-Tropsch/Slagging Lurgi
13. Fischer-Tropsch/Lurgi (sub-bit. coal)
14. Mobil 'M'/Texaco Gasifier
15. Mobil 'M' + SNG/Lurgi (sub-bit. coal)
16. Mobil 'M' (no SNG)/Lurgi (sub-bit. coal)

Appendix II-C-1 -- KEY FEATURES OF SOLVENT PROCESSES FOR ACID GAS REMOVAL (223)

Process Name	Solvent/Reagent	Operating Pressure (acid gas partial pressure)	Selectivity H_2S/CO_2	Selectivity CO_2/HC	Component Distribution* COS	CS_2	RSH	NH_3	HCN	Higher Organics	Water Vapor	Solvent Losses (Replacement Requirement)	Utility Requirements†
PHYSICAL SOLVENTS													
Rectisol	Methanol	High	Good	Poor	a,b	a,b	a,c,d	c,d	a,c,d	a,b,c,d	[illegible]	High	Moderate/low
Selexol	Dimethyl ether of polyethylene glycol	High	Good	Moderate	a,b	a,b	a,c,d	c,d	a,c,d	a,b,c,d	[illegible]	Low	Low
Purisol	N-methyl 2-pyrrolidone	High	Good	Moderate	a,b	a,b	a,d	a,d	a,c,d	a,b,c,d	[illegible]	Low	Low
Fluor solvent	Propylene carbonate	High	Moderate	Moderate	a,b	a,b	a,d	a,d	a,c,d	a,b,d	d	Low	Low
Estasolvan	Tri-n-butyl phosphate	High	Moderate	Moderate	a,b	a,b	a,d	a,d	a,c,d	a,b,d	d	Low	Low
CHEMICAL SOLVENTS													
Amine Solvents													
Sulfiban	Monoethanolamine (MEA)	Low	Poor	Good	e	e	a,b,d	a,d	e	a,d	d,g	High	Very high
MDEA	Methyl-diethanol-amine	Low	Moderate	Good	a,b	a,b	a,b,d	a,d	e	a,d	d,g	Moderate	High
DEA	Diethanolamine	Low	Poor	Good	a,b	a,b	a,b,d	a,d	e	a,d	d,g	High	Very high
ADIP	Diisopropanolamine	Low	Poor	Good	a,b	a,b	a,b,d	a,d	e	a,d	d,g	Moderate	High
Fluor Econamine	Diglycolamine (DGA)	Low	Poor	Good	a,b	a,b	a,b,d	a,d	e	a,d	d,g	Low	High
Alkazid	Dimethyl or diethyl glycine	Low	Moderate	Good	f,g	f,g	d,g	a,d	e	a,d	d,g	Low	High
Carbonate Solvents													
Benfield	Potassium carbonate and diethanolamine	Moderate	Moderate	Excellent	f,g	f,g	f,g	a,d	f,a,d	g	g	Low	Moderate
Catacarb	Potassium carbonate and amine borates	Moderate	Moderate	Excellent	f,g	f,g	f,g	a,d	f,a,d	g	g	Low	Moderate
MIXED SOLVENTS													
Sulfinol	Cyclotetramethylene sulfone and diisopropanolamine	Moderate	Poor	Moderate	a,b	a,b	a,d	a,d	a,d	a,b,d	d,g	Low	Moderate
Amisol	Methanol and mono- or dietnanolamine	Moderate	Poor	Moderate	a,b	a,b	a,d	a,d	a,d	a,b,d	d,g	High	Moderate
REDOX PROCESSES													
Giammarco-Vetrocoke	Potassium carbonate and arsenate/arsenite	Moderate	Good	Excellent	f,g	f,g	f,g	a,d	f,a,d	g	g	Low	Moderate
Stretford	Alkaline metavanadate and anthraquinone di-sulfonic acid	Moderate	Good‡	Excellent	g	g	g	g	e	g	g	Low	Moderate

* a) with acid gas stream after simultaneous CO_2 and H_2S removal
b) with CO_2 stream after separate CO_2 and H_2S removal
c) with H_2S stream after separate CO_2 and H_2S removal
d) with aqueous or organic liquid phase prior to or integral with process
e) degrades solvent
f) hydrolyzes
g) remains with treated gas

†Depends on acid gas partial pressure, selective vs. non-selective design, and residual sulfur allowed, rating is for moderate to high pressure application with <10 ppm residual H_2S in treated gas.

‡Selectivity good, but high CO_2 lowers H_2S absorption rate and requires large systems for efficient H_2S removal.

Appendix II-C-1 ----------- COMPARISON OF LOW TEMPERATURE ACID GAS REMOVAL PROCESSES (226)

	Chemical Solvent Processes					
	MEA	MDEA	DEA	DIPA	DGA	Benfield
Control Effectiveness						
• H_2S	99.9+%	99.9+%	99.9+%	99.9+%	99.9+%	99.9+%
• CO_2	99+%	99+%	95+%	DNA	99+%	99.9+%
• COS/CS_2	D	DNA	90-99%	DNA	D	75-99%
• R-SH	D	DNA	DNA	DNA	D	68-92%
• HCN	DNA	DNA	DNA	DNA	D	99+%
• NH_3	DNA	DNA	DNA	DNA	DNA	DNA
Capable of Being Operated Selectively (to remove H_2S without CO_2	DNA	yes	DNA	yes	DNA	yes
Operating Requirements						
• Steam	✓	✓	✓	✓	✓	✓
• Electricity	✓	✓	✓	✓	✓	✓
• Cooling Water	✓	✓	✓	✓	✓	✓
• Fuel Gas						
• Chemicals						✓
Discharge Streams Requiring Further Control						
• Gaseous	✓	✓	✓	✓	✓	✓
• Aqueous	✓	NR	NR	NR	✓	✓
• Solid	NR	NR	NR	NR	NR	NR
By-Products	NR	NR	NR	NR	NR	NR
Process Limitations	Organic sulfur compounds degrade solvent	Corrosion problems greater than MEA	Corrosion problems greater than MEA		Organic sulfur compounds degrade solvent	

(continued)

Appendix II-C-1 --------- COMPARISON OF LOW TEMPERATURE ACID GAS REMOVAL PROCESSES (226)

(continued)

	Physical solvent processes					Combination processes	
	Rectisol	Selexol	Purisol	Estasolvan	Fluor solvent	Sulfinol	Amisol
Control Effectiveness							
• H_2S	99.9+%	99.9+%	99.9+%	99.9+%	99.9+%	99.9+%	99.9+%
• CO_2	99.9+%	99.9+%	99.9+%	99.9+%	99.9+%	99+%	99+%
• COS/CS_2	99.9+%	99.9+%	99+%	98+%	DNA	90+%	99+%
• R-SH	99.9+%	99.9+%	DNA	97+%	DNA	90+%	DNA
• HCN	DNA	DNA	DNA	DNA	DNA	DNA	DNA
• NH_3	DNA	DNA	DNA	DNA	DNA	DNA	DNA
Capable of Being Operated Selectively (to remove H_2S without CO_2	yes	yes	yes	yes	yes	yes	DNA
Operating Requirements							
• Steam	✓	✓	✓	✓	✓	✓	✓
• Electricity	✓	✓	✓	✓	✓	✓	✓
• Cooling Water	✓	✓	✓	✓	✓	✓	✓
• Fuel Gas	✓	✓	✓	✓	✓		
• Chemicals	✓	✓	✓	✓	✓		
Discharge Streams Requiring Further Control							
• Gaseous	✓	✓	✓	✓	✓	✓	✓
• Aqueous	✓	NR	✓	NR	NR	NR	NR
• Solid	NR	NR	NR	NR	NR	NR	NR
By-Products	Naphtha	NR	NR	NR	NR	NR	NR
Process Limitations	Low temp. required to limit solvent losses; retains heavy hydrocarbons, high pressure	Retains heavy hydrocarbons, high pressure	Retains heavy hydrocarbons, high pressure	Retains heavy hydrocarbons, high pressure	Retains heavy hydrocarbons, high pressure	Solvent is expensive	

NR - none reported
DNA - data not available
D - solvent degrades forming nonregenerable compounds
✓ - indicates presence of a utility requirement or discharge stream

Appendix II-C-1

Written Comparisons - Acid Gas Removal (223)

- Physical solvents are likely candidates for high pressure selective acid gas removal. Processes such as Rectisol and Selexol offer high selectivity toward H_2S and would be economical for high pressure operation. Residual sulfur and CO_2 levels obtained are consistent with methanation catalyst protection requirements (i.e., only small sulfur guard beds would be required). Also, water vapor and organics which can deactivate either the sulfur guard or the methanation catalyst are largely removed.

- Amine based processes are not likely to be commercially employed for bulk acid gas removal in SNG production. MEA and DEA suffer both excessive degradation and vaporization losses. Even the more stable and less volatile solvents (e.g., DIPA, DGA) are uneconomical at high pressures and are not selective enough toward H_2S. The use of such processes would result in an acid gas stream containing as low as 0.3% H_2S and the remainder CO_2. This presents a major problem for subsequent sulfur recovery/removal. One amine solvent ADIP) has been proposed for use in a commercial SNG facility for the purpose of recovery of hydrocarbons and concentration of H_2S from the concentrated acid gas stream from a physical solvent process (Rectisol)[9,37].

- Carbonate systems may have application for both selective and non-selective acid gas removal from product gases at moderate pressures. Carbonate systems can be more economical than physical solvent systems for moderate pressure applications. Carbonate systems are ineffective in removing organics and produce a gas which is saturated with moisture. The high moisture and organics content of treated gases may necessitate additional treatment prior to methanation.

- Mixed solvents (Sulfinol and Amisol) are not likely to be employed in SNG application, due to their relatively low H_2S removal efficiency (e.g., compared to the carbonate system), lack of selectivity and high solvent costs.

- Redox systems which would be suitable for "tail" gas treatment are not likely to be employed for acid gas removal from product gas in high Btu gasification. Capital and operating costs for Redox systems would be significantly higher than for amine, physical solvent, and carbonate systems handling the same volume of gas. This is despite the fact that separate recovery of sulfur is not required with Redox systems. Other disadvantages of the Redox system include excessive solution degradation when treating gases containing HCN (e.g., in the case of the Stretford process), inability to remove trace sulfur compounds (COS, CS_2, mercaptans) and organics (in the case of Stretford and Giammarco-Vetrocoke processes), and the use of hazardous solvents (e.g., use of arsenic in the Giammarco-Vetrocoke process solvent). It should be emphasized, however, that processes such as Stretford may find applications to the concentrated acid gas stream generated by other acid gas removal systems (see Chapter 5.0).

Appendix II-C-2

KEY FEATURES OF SULFUR RECOVERY TAIL GAS TREATMENT PROCESSES (233)

Tail Gas Removal Process	Process Principle	Feed Stream Requirements/ Restrictions	Sorbents/ Solvents	Product	Utility Requirements	COS and CS_2 Removal	Efficiency	Effect of CO_2 in Feed Gas
Chiyoda Thoroughbred 101	Thermal oxidation of sulfur compounds to SO_2, followed by liquid absorption	Incinerated Claus tail gas; no specific requirement on $H_2S:SO_2$ ratio	2% (by wt.) sulfuric acid solution	Gypsum ($CaSO_4 \cdot H_2O$) 5 to 20% moisture content	Very high	Largely oxidized by incineration, not absorbed by solution	95% SO_2 or less than 300 ppmv	No effect
Beavon	Catalytic reduction of sulfur compounds to H_2S, followed by Stretford process	Sulfur recovery process tail gas is heated upstream of catalytic reactor; no specific $H_2S:SO_2$ ratio required	Stretford process solution	Elemental sulfur	Low	Catalytically converted to H_2S	99.8% removal for Claus tail gas containing 4% equivalent H_2S	Reduces conversion efficiency by catalyst; decreases H_2S absorption by Stretford solution
CleanAir	Catalytic reduction of sulfur compounds to H_2S, followed by a continuation of the Claus reaction and Stretford process	$H_2S:SO_2$ ratio can vary up to 8:1 without affecting efficiency; designed specifically for Claus tail gas	Unknown aqueous solution and Stretford process solution	Elemental sulfur	Very low	Catalytically converted to H_2S	Plant effluent normally guaranteed to contain less than 250 to 300 ppm SO_2 equivalent	Reduces conversion efficiency of catalyst; decreases H_2S absorption by Stretford solution
IFP-1	Liquid phase continuation of Claus reaction at a low temperature	$H_2S:SO_2$ ratio maintained in the range of 2.0 to 2.4	Polyalkaline glycol	Elemental liquid sulfur	Very low	Not removed in catalytic reactor	Capable of reducing sulfur species in Claus tail gas to 2000 ppm as SO_2	No effect
IFP-2	Incineration of tail gas followed by ammonia scrubbing. Solution is evaporated to produce a concentrated SO_2 stream which is returned to the Claus plant.	$H_2S:SO_2$ ratio maintained in the range of 2.0 to 2.4	Aqueous ammonia solution	Elemental liquid sulfur	High	Oxidized by incineration, not removed in catalytic reactor	Capable of reducing sulfur species in Claus tail gas to less than 500 ppm	No effect

(CONTINUED)

Tail Gas Removal Process	Process Principle	Feed Stream Requirements/ Restrictions	Sorbents/ Solvents	Product	Utility Requirements	COS and CS_2 Removal	Efficiency	Effect of CO_2 in Feed Gas
Sulfreen	Solid phase continuation of Claus reaction at a low temperature	Optimum performance requires H_2S:SO_2 ratio of 2:1	None; sulfur vapor condensation process utilized	Elemental liquid sulfur	Very low	Not appreciably removed	Capable of removing 80 to 85% of sulfur in the tail gas	No effect
Shell Copper Oxide	Thermal oxidation of sulfur compounds to SO_2, followed by adsorption by CuO; a concentrated SO_2 stream is produced by desorption with a reducing gas (H_2)	Incinerated Claus tail gas; no specific requirement on H_2S:SO_2 ratio	Copper oxide	Concentrated SO_2 stream	No data available	Oxidized by incineration	90% SO_2 removal	?
Wellman-Lord	Thermal oxidation of sulfur compounds to SO_2, followed by liquid absorption; concentrated SO_2 is produced and recycled to Claus plant	Incinerated Claus tail gas; process can handle SO_2 concentrations well over 10,000 ppm	Concentrated sodium sulfite, bisulfite solution	Concentrated SO_2 stream (up to 90% SO_2 content)	High	Oxidized by incineration, not removed by process	Can remove in excess of 95% of SO_2	No effect
SCOT	Sulfur species are catalytically reduced to H_2S; H_2S is scrubbed in a regenerable amine system	Applicable to Claus tail gas	Alkanolamine solution	Concentrated H_2S stream	Moderate	Catalytically reduced to H_2S	Can remove 97% of sulfur species	Reduces conversion efficiency by catalyst; high CO_2 levels reduce efficiency of alkanolamine system

GENERAL CHARACTERISTICS OF SULFUR RECOVERY PROCESSES (223)

Process	Process Principle	Limits of Applicability	Control Efficiencies (%)						By-Product	Effect of CO_2	Commercial Applications
			H_2S	COS/CS_2	R-SH	HCN	NH_3	HC			
Claus	Catalytic oxidation of H_2S to elemental sulfur	Straight-through system utilized for higher H_2S concentrations. Split-stream system utilized for H_2S concentrations of 10%-15%. Sulfur-burning mode used for H_2S levels down to 5%.	90 - 95	90	95	Partially oxidized	Partially oxidized	90	Elemental liquid sulfur	Can adversely affect sulfur removal ability and therefore increase plant size. If CO_2 exceeds 30% and NH_3 exceeds 500 ppmv, catalyst plugging problems may occur.	Widely employed in petroleum refinery, natural gas, and by-product coke industry. One known application to coal gasification in South Africa.
Stretford	Liquid phase oxidation of H_2S to elemental sulfur in an alkaline solution of metavanadate and anthraquinone disulfonic acid (ADA) salts.	Present applications are generally for 1% sulfur or less.	99.9 or greater	0	0	~100 (converted to SCN^- in Stretford solution)	0	0	Elemental sulfur	High CO_2 concentrations will decrease absorption efficiency by lowering solution alkalinity. Increasing absorber tower height and base addition are required.	Primarily natural gas service, a few applications to petroleum refining and by-product coke industries. A unit has been constructed at the Lurgi gasification facility at Sasol, So. Africa.
Giammarco-Vetrocoke (G-V)	Liquid phase oxidation of H_2S to elemental sulfur in potassium carbonate and arsenate/arsenic alkaline solution. A concentrated CO_2 stream with very low H_2S concentration is produced.	Maximum of 1.5% H_2S in feed stream.	99.99	Partially removed	Partially removed	?	0	0	Elemental sulfur which may require arsenic removal	Little or no effect. Process can be designed to selectively remove H_2S with low CO_2 absorption.	Primarily natural gas service; a few applications for hydrogen purification in petroleum refining and ammonia production.

Appendix II-C-2

(226) SUMMARY OF SULFUR RECOVERY AND CONTROL PROCESSES

	Sulfur recovery process		Tail gas cleanup processes		
	Claus	Stretford	Beavon	SCOT	Wellman-Lord
Development Status	Commercial	Commercial	Commercial	Commercial	Commercial
Control Effectiveness					
• H_2S	90-95%	99.9+%	99.9+%	99.8+%	99.0+%
• COS/CS_2	90%	-	98+%	98+%	99+%
• R-SH	95%	-	DNA	DNA	99+%
• HCN	DNA	D	D	DNA	DNA
• NH_3	DNA	-	DNA	DNA	DNA
• Hydrocarbons	90%	-		-	
Operating Requirements					
• Steam		✓	✓	✓	✓
• Electricity		✓	✓	✓	✓
• Cooling Water	✓				✓
• Fuel Gas			✓	✓	
• Chemicals (including catalyst)	✓	✓	✓		✓
• Process Water		✓	✓		
Discharge Streams Requiring Further Control					
• Gaseous	✓		✓a		
• Aqueous			✓	✓	✓
• Solid	✓				
By-Products					
• Sulfur	✓	✓	✓		
• Other					Steam
Applicability To Coal Gasification					
• Proven					
• Technically Feasible	✓	✓	✓	✓	✓
Process Limitations	High hydrocarbon feed can result in formation of organic sulfur compounds	Does not remove organic sulfur compounds			

a If organic sulfur compounds are present in feed stream

D - Solvent degrades forming nonregenerable compounds

DNA - Data not available

✓ - Indicates presence of an operating requirement, discharge stream, by-product, or applicability characteristic

Appendix II-C-3

Processes of H_2S Removal

(141)

Category	Process
Low-temperature chemical absorption using amines	DEA DIPA MDEA
Low-temperature chemical absorption using alkali salts	Alkazid "DIK" Benfield Catacarb
Low-temperature physical solvent absorption	Rectisol Selexol
Low-temperature mixed chemical/ physical absorption	Sulfinol
Low-temperature absorption-oxidation system	Stretford Takahax
High-temperature H_2S removal	Battelle Molten Salt Conoco Dolomite MERC iron oxide/fly ash
Low-temperature solid sorption	Molecular sieve

Category	Process
Amine	MDEA
Alkali salt	Benfield
Physical solvent	Selexol
Mixed solvents	Sulfinol
Absorption/oxidation	Stretford
High-temperature	MERC iron oxide
Low-temperature solid sorption	Molecular sieve

Appendix II-C-3

OPTIONS FOR THE MANAGEMENT OF SULFUR-BEARING WASTE GASES IN INTEGRATED FACILITIES (233)

Waste Gas	Control Options*	Comments
Concentrated Acid Gases	1. Claus plant sulfur recovery	1. Probably unacceptable because of high concentration of total sulfur in the tail gas; only applicable to streams containing more than 15% H_2S.
	2. Claus plant sulfur recovery and tail gas incineration	2. Probably unacceptable because of high levels of SO_2 in the tail gas; only applicable to streams containing more than 15% H_2S.
	3. Claus plant sulfur recovery and tail gas treatment	3. Tail gas treatment not highly effective when feed gases contain high levels of CO_2; only applicable to streams containing more than 15% H_2S.
	4. Same as 1 plus SO_2 control and/or recovery	4. Reasonable option when feed gases contain more than 15% H_2S; total sulfur removal efficiency may be less than option 3.
	5. Stretford or G-V sulfur recovery	5. Inapplicable to waste gases containing high levels of H_2S; may not be economical for gases containing high CO_2 levels; discharge may contain high COS and HC levels.
	6. Same as 5 plus tail gas treatment	6. Same as for Option 5.
	7. Same as 6 plus incineration	7. Same as for Option 5 except for oxidation of CO and HC compounds
	8. Incineration	8. Unacceptable because of high SO_2 emissions.
	9. Same as 8 plus SO_2 control and/or recovery	9. Many SO_2 recovery processes generate sludges requiring disposal; no by-product sulfur is recovered; regenerable SO_2 removal processes must be operated in conjunction with sulfur recovery units.
	10. Incineration, treatment for control and/or recovery in combination with flue gases from utility boilers or char combustion	10. Same as for Option 9; some economy of scale may be realized if flue gas desulfurization is required on utility boilers.
Depressurization and Stripping Gases	1. Combining with concentrated acid gas streams and use of any of the treatment options listed above	1. See individual options above; may have considerable dilution effect on the concentrated acid gas streams.
	2. Compression and addition to product gas stream	2. Permits material recovery; some energy input required for compression.
	3. Use as fuel	3. Stripping gases may have limited fuel value; may have high SO_2 emissions.
	4. Incineration	4. High levels of SO_2 emissions.
	5. Same as 4 plus SO_2 control and/or recovery	5. See comments for Options 9 and 10 for Concentrated Acid Gases.
Pretreatment Off-Gases	1. Combining with product gas	1. Product gas dilution and energy requirement for compression; permits material and energy recovery.
	2. Injection into gasifier	2. Permits material and energy recovery; will require gasifier design modification and energy input for compression.
	3. Use as fuel	3. May have high SO_2 emissions.
	4. Incineration	4. See comment for Option 4, Depressurization and Stripping Gases.
	5. Same as 4 plus SO_2 control and/or recovery	5. See comment for Option 5, Depressurization and Stripping Gases.
Lockhopper Vent Gases	1. Compression and recycling	1. See comment for Option 2, Pretreatment Off-Gases.
	2. Incineration	2. See comment for Option 4, Depressurization and Stripping Gases
	3. Same as 2 plus SO_2 control and/or recovery	3. See comments for Options 9 and 10, Concentrated Acid Gases.
	4. Use as fuel	4. See comment for Option 3, Depressurization and Stripping Gases.
Catalyst Regeneration/ Decommissioning Off-Gases	1. Incineration	1. See comment for Option 4, Depressurization and Stripping Gases.
	2. Same as 1 plus SO_2 control and/or recovery	2. See comments for Options 9 and 10, Concentrated Acid Gases.
Char Combustion, Incineration and Treatment Gases	1. Incineration (for transient gases)	1. See comment for Option 4, Depressurization and Stripping Gases.
	2. Same as 1 plus SO_2 control and/or recovery	2. See comments for Options 9 and 10, Concentrated Acid Gases.

*Except where gas compression and recycling is used, all options culminate in discharge of the treated gas to the atmosphere

Appendix II-C-3

SUMMARY OF DATA GAPS AND LIMITATIONS FOR GAS PURIFICATION AND UPGRADING OPERATIONS (233)

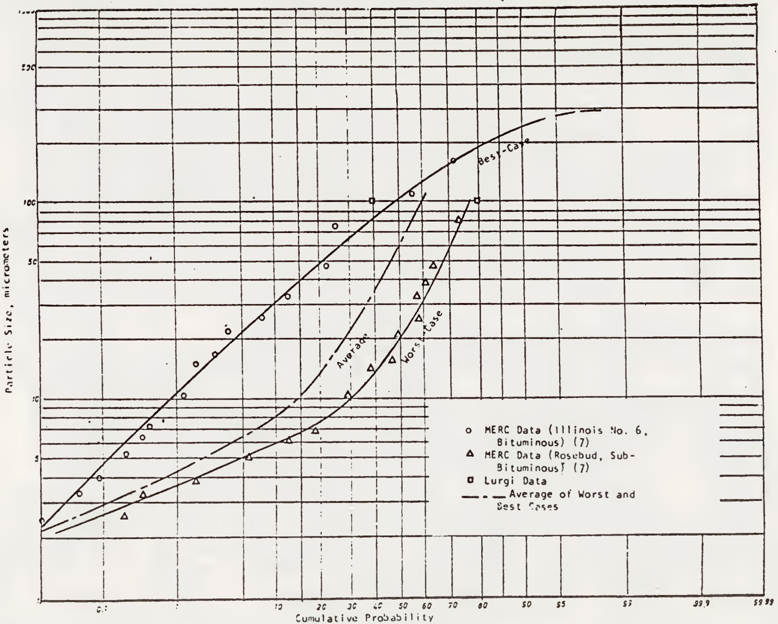
Module/Process	Process/Discharge Stream: Feed Gas	Treated Gas	Concentrated Acid Gas	Aqueous Condensate/Blowdowns	Solid Wastes/Sludges/By-Products	Comments
Shift Conversion	Major components well known. Additional data needed for COS, CS_2, NH_3, HCN, trace elements, organics and particulates	Same as feed gas	Not applicable	No data available	No data available for spent catalysts	The effect of catalyst on minor gas constituents not known
Acid Gas Removal						
• Hot gas H_2S removal	Same as above	Very limited data for major components and H_2S. No other data available	No data available	Not applicable	No data available	Hot gas H_2S removal is in very early development stage
• Physical solvents	Same as above	Considerable data on H_2S and CO_2 content in various applications. Limited data available for trace gases and organics. No trace element data	Same as treated gas	No data available	No data available	Only the Rectisol process has been employed in coal gasification applications to date
• Chemical solvents (amines)	Same as above	Same as above	Same as treated gas	No data available	No data available	Only the DGA process has been tested in coal gasification service
• Carbonate solvents	Same as above	Considerable data on H_2S and CO_2 content in various applications. Limited data for trace gases	Same as treated gas	Limited data are available on composition of Benfield solution after prolonged service in coal gasification. Quantities of and trace constituents in blowdown (if any) are not known	No data available	The Benfield process has been commercially used for acid gas removal in coal gasification service
• Mixed solvents	Same as above	Limited data on H_2S and CO_2. No data on trace gases	Same as treated gas	No data available	No data available	A Sulfinol unit has been used in a gasification facility in Turkey, but no operating data are available
• Redox processes	Same as above	Limited data on H_2S and CO_2. Very little data on trace gases	Same as treated gas	No actual operating data available	No actual operating data available	Available data for the Stretford process are derived mainly from conceptual designs rather than actual operation. Neither the Stretford nor the Giammarco-Vetrocoke process has been used in coal gasification
Methanation Guards	Same as above	Limited data available on total sulfur and major components. No data available on trace gases	Not applicable	No data available (not applicable for some processes)	No data available	Methanation guards have not been employed in coal gasification applications to date
Methanation	Major constituents well known; no data on trace sulfur and nitrogen compounds	Major constituents well known. Little known about metal carbonyls which may be formed	Not applicable	No data available; expected to be very clean condensate	Limited data on nickel and sulfur content and physical properties of spent catalyst. No data on trace elements, organics or toxicity	Only fixed bed methanation is sufficiently well tested for SNG production at present. Essentially nothing is known about emissions resulting from catalyst decommissioning

Appendix II-D-1

SUMMARIZED PARTICULATE AND TAR LOADINGS AND PARTICLE SIZE DISTRIBUTIONS (213)

	Particulate Loading (g/m^3)	Tar Loading (g/m^3)	Percent Particles (by weight) Less Than Specified Diameter (in Micrometers)				
			1	5	10	50	100
Fixed Bed							
Best Case	0.5	10.0	<0.1	0.1	1	23	50
Worst Case	6.0	50.0	<0.1	4.0	30	67	76
Average	3.0	18.0	<0.1	2.0	15	45	63
Fluid Bed							
Best Case	1.2	None	0.1	1.0	2	13	22
Worst Case	120.0	None	0.5	5.0	12	52	78
Average	26.0	None	0.3	3.0	7	33	50
Entrained Bed							
Best Case	30.0	None	<0.1	0.5	2	12	24
Worst Case	230.0	None	<0.1	0.5	4	66	90
Average	110.0	None	<0.1	0.5	3	39	57

Appendix II-D-2



Particle size distribution for fixed-bed gasifiers. (213)

Appendix II-D-3

HYDROGEN FOR COAL LIQUEFACTION (041)

HYDROGEN DEMAND (DRY COAL BASIS) PROCESS	MAIN PRODUCT	NET CHEMICAL H_2, WT%	COAL FEED TO COMPLEX ST/CD	COMMERCIAL COMPLEX: NET PRODUCTS ENERGY 10^9 BTU/CD	FOEB/SD	H_2 PLANT SIZE 10^9 BTU/CD	MMSCFD/SD	OVERALL THERMAL EFFICIENCY
RECYCLE SRC-II	SRC SOLID	2.2	30,000 (KY9)	585	104000	90	310	73.4%
RECYCLE SRC-II	BOILER FUELS	4.3	30,000 (KY9)	560	99600	176	600	70.3%
H-COAL (HRI/DOE)	SYNCRUDE	4.9	25,000 (IL6)	~440	~78500	152	520	
EXXON EDS	SYNCRUDE	4.0	30,000 (IL6)	~525	84000	~163	~560	~68.0%

ESTIMATED

HYDROGEN COST (INTERNAL EQUIVALENT COST) - 1980$

PROCESS	FEED+FUEL/100 MMSCF H_2: RATE	TYPICAL PRICE	100 MMSCF/SD (~30 X 10^9 BTU/CD) H_2 PLANT: INVESTMENT, MM$: ONSITES	OFFSITES (PRORATED)	TOTAL	TRANSFER PRICE, $/MSCF: FEED	OPNS.	CAP.CHG.	TOTAL	HYDROGEN THERMAL EFFICIENCY
STEAM REFORMING OF NATURAL GAS	43.7 MMSCF (1050 BTU/SCF)	$3.15/MMBTU	41.3	21.3	62.2	$1.32	$0.10	0.55	$1.97	70.2%
PARTIAL OXIDATION OF CRUDE RESIDUALS	6100 BBL	$15/BBL (USGC)	93.9	65.4	159.3	0.92	0.29	1.44	2.65	82.7%
CONVENTIONAL COAL GASIFICATION (VIA K-T/RECTISOL	2380 ST (11390 BTU/LB)	$21/ST (IL#6 @ MINE)	146.7	99.7	246.4	0.52	0.46	2.21	3.19	59.4%
ADVANCED COAL GASIFICATION (VIA PRESSURE SLAGGER)	2200 ST (11390 BTU/LB)	$21/ST (IL#6 @ MINE)	122.4	77.7	200.1	0.48	0.38	1.80	2.66	64.1%

NOTES:

1. 1 SCF H_2 = 322 BTU HHV OR 1 MMBTU H_2 = 3100 SCF; 250 X 10^9 BTU/CD = ONE "STANDARD" SYNFUELS PLANT; 1 FOEB = 6.25 MMBTU HHV
2. NOTE 1 SCF CO ~ 1 SCF H_2 IN TERMS OF HHV AND HYDROGEN POTENTIAL (VIA WATER GAS SHIFT)
3. SERVICE FACTOR FOR COAL LIQUEFACTION PLANT ASSUMED TO BE 90% (330 SD/CY)
4. HYDROGEN UTILIZATION (I.E. NET CHEMICAL HYDROGEN CONSUMED OVER TOTAL HYDROGEN GENERATED) ASSUMED TO BE 90%
5. ALL INVESTMENTS AND COST ESTIMATES FROM ERDA-BNL 50663, EXXON/CHEM SYSTEMS (APR. '77) IN 1980 $
6. CAPITAL CHARGES ARE ABOUT 30% ON INITIAL CAPITALIZATION
7. ONSITES INVESTMENTS ARE PROBABLY GENERALLY APPLICABLE TO INTEGRATED H_2 PLANTS — OFFSITES ARE PRORATED AND MAY NOT BE FULLY APPLICABLE TO INTEGRATED H_2 PLANTS

Appendix II-D-4

Comparison of Crude and
Synthetic Crude Characteristics (104)

	Distillation Yields (Vol. %)									
	Gasoline C5–400°F	Kerosene 400–525°F	Heating Oil 525–650°F	Fuel Oil 650–975°F	Residium 975°F+	Gravity °API	Sulfur WT %	Hydrogen WT %	Oxygen WT %	Nitrogen WT %
East Texas Crude	40	14	12	20	14	38	0.33	14		0.09
H-Coal Syncrude	37	26	17	20	—	23	0.19	10.9	0.6	0.1
SRC-I	10	—	12	6	72	−6	0.4	6.6	3.5	1.8

Appendix II-E-1

Conoco Slagging Lurgi (148)

OVERALL HEAT & MATERIAL BALANCE

PIPELINE GAS COMMERCIAL PLANT

	Mass Flow Rate lb/Hr	Gross Heating Value Million Btu/Hr	Per Cent of Heat Value
Input			
Coal to Gasification	[illegible],4[illegible]6,566	14,532.50	79.00
Coal to Boilers	374,000	3,610.95	21.00
Excess Coal Fines	563,707	(Note 1)	-
Total Coal Input	2,344,273	18,143.45	100.00
Flux	69,154	-	-
Air to Air Separation Plant	3,182,671	-	-
Raw Water	5,102,023	-	-
Combustion Air	4,209,242	-	-
Chemicals	[illegible]	-	-
Total Input	1[illegible],9[illegible],083	18,1[illegible]	100.00
Products			
Pipeline Gas	430,325	9,666.79	53.28
Naphtha	11,988	265.64	1.46
Oil	21,873	373.24	2.06
Crude Phenols	5,712	73.23	0.40
Anhydrous Ammonia	4,010	38.77	0.21
Sulfur	76,556	[illegible]	1.70
Sodium Sulfate Purge	3,845	-	-
Coal Fines	563,7[illegible]	(Note 1)	-
Subtotal Products	1,[illegible]	[illegible]	[illegible]
Waste and Vent Streams			
Air Separation Plant Vents	[illegible]	-	-
Combustion & Dryer Vents	6,[illegible]87,821		-
Cooling Tower & Steam System Water to Atmosphere	[illegible]		-
Slag to [illegible]	[illegible]1,[illegible]	[illegible]	[illegible]
Mixed Waste Solids to Landfill	[illegible] 140		-
Net Water Loss	[illegible]		-
Subtotal Vents & Wastes	[illegible]	[illegible]	[illegible]
Heat Lost to Air Cooling	-	[illegible]	[illegible]
Evaporative Cooling & Heat Loss	-	[illegible]	[illegible]
Heat of Flux Calcination		[illegible]	[illegible]
Total Output	[illegible]	[illegible]	[illegible]

NOTES:

1. The excess coal fines which are sold have not been included in the plant [illegible] to avoid distorting the plant efficiencies. These coal fines are an additional heat [illegible] product of 5,741.31 Million Btu/Hr.

Appendix II-E-1

Conoco Slagging Lurgi (148)

SUMMARY OF POWER AND UTILITY REQUIREMENTS

Section	Electrical Power KW	STEAM CONSUMPTION, 1,000 LBS/HR ** 1,500 psig Super-heated	550 psig Super-heated	110 psig Saturated	35 psig Saturated	Cooling Water 1,000 gpm
Coal and Flux Handling and Preparation	3,012	-	-	-	-	-
Air Separation*	-2,004	1,226.6	-	-	-	122.0
Gasification	1,303	-	461.7	-	-	13.9
Shift Conversion	10	-	914.9	-	-	-
Gas Cooling	950	-	-	-	-	4.6
Rectisol and Refrigeration	18,000	-	945.1	362.2	-	61.2
Methanation	615	-	201.2	-	-	13.6
Product Gas Compression and Drying	449	-	256.2	-	-	19.9
Sulfur Recovery	1,291	-	-	-	-	0.1
Slag Handling and Disposal	350	-	-	-	-	-
Gas Liquor Separation	1,659	-	-	-	10.1	3.9
Phenol Extraction	450	-	-	5.7	17.6	0.6
Ammonia Recovery	540	-	15.1	78.1	172.9	5.2
Water Treatment and Steam Generation	23,473	1,524.0	343.1	40.2	322.0	42.4
Cooling Water System	10,620	-	150.2	-	-	0.1
Plant and Instrument Air System	570	-	-	-	-	0.2
Waste Water Treatment	3,150	-	-	7.0	430.0	31.7
Flare and Incinerator Facilities	980	-	-	6.9	-	-
Tankage, Shipping and Receiving	10	-	-	-	-	-
Buildings, Firewater System, etc.	1,654	-	-	-	8.5	-
Plant Total	67,082	2,750.6	3,287.5	500.1	961.1	319.4

*The air separation unit is a net producer of electrical power.

** Some sections generate steam in heat recovery exchangers; steam production is not shown on this table but may be found in FE-2512-10, Volume 2

Appendix II-E-1

Conoco Slagging Lurgi (148)

COMPOSITION AND QUANTITY OF NORMAL GASEOUS EMISSIONS

Pounds per Hour

	Section 200C:	Section 300C: Gasification		Section 800C:	Section 2000C: Steam Generation		Section 3000C:		
	Air Separation	Lock Hoppers	Quench Vent	Gas Drying	Stack Gas	Dryer Vent	Incinerator	Flare	TOTAL
Nitrogen & Rare Gases	2,336,432	-	1	-	2,763,995	353,090	139,573	-	5,593,091
Oxygen	57,219	-	77	-	136,342	106,892	7,024	-	307,554
Carbon Dioxide	-	3,965	967	-	911,550	1,264	1,588,954	176	2,506,876
Sulfur Dioxide	-	-	-	-	2,356	-	346	-	2,702
Water Vapor	19,782	-	116	534	407,878	38,393	17,540	7044	491,2[illegible]
Total	2,413,433	3,965	1,161	534	4,222,121	499,639	1,753,437	7220	8,901,51[illegible]
Temperature, °F	94	68	250	220	180	120	350	-	-

Note: The cooling water towers and steam system emit 5,475,300 pounds per hour of water vapor to the atmosphere.

Appendix II-E-2

Grand Forks Slagging Lurgi (150)

Effluent production and characteristics for two lignites at the same operating conditions

Run Number	RA-31	RA-40
Coal	Noonan	Indian Head
Moisture in Coal, pct.	30.3	34.7
Operating Pressure, lb./sq.in.	200	200
Production, lb./ton maf:		
Tar	90	70.2
Water	1,140	1,220
Ammonia	12.6	11.0
Total organic carbon	13.3	12.3
Concentration of Selected Constituents in Aqueous Phase:		
pH	9.3	9.5
Alkalinity, ppm $CaCO_3$	30,020	25,410
Ammonia, ppm	10,220	8,440
TOC, ppm	10,000	9,460
Phenol, ppm	5,689	4,260
o-cresol, ppm	1,000	836
m-p cresol, ppm	3,317	1,671
Concentration of Selected Components in Tar Phase, pct:		
Phenols	18.2	15.4
Naphthols	3.9	5.6
Dihydroxybenzenes	1.4	0.0
Naphthalenes	9.3	9.0
Aromatic hydrocarbons with 3 to 5 rings	8.5	8.2
Saturated hydrocarbons	10.2	22.0
Non volatiles at 300° C and 0.1 torr	2.4	3.6
Average mol. wt. of volatile compounds	152.2	156.9

Appendix II-E-3

(226) COMPOSITION OF GAS LIQUOR FROM SASOL COAL GASIFIERS

Component	Approximate Composition
Phenols	3,000 - 4,000 ppm
Ammonia (free)	500 - 750 ppm
Ammonia (fixed)	100 - 200 ppm
Sulfides (total)	200 - 250 ppm
Suspended Tar, Oil	∿5,000 ppm
Cyanides	<50 ppm
CO_2	<1.0%
Fatty Acids	<.05%

PROMISING WASTEWATER TREATING MODULES
FOR SASOL GAS LIQUOR

Process Module	Process
Suspended Solids Removal	Filtration, Flocculation and Flotation, and Oil-Water Separator
Dissolved Organics Removal	Phenosolvan, Carbon Adsorption, Biological Oxidation, Cooling Tower Stripping (Oxidation)
Dissolved Volatile Inorganics Removal	Acid Gas Stripping, WWT Acid Gas Stripping
Dissolved Salts Removal	Forced Evaporation
Ultimate Disposal	Evaporation Ponds

Appendix III-A

ESTIMATED COMPOSITION OF LURGI FEED LOCKHOPPER VENT GAS (233)

Component	Vol %
CO_2	28
Total sulfur	0.3
C_2H_4	0.4
CO	20
H_2	39
CH_4	11
C_2H_6	0.6
N_2 + Ar	0.4
Naphtha	0.1
H_2O	1.0

Appendix III-B

Production Rate and Composition of Lurgi (Raw Coal) Product Gas Stream

Montana Subbituminous Coal

(260)

Production Rate:	
Nm^3/kg coal (CO_2, N_2, and O_2 free basis)	0.98 m^3/kg
Gas Analysis:	
H_2	41.1%
O_2 (includes N_2+Argon)	1.2
CO	15.1
CH_4	11.2
CO_2	30.4
C_2H_6	0.5%
H_2S	666g/100Nm^3
Total Organic Sulfur	12-40
NH_3	0.09
HCN	0.27g/100Nm^3
Naphthalene	0.24
St. ClairdeVille Condensable	389

Appendix III-C

Composition of Lurgi Tar/Oil Separator Depressurization Gas

Montana Rosebud Coal

(233)

Constituent*	Tar Sep.	Oil Sep.
H_2S	3.8	8.6
NH_3	6.3	12.0
CO_2	64.7	59.3
CO	5.9	4.7
H_2	2.9	2.3
O_2 + Argon	3.1	2.5
N_2	8.0	6.4
CH_4	5.3	4.2

Kosovo Operational Data

GAS STREAM ANALYTICAL DATA FOR "HIGH-PRIORITY" PHASE I EMISSION STREAMS (260)

Compound	3.2 Lock Hopper Vent Cases Low Pressure	3.6 Lock Hopper Vent Cases High Pressure	13.1 Tar Tank Vent	13.3 Medium Oil Tank Vent	13.6 Tar Separation Expn. Cases	13.7 Phen. H_2O Tank Vent	14.5 Stripper Vent	7.1 H_2S Vent	7.2 CO_2 Vent	7.3 Rectisol Inlet Gas
Fixed Gases (Vol. %)										
H_2	34.0	32.0	TR	NF	11.0	TR	NF	-	0.8	36.1
O_2	0.7	0.2	21.0	0.9	0.5	13.0	9.0	0.5	0.1	0.6
N_2	2.5	6.1	76.0	3.4	0.6	53.0	58.0	1.4	0.3	1.6
CH_4	9.4	11.0	0.1	7.6	6.1	0.2	TR	4.2	0.9	13.0
CO	9.3	13.0	NF	NF	7.2	NF	NF	2.6	NF	13.0
CO_2	42.0	37.0	3.2	86.0	72.0	29.0	32.0	86.0	94.0	33.0
Hydrocarbons (Vol. %)										
C_2	0.7	0.7	TR	0.6	0.4	TR	TR	0.3	0.3	0.7
C_3	0.3	0.2	TR	0.2	0.3	TR	TR	0.2	0.3	0.4
C_4	0.1	0.02	TR	0.2	0.3	TR	TR	0.1	TR	0.2
C_5	0.05	0.02	TR	0.1	0.2	TR	TR	0.1	TR	0.04
C_6	0.03	0.01	TR	0.1	0.1	TR	NF	0.01	NF	0.02
Benzene	0.2	-	0.4	0.5	1.0	1.6	NF	-	-	0.06
Toluene	-	-	0.01	0.2	0.4	0.6	NF	-	-	-
Sulfur Species (ppm)										
H_2S	700	1100	1900	13,000	12,000	1900	7500	23,000	4.6	4700
COS	170	300	NF	<400	-	NF	NF	<560	0.5	80
CH_3SH	270	420	630	1000	950	680	150	4300	8.5	570
C_2H_5SH	90	270	250	480	290	420	30	740	3.5	100
Others (g/100 Nm^3)										
NH_3	530	NF	198	-	1500	920	5300	170	0.4	0.3
HCN	5.8	21	15.3	-	8.2	4.6	140	10	1.5	7.3

Data from Campaign Three Test; November 1978

Appendix III-D

CHARACTERISTICS OF ACID GASES PRODUCED BY THE RECTISOL PROCESS (233)

Constituents/ Parameters	1		2			3			4			5			6		
	Type A* [32]		Type A‡ [44]			Type A§ [31]			Type B* [32]			Type B [32]			Type B# [22]		
	22		21	22	23	21	22	23	21	22	23	21	22	23	21	22	23
H_2	0.4	--	21.4	2.6	0.14	29.6	0.4	--	0.15	0.79	--	0.76	--	--	0.33	--	--
CO	0.014	--	18.2	4.8	0.0	11.9	0.2	--	0.05	0.22	--	0.11	--	--	0.14	--	--
CH_4	0.017	--	11.4	7.2	0.9	31.0	0.6	--	--	0.05	--	0.06	--	--	0.00	--	--
CO_2	73.95	--	46.7	83.4	97.2	28.5	97.5	78.8	76.81	98.91	64.6	09.85	--	68.31	80.19	--	68.46
N_2 + Ar	25.62*	--	1.5	0.8	0.03	0.2	--	--	23.0†	0.05	0.1	8.22*	--	1.92	19.34*	--	--
H_2S	--	--	3176 ppm	4941 ppm	8824 ppm	--	0.8	12.6	2 ppm	2 ppm	35.2	5 ppm	--	29.77	<5 ppm	--	30.78
COS	--	--	--	--	0.003	--	--	--	--	--	0.1	--	--	--	8 ppm	--	0.76
C_2+	--	--	0.7	1.1	0.7	2.2	0.5	--	--	--	--	--	--	--	--	--	--
MeCN	--	--	--	--	--	--	--	8.6	--	--	--	--	--	--	--	--	--
CS_2	--	--	--	--	0.0002	--	--	--	--	--	--	--	--	--	--	--	--
RSH	--	--	--	--	0.028	--	--	--	--	--	--	--	--	--	--	--	--
Thiophene	--	--	--	--	0.0002	--	--	--	--	--	--	--	--	--	--	--	--
Temp: °K(°F)	--	--	273(32)	273(32)	268(23)	220(-50)	220(-50)	300(80)	--	--	--	--	--	--	295(72)	--	322(121)
Pressure: MPa (psia)	0.1(15)	--	1.3(195)	0.46(70)	0.1(15)	0.7(103)	.2(25)	0.1(15)	0.1(15)	0.24(36	0.24(36)	0.1(16)	--	0.2(28)	0.1(15)	--	0.5(73)
Rate: Nm^3/hr (scf/min)	45,090 (27,956)	--	4,500 (2,852)	15,000 (9,300)	98,000 (60,760)	14,100 (8,700)	355,000 (220,850)	9,720 (6,050)	41,480 (25,845)	14,130 (8,760)	1,980 (1,230)	50,280 (21,170)	--	2,390 (1,480)	30,800 (19,100)	--	673 (417)

*Type A - simultaneous removal of CO_2 and H_2S with simultaneous recovery of CO_2 and H_2S
Type B - simultaneous removal of CO_2 and H_2S with separate recovery of CO_2 and H_2S

†Includes N_2 stripper at 350,000 Nm^3/hr (223,000 scf/min)

‡Data are for SASOL, So. Africa Lurgi plant

§Concentrations/parameters assumed in the design of the El Paso Lurgi SNG facility

#Data are for an oil gasification plant using the Texaco gasification process

Appendix III-D

EMISSIONS FROM A 63 TRILLION KCAL (250 BILLION BTU) PER DAY LURGI SNG COAL GASIFICATION PLANT WITH ALTERNATIVE EMISSION CONTROLS (233)

Pollutant	Uncontrolled			Alternative I			Alternative II (Options 1 and 2)					
	(a)†	(b)†	(c)†	(a)	(b)	(c)	1(a)	1(b)	1(c)	2(a)	2(b)	2(c)
SO_2	--	--	--	418 (922)	1,012 (2,234)	2,777 (6,131)	209 (461)	426 (941)	1,035 (2,285)	215 (474)	441 (973)	1,067 (2,355)
H_2S	2,563 (5,658)	8,847 (19,530)	26,541 (58,589)	--	--	--	--	--	--	--	--	--
HC‡	7,954 (17,559)	7,954 (17,559)	7,954 (17,559)	113 (250)	113 (250)	113 (250)	113 (250)	113 (250)	113 (250)	113 (250)	113 (250)	113 (250)
Total Sulfur, as S	2,424 (5,325)	8,327 (18,381)	24,980 (55,143)	209 (461)	506 (1,117)	1,389 (3,066)	104 (230)	213 (470)	517 (1,142)	107 (237)	220 (436)	534 (1,178)
Sulfur Recovery, %	0	0	0	91.3	93.9	94.5	95.7	97.4	97.9	95.6	97.4	97.9

*All numbers in kg/hr (lb/hr) except where noted

†Sulfur/heating value ratios of 0.72, 2.2 and 6.5 kg/sulfur/10^6 kcal (0.4, 1.2 and 3.6 lb sulfur/10^6 Btu), respectively

‡Non-methane hydrocarbons, average molecular weight = 29

Appendix III-D

SUMMARY OF ESTIMATED EMISSIONS FOR AIR POLLUTION CONTROL OPTIONS *
(KG/HR) (233)

Option No.	Pollutant	Contribution from Rectisol Acid Gases	Contribution from Fuels	Total
1	SO_2	25	150	170
	HC	30	40	70
	CO	100	140	240
	NO_x	300	900	1200
	Particulates	Negligible	60	60
2	SO_2	250	20	270
	HC	10	37	47
	CO	25	75	100
	NO_x	100	1400	1500
	Particulates	Negligible	Negligible	Negligible
3	SO_2	20	280	300
	HC	20	20	40
	CO	50	50	100
	NO_x	Negligible	1100	1100
	Particulates	Negligible	50	50
4	SO_2	1200	300	1500
	HC	2*	18	20
	CO	5	45	50
	NO_x	100	1000	1100
	Particulates	Negligible	50	50
5	SO_2	240	280	520
	HC	20	20	40
	CO	80	50	130
	NO_x	100	1100	1200
	Particulates	Negligible	50	50

* see next page for description of options

FEATURES OF OPTIONS CONSIDERED FOR AIR POLLUTION CONTROL IN INTEGRATED LURGI SNG FACILITIES (233)

Option No.	Key Features	Proposed Commercial Project(s) Whose Designs Have Similar Features	Comments
1	• Stretford unit handles combined acid gases from Rectisol. • Stretford offgases incinerated in superheater furnace followed by SO_2 removal in conjunction with coal-fired boiler flue gases. • On-site energy needs met by burning coal, tar, oil, naphtha and phenols.	ANG Wyoming	ANG design does not feature coal use for on-site energy needs. Power is purchased from off-site source. All gasification byproducts are burned rather than marketed. Wyoming design is similar to ANG except that coal rather than gasification byproducts are burned to supply plant energy needs.
2	• Stretford unit handles combined acid gases from Rectisol. • Stretford offgases incinerated in gas turbine generators. • On-site energy needs met by fuel gas which has been desulfurized in Stretford unit.	El Paso	In the El Paso design, all on-site energy needs are met by fuel gas. Byproducts are sold and not used for fuel on site. Stretford offgas is incinerated in a catalytic converter rather than in turbines.
3	• All Rectisol acid gases are sent to ADIP unit for concentrating H_2S and removing hydrocarbons. • Claus plant used for sulfur recovery followed by Beavon/Stretford tail gas treatment. • Coal supplies all energy needs on site and boiler flue gases are treated for SO_2 removal.	WESCO Dunn Co.	In WESCO and Dunn Co. designs, only the rich H_2S Rectisol stream is sent to ADIP/Claus/tail gas treatment. The lean H_2S stream is sent to Stretford. Thus, WESCO and Dunn Co. are a combination of Options 1 and 3.

CONTINUED (233)

Option No.	Key Features	Proposed Commercial Project(s) Whose Designs Have Similar Features	Comments
4	• All acid gases are directly routed to utility boiler for incineration. SO_2 is subsequently removed from flue gases.	No proposed commercial facility has this feature.	--
5	• Rectisol unit is designed to selectively recover about 30% of feed H_2S as a concentrated stream suitable for Claus processing. • Stretford handles lean H_2S stream from Rectisol. • Claus plant tail gas treatment handles rich H_2S stream from Rectisol. • Stretford tail gas is incinerated with supplemental fuel. • Steam and power are supplied by coal-fired boiler. Flue gases are treated for SO_2 removal.	WESCO Dunn Co.	Stretford offgases are incinerated in utility boiler in WESCO and Dunn Co. designs rather than separately as in Option 5.

PROJECTED CONCENTRATIONS OF ARSINE, HYDROGEN SELENIDE, AND MERCURY IN THE H_2S/CO_2-FREE PRODUCT-GAS AND CO_2 VENT-GAS STREAMS (260)

Gasification Process	Lurgi	HYGAS	Koppers-Totzek	HYGAS
Acid-Gas Process	Rectisol	Selexol	Benfield	Benfield
	H_2S/CO_2-Free Product-Gas Stream, ppmv			
AsH_3	Neg*	Neg	Neg	0.694
H_2Se	Neg	Neg	Neg	Neg
Hg	0.00016	0.0078	0.015	0.021
	CO_2 Vent Gas Stream, ppmv			
AsH_3	<0.009**	<0.014**	Neg	0.0631
H_2Se	<0.007**	<0.005**	<0.001	<0.005
Hg	0.00016	0.0078	Neg	0.0090

* Neg = negligible

**Predictions based on conservative 99% removal in the first stage of acid gas removal. Actual concentrations are expected to be an order of magnitude lower.

PROJECTED ARSINE, ARSENIC, AND MERCURY CONCENTRATIONS IN RAW METHANATION PRODUCT-GAS STREAM, QUENCHED METHANATION PRODUCT-GAS STREAM, AND PRODUCT SNG (260)

Gasification Process	Lurgi	HYGAS	Koppers-Totzek	HYGAS
Acid-Gas Process	Rectisol	Selexol	Benfield	Benfield
	Raw Methanation Product Gas, ppmv			
AsH_3	Neg*	Neg	Neg	Neg
As_4	Neg	Neg	Neg	0.266
Hg	0.00032	0.0120	0.0234	0.0322
	Quenched Methanation Product Gas, ppmv			
AsH_3	Neg	Neg	Neg	Neg
As_4	Neg	Neg	Neg	Neg
Hg	0.00032	0.0120	0.0234	0.0322
	Product SNG, ppmv			
AsH_3	Neg	Neg	Neg	Neg
As_4	Neg	Neg	Neg	Neg
Hg	0.00032	0.0045	0.0045	0.0045

*Neg = negligible

Appendix III-F

Incinerator Flue Gas Composition
From Acid Gas Unit and Collection of Off-Gases (209)

	MPH	MOL % (Wet)
N_2	126,781.8	59.215
O_2	4,277.6	1.998
A	1,601.6	0.748
CO_2	57,726.3	26.962
SO_2	78.6	0.037
SO_3	1.6	0.001
NO_x*	54.75	0.025
Dry	190,522.25	88.986
H_2O	23,581.75	11.014
Total MPH	214,104.00	100.000

Total Lbs/hr	6,724,608
SCFM @ 60°F	1,354,350
ACFM @ 300°F 13 psia	2,237,675

*	% (v)	MPH	Mol %	Lbs/hr
NO	95	52.00	0.024	1,560
NO_2	5	2.75	0.001	126
Total		54.75	0.025	1,686

Appendix III-G

YEARLY ESTIMATED EMISSIONS (TONS/YEAR) FROM WESCO COAL GASIFICATION (LURGI) PLANT WITH POLLUTION CONTROL (140)

Item	Pollution control	SO_2	Particulates	COS	H_2S
Coal lock fan	Wet cyclone		0.4		
Ash lock fan	Wet cyclone		0.8		
Local vent[b]	None	7.8			Trace
Flare[b]	None	20.7			
Coal feed bin	Baghouse		3.9		
Coal lock	None			24	Trace
Boiler feed bin	Baghouse		1.0		
Steam boilers	Hot electrostatic precipitator and scrubber	2145	272		
Steam superheater	None	133	6.4		
Coal handling	Dust suppression		Trace		
Claus sulfur plant	Incineration and scrubber	480			
Stretford plant	Incineration and scrubber	63			
Gas liquor expansion gas	Incineration and scrubber	126			
Limestone handling	Baghouse		5.6		
Gas liquor vent gas	Incineration and scrubber	66			
Rectisol vent gas	Incineration	140			
Shift catalyst regeneration[c]	Scrubber	7.3			
Recovered hydrocarbons	Incineration and scrubber	73			
Total		3261.8	290.1	24	Trace

[a]Based on 7970 hr/year of full-capacity operation (N.B. -- 24 hr/day x 365 days/yr = 8760 hr/yr).
[b]During startup after periodic shutdowns.
[c]During catalyst regeneration only.

PROJECTED RESOURCE REQUIREMENTS AND PROCESS RESIDUALS OF GASIFICATION PROCESSES[a] (159)

	High Btu Lurgi with Methanation[d]		Low Btu[e]
	Four Corners, N.M. Coal	Fulton County, Illinois Coal	
Plant Size	82×10^{12} Btu/year (250×10^6 SCFD)	82×10^{12} Btu/year (250×10^6 SCFD)	4.5×10^{11} Btu/year
Resource Requirements			
Coal	6.6×10^6 tons/year	5.7×10^6	$2.5\text{-}3 \times 10^4$ tons/year
Water	7,950 acre feet/year	16,780	12.0 acre feet/year
Land for Facilities	400 acres	400	0.5-3 acres
Land for Disposal	25-30 acres/year[f]	25-30 acres/year[f]	negligible
Residuals			
Air Emissions (tons/year)			
SO_2	3,820	8,530	138
Particulates	1,020	460	6
NO_x	6,690	5,730	178
CO	495	425	N.D.[b]
Aldehydes	2.5	2.1	N.D.
Hydrocarbons	150	130	N.D.
Liquid Effluents (tons/year)			
Total Dissolved Solids	0	3,500	N.D.[c]
Suspended Solids	0	74	N.D.
Organics	0	35	N.D.
Solid Wastes (tons/year)	8.9×10^5	4.3×10^5	2,000

[a]Data not readily available for medium Btu facilities.

[b]N.D. - no data available.

[c]The amount of liquid effluents from low Btu plants will be small; they can be evaporated, and the residue incinerated.

[d]Source: ERDA-1547: Final EIS, Alternative Fuels Demonstration Program, September, 1977. Estimates for eastern coal are provided for comparison. Only western coals are practical for near term.

[e]Source: Extrapolated for full load operation of University of Minnesota gasifier; data from Environmental Assessment DOE-EA-001, February 1978.

[f]Estimate. In some cases, solid wastes may be returned to the mine for disposal.

[g]Zero discharge assumed. All process water and impounded runoff is treated and used for cooling tower make-up. All blowdown streams are collected and sent to lined evaporation ponds for disposal.

Appendix III-G Process Requirements and Pollutants Associated With Synfuel Conversion Technologies, Based on Preliminary Design Studies (Normalized to 50,000 Barrels Per Day Crude Oil Equivalent) (159)

Process	Input (tons/day)	Conversion Thermal Efficiency (%)	Water* Requirements (acre-ft/yr)	Air Emissions with Controls (tons/day)					CO_2 (tons/day)	Solid Waste (tons/day)
				SO_x	NO_x	CO	HC	TSP		
Oil Shale (Surface) (Refs 7, 8, 9, and 10)	125,000 (25 gal/ton shale)	65-70	6,000-10,000	1-5	10-30	1-5	1-5	3-10	18,000	Spent shale - 108,000 Shale dust and coke - 4,000
Oil Shale (Modified In Situ) (Refs 7, 8, 9, and 10)	140,000 (25 gal/ton shale)	58-63	2,000-4,000	1-3	5-20	1-2	1-2	1-2	20,000	Raw shale** - 45,000
Fischer-Tropsch (Indirect Liquefaction) (Refs 8 and 11)	31,000 (Subbituminous 8,500 Btu/lb) .45% sulfur	56-60	11,000-12,000	9-14	5-8	NA	NA	1-1.5	21,000	Coal prep refuse (Negligible, thick seam) Ash - 1,800-2,000 Sulfur - 65-70
Exxon Donor Solvent (Direct Liquefaction) (Refs 8, 11, and 12)	20,000 (Bituminous 12,663 Btu/lb) 4% sulfur	60-64	7,500-8,500	16-18	5-6	1-1.5	.01-1	.3-.4	14,000	Coal prep refuse - 8,000-9,000 Ash - 2,500-3,000 Sulfur - 500-600
Solvent Refined Coal (SRC) (Direct Liquefaction) (Refs 8, 11, and 13)	21,000 (Bituminous 12,518 Btu/lb) 3.5% sulfur	58-62	5,500-6,500	5-10	9-10	1.5-2.5	1-2	2-3	21,000	Coal prep refuse - 8,000-9,000 Ash and slag - 5,000-7,000 Sulfur - 450-500
Mobil Technology Coal-to-Methanol-to-Gasoline (Refs 8, 11, and 14)	31,000 (Subbituminous 8,500 Btu/lb) .45% sulfur	56-58	11,000-12,000	9-14	5-8	NA	NA	.5-1.5	21,000	Coal prep refuse (Negligible, thick seam) Ash - 1,800-2,100 Sulfur - 65-70
Lurgi Dry Ash (High-Btu Coal Gasification, 250 MMSCF/day) (Refs 8, 11, and 15)	38,000 (Lignite 6,783 Btu/lb) .6% sulfur	58-60	20,000	35-40	16-17	NA	NA	2-3	29,000	Coal prep refuse (Negligible, thick seam) Ash (coker) - 2,500-3,000 Sulfur - 500-600
Coal-Fired Powerplant (1330 MWe) (Refs 8 and 11)	12,750 (Bituminous 12,000 Btu/lb) 2% sulfur	36 (direct firing)	20,000	76	35	- (Negligible)	- (Negligible)	5	31,000	Coal prep refuse - 3,000-4,000 Ash - 1,500 Sludge - 1,600 (100% solids)

*The actual water requirements for a specific site can be substantially reduced through maximum use of dry cooling (Ref. 6)

**Can be surface retorted

Note: No attempt has been made to show emissions from the end-use applications of synfuels, e.g., fuel for boilers, motor fuels.

Appendix III-G

SUMMARY OF ESTIMATED CONTROLLED EMISSIONS FOR PROPOSED COMMERCIAL LURGI SNG FACILITIES (IN KG/HR) (233)

Proposed Project	Gasification Plant: Acid Gases*	Gasification Plant: Feed Lockhopper Vent Gas	Onsite Fuel Combustion	Facility Total	Factors Affecting Emissions
El Paso[2,22]					
SO_2†	116	6	41	163	Low sulfur/HHV ratio coal, high degree of H_2S removal in Stretford unit, desulfurized fuel gas used as plant fuel, Stretford off-gases not incinerated
NO_x	24	--	70	94	
NMHC	2523	17	--	2640	
Particulates	1	--	--	1	
CO	811	295	--	1106	
WESCO[3]					
SO_2	77	33	265	375	Low sulfur/HHV ratio coal, combination of Stretford and Claus sulfur recovery, tail gas treated with coal-fired boiler flue gases for SO_2 removal
NO_x	-- ‡	--	720	720	
NMHC	--	451	--	451	
Particulates	--	--	33	33	
CO	--	--	--	--	
ANG[15]					
SO_2	545	11	640	1196	Medium sulfur/HHV ratio coal, Stretford efficiency lower than that in the El Paso design, coal-fired boiler used with FGD
NO_x	-- ‡	--	500	500	
NMHC	--	--	45	--	
Particulates	--	--	77	77	
CO	--	--	164	--	
Wyoming[14]					
SO_2	164	26	1035	1125	Very low sulfur/HHV ratio coal, no FGD employed on coal-fired boilers, Stretford efficiency lower than that in the El Paso design
NO_x	310	--	1210	1520	
NMHC	--	--	--	--	
Particulates	--	--	140	140	
CO	--	--	--	--	
Dunn Co.[13]					
SO_2	460	12	860	1332	Same as for ANG design
NO_x	--	--	1300	1300	
NMHC	--	--	--	--	
Particulates	--	--	180	180	
CO	--	--	--	--	

*Includes sour water stripper overhead

†All sulfur emissions in this table are reported as SO_2 equivalent

‡Included in combustion emissions.

Appendix III-G

Variability in Predicted PM/SO_2 Emissions and Ambient Impact Data for 100,000-Barrel-per-day Synfuel Plant* (159)

(500 MM scf/d Gasification)

Reference	Oil Shale		Coal Conversion				
				Indirect Oil		Direct Oil	
	TOSCA II	Modified In Situ	Lurgi Gasification	Methanol	F-T	EDS	H-Coal
Emissions (ton/day) PM/SO_2**							
Mitre "Data Book"1/	17/6.4	24/3.7	14/29	15/26	---	---	2.7/16
Mitre Coal RDD2/	---	---	0.6/10.6	---	---	---	0.4/21
ERDA/SRI3/	10/40	---	---	7/12	---	---	7/11
Oil Shale Draft EIS4/	10/6.8	---	---	---	---	---	---
El Paso NG Environmental Statement5/	---	---	Trace/14.4	---	---	---	---
DOE/SRI5/	6.2/6.8	1.7/3.6	---	1.9/18	12/24	1.5/57	---
Maximum Predicted Concentrations ($\mu g/m^3$) PM/SO_2 - 24 hour avg.							
Mitre Coal RDD	---	---	---	1/2	---	---	0.6/6
ERDA/SRI	200/51	---	---	---	---	---	25/7
Oil Shale Draft EIS	17/12	---	---	---	---	---	---
DOE/SRI	72/60	2.3/1.9	---	2.2/24	-/12	7.5/83	---

* Data for several sources was adjusted (linearly) to 100,000 BPD plant size.
**First number is for particulate matter; second is for sulfur dioxide.

Appendix III-G

Stack-by-Stack Analysis of Estimated Emission Levels (179)

Equipment		Stack Diameter Ft.	Stack Height Ft.	Exit Velocity Ft./Sec.	Exit Temp. °F.	No. of Stacks	Emissions/Stack (# hr.) CO_2	SO_2	NO_x	Partic.	COS	CS2	H_2S
El Paso	Level*												
Gas Turbine &	288 MMCFD	12'	150'	54	300	7 **	77,294	40	67.3	--	--	--	--
Waste Heat	410 MMCFD	12'	150'	60	300	9	85,367	44	74.3	--	--	--	--
Standby	288 MMCFD	12'	150'	8	300	1 ***	11,042	5.7	9.6	--	--	--	--
Boilers	410 MMCFD	12'	150'	11	300	1	15,679	8.1	13.6	--	--	--	--
Steam Super-	288 MMCFD	8'	150'	47	300	1	76,500	39	66	--	--	--	--
Heater	410 MMCFD	8'	150'	33	300	2	54,315	28	47	--	--	--	--
Fuel Gas	288 MMCFD	4'	150'	43	300	1	16,770	9	15	--	--	--	--
Heater	410 MMCFD	4'	150'	31	300	2	11,906	6.4	10.7	--	--	--	--
Sulfur Plant	288 MMCFD	4'	150'	35	300	1	42,900	50	8	--	--	--	--
Incinerator	410 MMCFD	4'	150'	25	300	2	30,459	36	5.7	--	--	--	--
Sulfur Plant	288 MMCFD	14'	150'	40	700	1	1,627,780	216	45	--	0	0	0
Vent	410 MMCFD	14'	150'	28	700	2	1,155,724	153	32	--	0	0	0

NOTES:

* Burnham I, initial unit = 288 MMCFD
Burnham I, ultimate capacity = 410 MMCFD

** There will be one additional standby unit

*** Operates at 15% load except when needed

Appendix III-G

Stack-by-stack analysis of estimated emissions levels (182)

Source	Stack Diameter Ft.	Stack Height Ft.	Exit Velocity Ft./Sec.	Exit Temp. °F.	No. of Stacks	Emissions for Total Number of Stacks (lbs/hr) 3/ SO_2	NO_x	Hydro Carbons	Partic.	COS	CO	H_2S
Coal lock equipment	1.0	150	40	90	4	--	--	--	0.1	--	--	--
Ash lock fan	5.0	150	70	122	2	--	--	--	0.2	--	--	--
Local Vent	1.3	150	variable	212	4	1/ 1.9	--	1.1	--	--	--	--
Flare	5.0	300	variable	+800	1	1/ 5.2	--	--	--	--	--	--
Coal feed bin	1.5	150	40	amb	1	--	--	--	1.0	--	--	--
Boiler feed bin	.5	150	40	amb	3	--	--	--	0.25	--	--	--
Coal lock	9.0	200	100	300	1	68.5	96.6	2/ 993.9	1.6	6.0	--	Trace
Limestone handling	1.5	100	60	amb	1	--	--	--	1.4	--	--	--
Recovered hydrocarbons Steam boiler, Gas liquor expansion gas, Gas liquor vent gas, Shift catalyst regeneration, Claus sulfur plant, Stretford Plant	17.0	300	approximately 100	240	1	742.7	1,456.4	--	68.2	--	--	--

1/ During startup operations and after periodic shutdowns.
2/ Approximate hydrocarbon disposition: 83% C_2H_6, 6% C_2H_4, 8% C_3H_8 and 3% C_3H_6.
3/ Based on 7,970 operating hours at full capacity operation per year.

Appendix III-G

SUMMARY OF GASEOUS EFFLUENT STREAMS FROM LURGI COAL GASIFICATION (186)

Waste Stream	Temperature °F	Pressure psi	Stream Rate lb/hr	Contaminants	Quantity of Contaminants
Boilers and Turbines Stack Gas	300°F	15	6.59×10^5	Particulates NO_x SO_2	negligible 481 lb/hr 286 lb/hr
Steam Super Heater Stack Gas	300°F	15	361×10^3	Particulates NO_x SO_2	negligible 66 lb/hr 39 lb/hr
Fuel Gas Heater Stack Gas	300°F	15	79.1×10^3	Particulates NO_x SO_2	negligible 15 lb/hr 9 lb/hr
Incinerator Stack Gas	300°F	15	78.3×10^3	Particulates NO_x SO_2	negligible 8 lb/hr 50 lb/hr
Oxygen Production Vent Gases	ambient	15	1.59×10^6	none	-
Sulfur Recovery Vent Gases	150°F	15	1.80×10^6	CO COS CS_2 H_2S CH_4 C_2H_4 C_2H_6	1,780 lb/hr 172 lb/hr 6 lb/hr 12 lb/hr 3,230 lb/hr 2,393 lb/hr 3,390 lb/hr
Water Treating Degasser Vent	ambient	15	17.5×10^3	none	-
Steam and Power Production Deaerator Vents	200°F	15	31.9×10^3	negligible	-
Cooling Tower Evaporation	ambient	15	1.04×10^6	H_2S NH_3	-
Cooling Tower Drift	ambient	15	16.5×10^3	Dissolved Solids Trace Elements Trace Organics	
Pond Evaporation	ambient	15	606×10^3	negligible	-
Fugitive	-		50	H_2S NH_3 CO HC Trace Elements Trace Organics	-

Appendix III-G

SUMMARY OF AIR EFFLUENT STREAMS FROM K-T COAL GASIFICATION (186)

Waste Stream	Temp °F	Press psi	Stream Rate M scfm	Contaminants	Quantity of Contaminants
Drying and Grinding Off Gas	530	15	15.4	dust	(7 lb/hr)
Conveying Balance Vents	530	15		dust	negligible
Slag Quench and Gas Cooling	amb.	15		H_2S	1-2 vppm
Cooling Towers				COS	
				NH_3	
				CH_2O	
				SO_2	measurable
				HCN	
				CS_2	
				HCOOH	
Rectisol Regeneration Effluent	amb.	15		H_2S	
				COS	
				NH_3	unknown
				CH_2O	
				SO_2	
				methanol	measurable
Dehydration Off Gas	125	15		methanol	unknown
Treated Tail Gas	590	1.9		H_2S	10 vppm
				COS	90 vppm

SUMMARY OF AIR EFFLUENT STREAMS FROM K-T COAL GASIFICATION (186)

Waste Stream	Temp °F	Press psi	Stream Rate M scfm	Contaminants	Quantity of Contaminants
Utility Boiler Flue Gas	355	15	21.6	particulates	11.2 lb/hr
				NO_x	78.9 lb/hr
				SO_2	135 lb/hr
				CO	4.8 lb/hr
				HC	1.5 lb/hr
				Trace Elements	
				Polynuclear Compounds	
Utility Cooling Tower Gas	amb.	amb.		none	
Fugitive	amb.	amb.		Combustion Products	trace amounts
				Trace Elements	trace amounts
				Polynuclear Compounds	trace amounts

Appendix IV-A

Estimated Emissions from the Acid Gas Removal Unit and the Fischer-Tropsch Synthesis Unit for 50,000 bpd Liquefaction Plant. (N/A means data not available). (190)

Acid Gas Removal Unit

Claus Unit

CO_2	N/A
CO	200 ppm
H_2	5 ppm

Tail Gas Clean-up Unit

CO_2	N/A
CO	1,000 ppm
COS	120 ppm
H_2S	1 ppm

Fischer-Tropsch Synthesis Unit

CO_2	N/A
CO	144 ppm
$HClCH_4$	75 ppm

Appendix IV-A

Combined Gaseous Effluents (190)

Gaseous Effluent	Amount	Concentration (ppm)
Carbon Dioxide	42,647 TPD	-
Carbon Monoxide	10.9 TPD	306
Carbon Oxysulfide	1.4 TPD	18
Organics (C_2 - C_6 Hydrocarbons)	1.1 TPD	21
Hydrogen Sulfide	261 lb/day	3

Sulfur Balance (TPD) (190)

Total Input from the Typical Feed Coal		1020.0
Outputs:	As Elemental Sulfur from Coal Gasifier Gas	1011.4
	As Reduced Sulfur Emissions (19% H_2S, 81% COS)	0.8
	As Sulfur Dioxide Emissions (actually emitted every six months on regeneration of the shift catalyst)	0.8
	In the Ash	7.0
		1020.0

Appendix IV-A

Comparison of Gaseous Emissions with Illinois and New Mexico Source Emission Standards (190)

Pollutant	Illinois Standards, Petrochemical Plant	New Mexico Standards, Coal Gasification Plant	Gaseous Effluents, Fischer-Tropsch Plant
Particulate Matter	78 lb/hr	0.03 gr/ft^3	67 lb/hr,[a] 0.03 gr/ft^3
Sulfur Dioxide	1.2 lb/MM Btu	-	Nil[b]
Carbon Monoxide	200 ppm, 50% xs air	-	164 ppm[c]
Nitrogen Oxides	0.7 lb/MM Btu	-	Nil
Organics (methane excluded)	100 ppm (CH_4 equivalent)	-	55 ppm
Total Reduced Sulfur (H_2S + COS + CS_2)	-	100 ppm	21 ppm
Hydrogen Sulfide	-	10 ppm	3 ppm
Hydrogen Cyanide	-	10 ppm	Nil
Hydrogen Chloride/ Hydrochloric Acid	-	5 ppm	Nil
Ammonia	-	25 ppm	Nil
Gas Burning Process Boilers, Particulate Matter	-	0.03 lb/MM Btu, LHV	-[d]
Gas Burning Process Boilers, Sulfur Dioxide	-	0.16 lb/MM Btu, LHV	-[d]
Total Sulfur	-	0.008 lb/MM Btu of feed (coal) heat input, HHV	0.003 lb/MM Btu[e]

(a)From coal-drying plant

(b)47.4 tons of sulfur dioxide emitted twice a year, over 24-48 hours, on regeneration of the catalyst of each shift reactor (six reactors total). If this value were averaged out over the year, it would correspond to 0.004 lb/MM Btu/day.

(c)Value obtained on application of the 50% excess air correction to the streams originating from the acid gas removal unit and from the sulfur plant.

(d)Not applicable (none included in the design).

(e)Includes the sulfur dioxide emitted occasionally on regeneration of the shift reactor catalyst (see Note(b) above).

Appendix IV-B

EMISSIONS FOR SASOL METHANOL PLANT USING MANUFACTURED FUEL GAS
(16,000 m^3/day) (200)

Source	Emissions Without Control Devices: Type	Factor	Rate (g/s)	Control Methods: Device or Other Method	Device Efficiency (%)	Emissions Remaining With Best Control: Loading	Rate (g/s)
Combustion							
Purge gas	Particulates	290 kg/10^6 m^3	4.6	None		7.3 g/GJ	4.6
	SO_2	9.2	0.1	None		0.16	0.1
	NO_x	3700	60	None		95	60
	HC	48	0.8	None		1.3	0.8
Manufactured fuel gas	Particulates	290	16	None		7.3	16
	SO_2	9000	151	Treated fuel		71	151
	NO_x	3700	202	None		95	202
	HC	48	2.7	None		1.3	2.7
Sulfur plant	SO_2	1960 ppm (vol)	194	Tail-gas scrubber	95	250 ppm (vol)	9.7

Appendix IV-B

EMISSIONS FOR SASOL METHANOL PLANT USING COAL FOR FUEL
(16,000 m^3/day) (200)

Source	Emissions Without Control Devices: Type	Factor	Rate (g/s)	Control Methods: Device	Device Efficiency (%)	Emissions Remaining With Best Control: Loading	Rate (g/s)
Combustion							
Purge gas	Particulates	290 kg/10^6 m^3	4.6	None		7.3 g/GJ	4.6
	SO_2	9.2	0.1	None		0.16	0.1
	NO_x	3700	60	None		95	60
	HC	48	0.8	None		1.3	0.8
Coal	Particulates	154 kg/10^3 kg	13960	Electrostatic precipitator	99.5	39	70
	SO_2	13.1	1190	Flue gas desulfurization	90	66	119
	NO_x	9	816	None		450	816
	HC	0.15	14	None		7.7	14
Sulfur plant	SO_2	1960 ppm (vol)	134	Tail-gas scrubber	95	250 ppm (vol)	6.7

Appendix IV-C

STACK PARAMETERS AND EMISSION RATES FOR A 45,000 B/D FISCHER-TROPSCH PLANT WITH EMISSIONS CONTROLLED (159)

Location	Description of Unit	Flow Rate (all stacks) (m^3/s)	Temp. (C^{o}).	Stacks	Stack Height (m)	Diameter (m)	Velocity (m/s)	Emissions (all stacks) (g/s) Particulates	SO_2	NO_x
1	Utility boiler/ incinerator	1250	220	1	50	8.9	20	13.3	115	223
2	Catalyst plant	110	17	1	50	3.25	20	43.2	—	—

Process Requirements and Pollutants Associated With Synfuel Conversion Technologies, Based on Preliminary Design Studies (Normalized to 50,000 Barrels Per Day Crude Oil Equivalent) (190)

Process	Input (tons/day)	Conversion Thermal Efficiency (%)	Water* Requirements (acre-ft/yr)	Air Emissions with Controls (tons/day) SO_x	NO_x	CO	HC	TSP	CO_2 (tons/day)	Solid Waste (tons/day)
Fischer-Tropsch (Indirect Liquefaction) (Refs 8 and 11)	31,000 (Subbituminous 8,500 Btu/lb) .45% sulfur	56-60	11,000-12,000	9-14	5-8	NA	NA	1-1.5	21,000	Coal prep refuse (Negligible, thick seam) Ash - 1,800-2,000 Sulfur - 65-70

Appendix IV-C

Gaseous Discharges From Coal Liquefaction Systems For Conceptualized 7,950 m^3 (50 kbbl) per day plants (190)

Source[+*]	Process: H-Coal			
	Raw wastes		After treatment**	
	Metric tons/day	(tons/day)	Metric tons/day	(tons/day)
Acid gas (process)				
Total	1,201	(1,325)	659	(727)
H_2S	680	(749)		2-10ppm***
NH_3	0.5	(0.6)	0.5	(0.6)
CO_2	493	(544)	493	(544)
Hydrocarbons	20	(22)	20	(22)
H_2O	8.6	(9.5)	145	(160)
Acid gas (hydrogen production)				
Total	8,932	(9,847)	8,789	(9,690)
H_2S	140	(154)		2-10ppm***
NH_3	0.9	(1)	0.9	(1)
CO_2	8,738	(9,633)	8,738	(9,633)
SO_2	0.2	(0.24)	****	
HCN	21	(2.3)	trace	
N_2	50.8	(56)	50.8	(56)
NO_x	trace		trace	
Flue gas (heat & power)				
Total	N.A.		N.A.	
SO_2	N.A.		N.A.	
NO_x	N.A.		N.A.	

+ Until thorough environmental sampling and analyses of all streams have been performed, these lists will not be complete.
* Emissions from coal preparation, fugitive emissions from leaks and spills, and other miscellaneous atmospheric discharges have not been quantified.
** Acid gas streams are combined before treatment.
*** Released as SO_2, after flaring.
**** Released as SO_2, after flaring; quantities not available.
N.A.- Not available.

Appendix IV-D ------- FUEL AND FLUE GAS COMPOSITIONS FROM THE COAL PREPARATION MODULE (222)

Flue gas to flow dryer	227 metric tons/day
Combustion air	4,536 metric tons/day
Flue gas from flow dryer	4,763 metric tons/day

Composition by weight % of typical fuel gas used in flow dryer

H_2	7.2%
N_2	0.8
CO	12.6
CO_2	1.0
H_2S	0.1
HC	77.5
H_2O	0.8
TOTAL	100%

Composition by weight % of typical flue gas discharged from flow dryer

N_2	75.7%
H_2O	6.9
O_2	5.2
CO_2	12.2
SO_2	0.007
TOTAL	100%

Appendix IV-E COMPOSITION BY WEIGHT PERCENT OF A TYPICAL FUEL GAS UTILIZED IN THE H-COAL PROCESS (222)

Fuel gas produced in acid gas removal process

H_2	7.2% (by weight)
N_2	0.8
CO	12.6
CO_2	1.0
H_2S	0.1
Hydrocarbons	77.5
H_2O	0.8
	100%

Typical flue gas discharged from process heaters

N_2	75.7% (by weight)
H_2O	6.9
O_2	5.2
CO_2	12.2
SO_2	0.007
NO_x	Trace
	100%

Appendix IV-F

H-Coal Solids Separation Module
Process and Waste Streams
(222)

Stream	Metric tons/day
Vent gas	
CO_2	0.6
H_2S	0.5
NH_3	0.09
H_2O	0.09
Hydrocarbons	0.6
	1.8

Appendix IV-G

Acid Gases Before and After Treatment

metric tons/day

(222)

Component	H-Coal Before	H-Coal After
H_2S	819	2-10* ppm
H_2O	8.6	145
NH_3	1.5	1.5
Hydrocarbons	20	20
CO	---	---
CO_2	9,232	9,232
N_2	51	51
SO_2	0.22	*
HCN	2.1	trace
NO_x	trace	trace
Total feed	10,134	9,449
Sulfur recovered	775	

* Released as SO_2 after flaring.

Appendix V-A

Maximum Predicted Ground-Level Concentrations of Sulfur Dioxide and Nitrogen Oxides (179)

	Concentration on p/m (volume)			
	(288 MMCFD)		(410 MMCFD)	
Annual	SO_2	NO_x	SO_2	NO_x
Resulting from emission	0.0012	0.0018	0.0017	0.0026
Background	0.007	0.0005	.007	0.0005
Total	0.0082	0.0023	.0087	0.0031
New Mexico standard	0.02	0.05	0.02	0.05
24 hour				
Resulting from emission	0.008	0.012	0.011	.017
Background	0.014	0.015	0.014	.015
Total	0.022	0.027	0.025	.032
New Mexico standard	0.10	0.10	0.10	.010
3-hour				
Resulting from emission	0.046	-	.065	-
Background	0.016	-	.016	-
Total	0.062	-	.081	-
U.S. secondary standard	0.50	No Standard	0.50	-

The following assumptions were used to calculate these concentrations:

1. Emissions are those found in Table 3-3, Stack-by-Stack Complex Effluents

2. Background levels are those in Section 2.1.1.3.

3. Winds and air stability regimes are based on the data presented in Section 2.1.1.2.

4. Calculations were made by using a dispersion model based upon

Appendix V-A

Maximum Predicted Ground-Level Concentrations of Sulfur Dioxide, Nitrogen Oxides, Total Suspended Particulates and Nonmethane Hydrocarbons for Proposed WESCO Plant.

(182)

	One Plant				Four Plants			
	SO_2 (ppm)	NO_x (ppm)	Particulates ($\mu g/m^3$)	Nonmethane Hydrocarbons (ppm as CH_4)	SO_2 (ppm)	NO_x (ppm)	Particulates (ug/m^3)	Nonmethane Hydrocarbons (ppm as CH_4)
Annual								
Resulting from emission	0.0005	0.0012	1	--	0.0009	0.0026	1	--
Background	0.0007	0.0005	20	--	0.0007	0.0005	20	--
Total	0.0012	0.0017	20	--	0.0016	0.0031	21	--
New Mexico Standard	0.02	0.05	70*	No Standard	0.02	0.05	70*	No Standard
24-hour								
Resulting from emission	0.0009	0.0024	1	--	0.0021	0.005	1.2	--
Background	.022	.033	69	--	0.022	0.033	69	--
Total	.0229	.0354	70	--	0.0241	0.038	70.2	--
New Mexico Standard	0.10	0.10	150	No Standard	0.10	0.10	150	No Standard
3-hour								
Resulting from emission	0.019	0.051	3	0.16	0.037	0.10	--	--
Background	0.041	0.06	--	--	0.041	0.06	--	.22**
Total	0.060	.161	--	--	0.078	0.16	--	--
U.S. Secondary Standard	0.50	No Standard	No Standard	0.24	0.50	No Standard	No Standard	0.24
N.M. Standard	No Standard	No Standard	No Standard	0.19	No Standard	No Standard	No Standard	0.19

* 70 ug/m^3 arithmetic mean - 60 ug/m^3 geometric mean.

Appendix V-B

SUMMARY OF POLLUTANT CONCENTRATION INCREASES FROM COAL AND OIL SHALE CONVERSION TECHNOLOGIES (133)

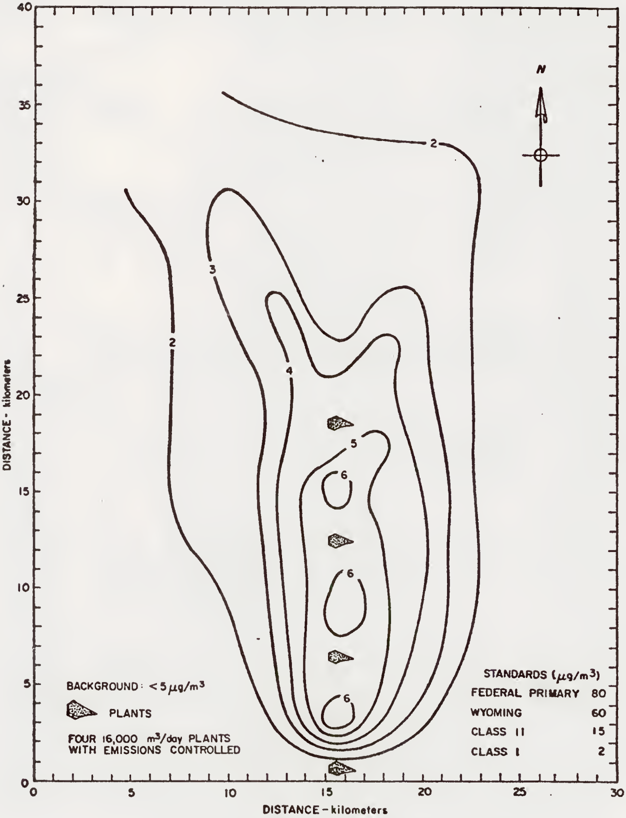
Plant Type	Meteorology	Peak Annual Average Concentrations micrograms/m^3			Peak 24-hour Concentration Worst Case 24-Hour Meteorology micrograms/m^3			Peak 3-Hour SO_2 Concentrations micrograms/m^3
		Particulates	SO_2	NO_2	Particulates	SO_2	NO_2	
Oil Shale								
C-a Tract (Combined Modified In-situ and TOSCO II Processes) (76,000 b/d)	Grand Junction, Colorado	0.32	0.24	1.3	2.5	2.6	12	3.4
Colony (TOSCO II Processes) (50,000 b/d)	" "	5.0	1.4	4.8	18	15	71	31
Occidental (Modified In-situ) (57,000 b/d)	" "	0.06	0.07	0.62	0.7	0.6	14	_*
Union (50,000 b/d Unit) (2 units planned)	" "	3.0	2.0	8.5	_*	24	_*	_*
Coal Liquefaction								
45,000 eob/d Methanol-to-Gasoline	Moorecroft, Wyoming	0.007	0.06	0.10	0.6	5.3	9.3	_*
Fischer-Tropsch (45,000 eob/d)	" "	2.1	0.07	0.15	—	5.3	10	_*
EDS without on-site electricity generation (60,000 b/d)	Pulaski, Virginia	0.4	7.2	2.3	2.3	31	9.89	_*
EDS with on-site electricity generation (60,000 b/d)	" "	0.4	7.3	2.4	2.3	28	9.10	67

Appendix V-B

SUMMARY OF EMISSIONS AND CONTROL REQUIREMENTS (200)

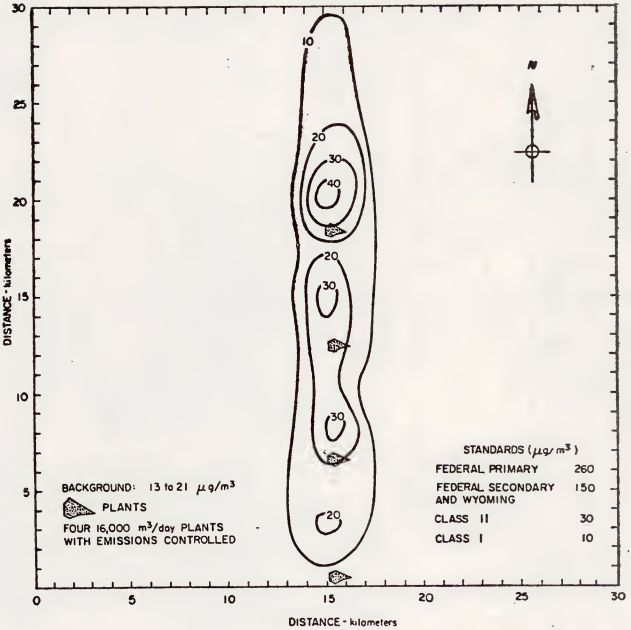
Type	Amount (kg/hr)	Control Device or Method	Efficiency With Best Control (%)	Emissions Remaining With Best Control (kg/hr)	Ambient Air Quality Comparisons*: Calculated from Best Control Case ($\mu g/m^3$)	Ambient Air Quality Comparisons*: Class II Standard ($\mu g/m^3$)	Additional Control Requirement (%)
Oil shale							
Particulates	107,700	Baghouse, cyclone, scrubber	99.66	370	200	30	85
SO_2	2671	Treated fuels, tail-gas	47	1417	18	15	17
NO_x	5343	--	65	1849	23	100†	None
HC	--	Incinerator	--	272	11	160†	None
Coal liquefaction							
Particulates	28,300	Multiple cyclones, Venturi scrubber, electro-static precipitator	99.12	250	25	30	None
SO_2	2700	Scrubber	88	330	2	15	None
NO_x	2890	None		2890	15	100‡	None
HC	47.2	None		47.2	4	160‡	None

*Based on Table 16-15 and accompanying text.
†Federal primary standard. No Class II standard exists.
‡Federal primary standard. No Class II standard exists.

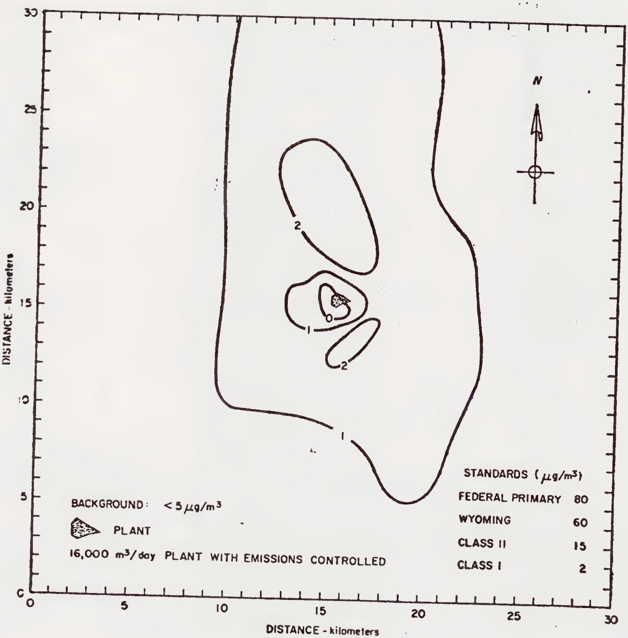


ANNUAL AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$)
FOR A COMPLEX OF COAL LIQUEFACTION PLANTS (200)

Appendix V-B

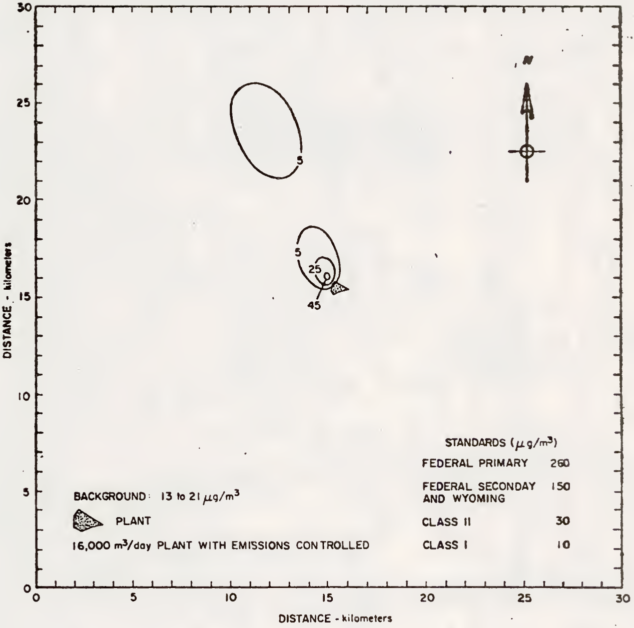


WORST CASE 24-HOUR AVERAGE PARTICULATE CONCENTRATIONS (μg/m³) FOR A COMPLEX OF COAL LIQUEFACTION PLANTS (200)



ANNUAL AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$) FOR A COAL LIQUEFACTION PLANT (200)

Appendix V-B



WORST CASE 24-HOUR AVERAGE PARTICULATE CONCENTRATIONS ($\mu g/m^3$) FOR A COAL LIQUEFACTION PLANT (200)

Appendix V-B

Model Results From Rough Terrain (159)

Process	Capacity (10^3 barrels per day)	Site	Max. Terrain Above Plant (m)	Emissions (g/s) PM	Emissions (g/s) SO_2	Model	Maximum Concentration ($\mu g/m^3$ - 24 hr avg.) PM	Maximum Concentration ($\mu g/m^3$ - 24 hr avg.) SO_2
EDS**	60	IL	43	6.4	217.0	CRSTER		
		ND	53			VALLEY	2.5	42.4
		MN	101			VALLEY	3.0	139.0
		WV	488			VALLEY	166.0	5590.0
MMG	45	ND	53	8.8	84.0	VALLEY	*	*
		MN	101			VALLEY	*	*
		WV	488			VALLEY	129.0	1230.0
FT	45	IL	43	56.5	115.0	CRSTER	24.0	2.3
		ND	53			VALLEY	11.0	*
		MN	101			VALLEY	*	*
		WV	488			VALLEY	1260.0	1740.0
Colony	50	CO	314	32.6	35.5	VALLEY	214.0	250.0
Union	50	CO	314	17.6	68.0	VALLEY	194.0	494.0
Ca-MIS	76	CO	314	79.5	76.5	VALLEY	200.0	180.0
Occ-MIS	57	CO	314	10.4	21.8	VALLEY	29.0	62.0
					PSD II Increments		37	91

*Emissions do not impact nearby terrain, refer to flat terrain results.

**Note: A correction in emission data has resulted in reestimates of both PM and SO_2 concentrations by (roughly) a factor of 2, for the EDS process. This will be corrected in the final document, but these results are provided to show trends.

Appendix V-B

Flat Terrain Model Results (SRI/DOE Emission Data) (159)

Process	Capacity (10^3 BPD)	Meteorology	Fuel	Percent S	Emissions (g/s) PM	Emissions (g/s) SO_2	Maximum Concentration ($\mu g/m^3$) 24 hr avg. @ 25 km PM	24 hr avg. @ 25 km SO_2	PM AN	PM 24	SO_2 AN	SO_2 24
Coal Liquefaction												
EDS*	60	Atlanta	IL #6	3.5	9.5	344.0	0.4	13.0	0.1	2.6	3.1	48.0
MMG	45	Cheyenne	PR	0.5	8.8	84.0	0.1	1.2	0.03	0.3	0.3	2.5
F-T	45	Cheyenne	PR	0.5	56.5	115.0	1.8	1.4	2.4	14.0	0.3	2.6
Oil Shale												
Colony	50	Grand Junction	-	-	32.6	35.5	4.1**	5.1**	3.0	26.0	1.7	14.0
Ca-MIS	76	Grand Junction	-	-	79.5	76.5	1.4***	0.9***	0.9	7.1	0.5	4.3
Occ-MIS	57	Grand Junction	-	-	10.4	21.8	0.1	0.2	0.04	0.4	0.07	0.8
Union	50	Grand Junction	-	-	17.6	68.0	3.1**	8.4**	1.0	11.0	2.6	22.0
						PSD Increments						
						Class I			5	19	2	20
						Class II			10	37	5	91

*EDS PM calculations are estimates.
**Concentration is at 10 km.
***Concentration is at 20 km.

Model Results Using Modified Inputs*** (159)

Process	Modification	Location	Power Generation	Feedstock	Emissions (g/s)		Maximum Concentration (µg/m³)					
							24 hr avg. @ 25 km		PM		SO_2	
					PM	SO_2	PM	SO_2	AN	24	AN	24
EDS	Set all stacks at 50 m	East	Onsite	IL #6	6.4	216.0	0.3	12.0	0.07	1.1	1.9	29.0
EDS	Import electricity	East	Offsite	IL #6	1.7	87.0	0.2	10.0	0.13	2.5	2.9	48.0
EDS	Set all stacks at 150 m	East	Onsite	IL #6	*	216.0	*	5.0	*	*	0.6	15.0
EDS	Set all stacks at 10 m**	East	Onsite	IL #6	*	216.0	*	22.0	*	*	4.4	67.0
F-T	Set all stacks at 10 m**	West	Onsite	PR	56.0	115.0	4.2	2.0	6.9	40.0	0.3	3.0
Occ-MIS	Set all stacks at 10 m**	West	Onsite	PR	10.4	21.8	0.5	1.0	0.1	0.9	0.2	1.3
					Class II PSD Increments				10	37	5	91

*Not modeled

**This stack assumption is equivalent to assuming any stack height necessary to exceed height of irregular terrain by at least 10 m.

***Note: A correction in emission data has resulted in reestimates of both PM and SO_2 concentrations by (roughly) a factor of 2, for the EDS process. This will be corrected in the final document, but these results are provided to show trends.

Appendix VI-A

ENVIRONMENTAL CONCERNS AND RESEARCH REQUIREMENTS (131)

ENVIRONMENTAL CONCERN	ENVIRONMENTAL, HEALTH AND SAFETY REQUIREMENTS	RESEARCH TIME (YEARS)	RESEARCH STATUS
1. WATER QUALITY Degradation of water resources could result from organic and inorganic contaminants produced during underground gasification and from surface disposal of liquid and solid wastes from processing units. Organic contaminants of concern include phenols, pyridines, anilines, quinolines and aromatic hydrocarbons. Substances of concern in the main process plant include spent quench liquor and spent sorbents and reactants from the acid gas removal process	1-1 Assess current information on surface and subsurface water resources in the regions where development is anticipated.	Continuous	B-1976 (LLL; LETC; USGS)
	1-2 Develop improved procedures for sampling and monitoring of water for pollutants which adversely affect man and the environment.	3-5	C-1976 (LLL; LETC; NIOSH)
	1-3 Accumulate baseline, operation and post-operational water quality data for compliance purposes.	3-5	Planned
	1-4 Characterize, identify and quantify the chemical constituents of liquid and solid waste from processing operations; and provide samples for bioassay screening study.	Continuous	B-1976 (LLL; LETC; METC)
	1-5 Obtain data on sorptive properties of coals and chars to integrate with on-going modeling studies to predict dispersion and movement of the groundwater plume and extent of groundwater quality degradation.	2-3	B-1976 (LLL; LETC)
	1-6 Model the environmental transport and fate of the pollutants released to surface and subsurface waters, and determine the residence time in the soil/water environment.	5-7	B-1976 (LLL; LETC)
	1-7 Characterize or develop systems for simulating the chemical and microbiological transformation of liquid wastes in solid and aquatic media and supply such environmental reaction products for bioassay.	--	Not Currently Programmed
2. PHYSICAL DISTURBANCE Subsidence of the strata above the burned out coal seam could occur resulting in surface deformation and aquifer disruption. The potential exists for a change in groundwater flow patterns or rates resulting from inter-connection of aquifers by fracturing caused by subsidence.	2-1 Measure mechanical properties of subsurface formations in regions where field testing is anticipated to predict subsidence.	Continuous	B-1976 (LLL; LETC)
	2-2 Verify predictions by measuring subsidence in the field.	Continuous	B-1976 (LLL)
	2-3 Develop methodology to predict disruption of groundwater flow patterns and rates due to subsidence.	Continuous	B-1976 (LLL)
	2-4 Verify predictions by monitoring groundwater in the field.	Continuous	B-1976 (LLL)
	2-5 Determine potential for contaminant leakage due to subsidence and fracturing.	Continuous	B-1976 (LLL)
	2-6 Determine temperature effects on underground formations adjacent to the reaction zone.	Continuous	A-1981 (On-going Research at West Virginia University)
	2-7 Determine potential for uncontrollable burn and monitor extent of underground burn zone.	Continuous	A-1981 (On-going Research at West Virginia University)

A - No R&D in place, work should be initiated in FY indicated
B - Work in progress since FY indicated and to continue at same level of effort
C - Work in progress since FY indicated; increase level of effort
LLL - Lawrence Livermore Laboratory
LETC - Laramie Energy Technology Center
METC - Morgantown Energy Technology Center

Appendix VI-A

ENVIRONMENTAL CONCERNS AND RESEARCH REQUIREMENTS

ENVIRONMENTAL CONCERN	ENVIRONMENTAL, HEALTH AND SAFETY REQUIREMENTS	RESEARCH TIME (YEARS)	RESEARCH STATUS
3. AIR QUALITY			
The potential exists for air emissions from the underground combustion zone through cracks and fissures in the overburden caused by subsidence. Potential pollutants of concern in the raw product gas include particulates, trace elements such as mercury (Hg), lead (Pb), arsenic (As), and selenium (Se); CO, HCN and condensible hydrocarbons. Combustion of the product gas will result in emission of SO_2, NO_x, particulates consisting of small amounts of hydrocarbons and other organic species.	3-1 Assess current information on meteorology and air quality in the regions where development is anticipated.	Continuous	A-1980
	3-2 Develop improved standardized procedures and systems for sampling and monitoring of air for pollutants which adversely effect man and the environment.	Continuous	B-(EPA; NIOSH)
	3-3 Accumulate baseline, operational and post-operational air quality data for compliance purposes.	Continous	A-1980
	3-4 Characterize, identify and quantify the chemical constituents of raw gas, by-products, fugitive emissions and combustion products that could be released to the atmosphere.	3-5	A-1980
	3-5 Characterize chemical transformation of atmospheric releases; supply samples of reaction products for bioassay screening.	--	Not Currently Programmed
	3-6 Improve the ability to forecast atmospheric concentrations and transport of biologically active species as a function of regional atmospheric characteristics especially in rugged terrain.	--	Not Currently Programmed
	3-7 Develop capability for response to major accidental releases.	1-2	A-1981
	3-8 Confirmatory data regarding gaseous and particulate emissions; identify control requirements, assess current state-of-the-art, identify technology options and strategies; evaluate cost/benefit of various options.	4-5	A-1980
4. OCCUPATIONAL HEALTH AND SAFETY			
Protecting the worker from hazardous conditions and avoiding inhalation of gaseous emissions and physical contact with liquids and solid substances containing contaminants is the prime objective of Occupational Health and Safety. Concerns unique to UCG include the potential for inhalation of gases in the field stations caused by inadvertent gas leakage from the underground reaction zone and safety problems associated with potential subsidence. Occupational health is of concern in process plants where workers are in close contact with equipment and by-products from gas clean-up and desulfurization units, air compressors and other auxiliary equipment and even the main power plant which is utilizing the product gas.	4-1 Identify hazardous effluents (including definition of physical and chemical characteristics) which are emitted into the work-place environment.	1-2	A-1981
	4-2 Develop appropriate area and personal monitoring instruments to estimate individual dosages of PNA and other coal derived residues.	3-5	A-1981
	4-3 Establish and implement industrial hygiene surveys and assessments which measure worker exposure and dosage to non-criteria toxic substances found in the work place.	1-2	A-1981
	4-4 Develop and implement additional occupational health and safety guidelines for in-plant handling, storage and utilization standards to minimize accidental exposure to potentially hazardous substances and working conditions.	1-2	A-1982
	4-5 Establish and implement clinical medical surveillance component of integrated occupational health program for research and support personnel; and apply to development of comprehensive occupational health program for later phases, including commercialization.	--	Not Currently Programmed
	4-6 Apply results of epidemiological data arising from health studies, and from other sources to occupational health and safety standards and program guidance.	--	Not Currently Programmed

A - No R&D in place, work should be initiated in FY indicated
B - Work in progress since FY indicated and to continue at same level of effort
C - Work in progress since FY indicated; increase level of effort
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Appendix VI-A

ENVIRONMENTAL CONCERNS AND RESEARCH REQUIREMENTS

ENVIRONMENTAL CONCERN	ENVIRONMENTAL, HEALTH AND SAFETY REQUIREMENTS	RESEARCH TIME (YEARS)	RESEARCH STATUS
5. HEALTH Human health concerns for UCG center on the long-term chronic effects of public exposure to toxic and hazardous compounds. The risks from these chemical compounds are subtle and difficult to deal with, since a large variety of potentially toxic carcinogenic or mutagenic substances may result from UCG. These substances will likely be present in complex mixtures, and include other compounds which are unknown and need to be identified and assessed for health impacts. In particular, the effects of chronic low-level exposure to potent by-product carcinogens, such as polycyclic aromatic hydrocarbons and aromatic amines, are poorly understood.	5-1 Screen samples with simple cell bioassays for mutagenic and carcinogenic substances.	2-3	C-1978 (LLL)
	5-2 Conduct secondary biological screening, to assess toxicity, mutagenicity and chromosome damage from partially characterized constituents from above to determine which mixtures, classes or compounds warrant testing in animals.	3-4	C-1979 (LLL)
	5-3 Conduct acute and subchronic animal toxicity studies on any unique compounds to UCG (as compared to surface gasification) unique emissions, by-products and water contaminants.	2-3	A-1980
	5-4 Quantify metabolic fate and tissue dose for unique emissions, by-products and water contaminants.	2-3	A-1981
	5-5 Provide animal dose response data for chronic toxicity, carcinogenicity, embryo toxicity and reproductive damage for unique UCG emissions, by-products and water contaminants.	3-4	A-1982
6. ECOLOGY Aquatic and terrestrial ecosystem in the vicinity of the UCG sites may be affected by long-term, low-level toxic emissions in the waste streams or by inadvertent releases from the underground reaction zone. Both western and eastern ecosystems should be assessed particularly with regard to the potential for ecological cycling of pollutants through the food chain to man. The ecosystem may also be affected by changes in the natural water supply regime caused by disturbances to the aquifers in the vicinity of the sites	6-1 Screen samples of atmospheric emission, liquid waste and organic, trace or solid residues for acute toxicity to standard terrestrial and aquatic organisms, and those indigenous to development sites. Develop comparative toxicity data on gasification processes.	Continuous	B-1979 (LLL)
	6-2 Determine potential for toxic materials to accumulate in aquatic and terrestrial biota. Develop data base for effluent samples and compounds representative of major classes of compounds in effluents.	Continuous	B-1979 (LLL)
	6-3 Develop and apply models of transport and fate of toxic materials in terrestrial and aquatic ecosystems and characterize significant food chain transfers.	--	Not Currently Programmed
	6-4 Determine the effects of sublethal exposure of representative classes of compounds on organism and population characteristics.	--	Not Currently Programmed
	6-5 Determine the effects of key contaminants on functional aspects of model ecosystems.	--	Not Currently Programmed
	6-6 Inoculate and dose ecosystems in the field to determine transport, fate, and effects of toxic materials. Employ the aid of ecosystem models.	--	Not Currently Programmed
	6-7 Evaluate changes in community structure and monitor for signs of toxicity in areas impacted by operating facilities.	Continuous	B-1979 (LLL)

A - No R&D in place, work should be initiated in FY indicated
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C - Work in progress since FY indicated; increase level of effort
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Appendix VI-A

ENVIRONMENTAL CONCERNS AND RESEARCH REQUIREMENTS

ENVIRONMENTAL CONCERN	ENVIRONMENTAL, HEALTH AND SAFETY REQUIREMENTS	RESEARCH TIME (YEARS)	RESEARCH STATUS
7. MULTIMEDIA REQUIREMENTS In order to comply with all existing and emerging effluent and air emission requirements as stipulated in the applicable public health laws (Clean Water Act, Clean Air Act Amendments 1977, Toxic Substances Control Act, the Safe Drinking Water Act, and the Resource Conservation Recovery Act), it will be necessary to develop control systems and mitigation strategies for criteria and non-criteria pollutants. Identification and enforcement of applicable OSHA standards is also of concern. Mitigation strategies for physical disturbances, especially subsidence, need to be developed.	7-1 Define pollution control requirements based on regulatory standards (if existing), or anticipated quantification of pollutant releases, health/ecological effects data and transport/transformation fate studies.	Continuous	B-1976 (LETC)
	7-2 Determine facility compliance with federal, state and other environmental regulations and standards.	Continuous	Planned
	7-3 Identify and/or develop control technology options or strategies for underground pollutants and evaluate effectiveness.	Continuous	B-1976 (LETC; LLL)
	7-4 Assess the atmospheric emissions and particulate control needs.	Continuous	A-1980
	7-5 Evaluate control technology to mitigate the impacts of physical disturbances.	Continuous	B-1976 (LETC; LLL)
	7-6 Assess the reclamation effort needed due to physical disturbances.	--	Not Currently Programmed
	7-7 If needed, develop reclamation management plans to include pre-operational collection of plant materials for re-establishment after UCG operations are completed.	--	Not Currently Programmed
	7-8 Evaluate effectiveness of contaminated water cleanup, management and disposal procedures. Identify control technology needs and options for control of gaseous, liquid and solid wastes and pollutant discharges.	Continuous	B-1976 (LLL)
8. SOCIO-ECONOMIC FACTORS Socio-economic concerns center on the analysis of potential quantitative impacts related to population, employment, community services, fiscal and tax base and other institutional affects. Emphasis should be placed on the different economic bases of the eastern states and the western states and integrated assessments which consider several energy resource development scenarios for the same resource. Competition for consumptive water could effect plant siting or induce hardships on other industries and future utilization of land overlying burned out coal seams is a major concern.	8-1 Conduct demographic, social and economic base studies in coal resource areas.	--	These are not true research requirements and will be addressed in the various NEPA documents scheduled by DOE and EPA
	8-2 Predict local and regional population-related effects.	--	
	8-3 Predict employment impacts.	--	
	8-4 Assess housing and community service requirements.	--	
	8-5 Assess fiscal implications and impacts on tax base.	--	
	8-6 Assess impacts on quality of life, life style and culture.	--	
	8-7 Evaluate land use changes induced directly (subsidence, construction of facilities) and indirectly (increased pressure for development).	--	
	8-8 Determine potential for increased competition for water resources between local and regional communities.	--	
	8-9 Assess states needs for enabling legislation or other institutional requirements to administer energy development programs	--	

A - No R&D in place, work should be initiated in FY indicated
B - Work in progress since FY indicated and to continue at same level of effort
C - Work in progress since FY indicated; increase level of effort
LLL - Lawrence Livermore Laboratory
LETC - Laramie Energy Technology Center
METC - Morgantown Energy Technology Center

Appendix VI-B

Analysis Summary (128)

Technologies Assessment

- Risks exist because environmental R&D and all relevant regulations are not complete:
  - major design of environmental R&D programs to anticipate environmental problems of new plan is needed
  - greatest risk areas are level of hazardous wastes in high volume wastes, reclamation in arid areas, toxics in products and work place, fugitive venting and in-situ technologies/water intrusion
  - yet-to-be-defined regulations have biggest potential impact (RCRA, OSHA, TSCA, NO_x, visibility, PSD, underground injection), specific technologies could become unacceptable under stringent regulation of any of these
  - specific subprocesses, such as processes following gas synthesis in indirect liquefaction, require additional environmental characterization to better determine control needs relative to environmental standards
- Assessments assume stringent state-of-the-art controls for NSPS and for permitting conditions:
  - need for early and updated guidelines and procedures by Federal units
  - ability to meet ambient standards depend on using stringent controls and engineering practices

Siting Analyses - Coal Conversion

- Location of counties for siting opportunities suggest that physical environmental and resource constraints can be met for multiple locations:
  - need for nearby coal reserves can be met in 160 counties of 16 states, based on proven reserves, committment on long-term leasing are not considered
  - locations in and near all identified PSD Class I and nonattainment counties were excluded
  - physical accessibility to water in air quality acceptable counties is not a problem, but institutional barriers can be a major delay constraint and can limit industry size
  - 41 counties in 8 states remain as areas with siting opportunities (Montana, Wyoming, North Dakota, Illinois, West Virginia have over 5 counties)
  - 13 Western counties appear able to support several-module facilities
  - results are dependent on analysis assumptions, see Table 2
- Constraints not factored in would limit sites and facility sizes, and delay deployments. These include:
  - in East, prior long-term commitments of coal reserves
  - level of Class II air increments used by electric utilities, new industry
  - in West--and universally--inability of rural communities to absorb population growth
  - in some areas, population likely to oppose changing way of life
  - in West, ability to solve water rights, and water transport and storage institutional constraints
- Overall, opportunities for sites exist to allow multiple site selection so that alternative siting strategies of areas most-amenable to solving institutional factors can be stressed.

Analysis Summary (Continued) (128)

<u>Siting Analysis - Oil Shale</u>

- Using same air quality judgements as for coal conversion, 3 shale resource counties of Colorado and Utah containing shale are 200,000 BPD siting opportunities.
- Recent WRC water assessments suggest surface water can support industry in excess of 1.3 million BPD
- Rural community growth constraints are severe
- Proposed wilderness area can impact Utah siting

<u>Permitting Concerns</u>

- Lack of defined permitting requirements to allow definitive analysis of problem areas
- Solutions to some problems are underway
  - State of Colorado procedures development
    - lead agency, with CEQ model joint assessment and review procedures
    - coordinated public hearings
  - EPA proposed consolidated permitting procedures
    - RCRA, NPDES, PSD, and underground injection
    - Also EPA-DOI surface mining coordination
  - Draft procedures by EPA and DOE to set performance standards guidelines for use by permitting agencies
  - Executive Orders implemented the Federal critical Energy Facility Program and the Energy Coordinating Committee

- Federal Needs
  - better coordination, perhaps a lead agency; concurrent review steps
  - participation in interstate solutions and compacts
  - joint review processes with state and local permitting groups
  - technical and training aids to states, funding subsidies for impacted agencies
  - reducing redundancy in Federal and state parallel steps
  - carefully structured mediation and negotiation mechanisms to address issues and reduce potential for litigation
- State Needs
  - augmented, trained staffs
  - coordination among state units
  - cooperation across states and with Federal permitting, reviewing agencies
  - earlier public involvement, particularly focused requests for public input during environmental assessment preparation
- Other Concerns
  - institutional barriers problem
  - local perceptions and interests
  - reduce likelihood and litigation
    - better defined processes, data
    - use of mediation, negotiation
    - defined times for litigation
    - cut ability to retrace earlier decision points

SUMMARY STATEMENT ON BIOLOGICAL EFFECTS OF COAL LIQUIDS (128)

Biological research on coal liquids derived from processes under development by DOE (H-coal, SRC II, Exxon donar solvent) is in its infancy, and thus no conclusive statement on risk associated with production, transportation, handling, and end-use of these materials can be made. However, based upon research with materials primarily derived from the SRC II process, the following preliminary statements can be made:

1. SRC II liquids have industrial toxicity ratings, based upon acute and subchronic toxicity experiments similar to those of many compounds in commercial use. Their acute toxicity via ingestion to rodents is similar to that of benzoic acid, phosphoric acid, and sodium tartrate. SRC materials are significantly less toxic (by from 1 to 2 orders of magnitude on a g ingested/g body weight rodent) than pesticides such as dieldrin and chlordane. Chronic experiments in which toxicity is determined after different routes of entry are needed to assess the effects of long-term exposure.

2. SRC II liquids, in subchronic ingestion experiments, cause embryotoxicity in rats at levels approaching doses for maternal toxicity. This implies that the fetus may not be at considerably greater risk than the adult, female animal. Experiments with other species and routes of exposure as well as quantitative studies on the crossplacental movement of SRC II materials will better define potential risks to the prenatal individual.

3. Liquids derived from coal pyrolysis (Bergius process), the Union Carbide Institute, West Virginia, coal liquefaction pilot facility, and from two coal liquefaction technologies no longer under development have been shown in mice to be skin carcinogens. Light fuels derived by indirect liquefaction (Fischer-Tropsch synthesis) do not appear to be skin carcinogens in mice. Comparatively, surface-retorted shale oil and crude petroleum distillates have also been shown to be skin carcinogens in mice. It should be noted that industry has worked, unknowingly, with carcinogenic agents for many years (e.g., chlorinated diphenyl mixtures such as aroclor and kaneclors, vinyl chloride). Knowing the carcinogenic potential of a material prior to its large-scale production and dissemination may result, when appropriate steps are taken, in a lesser risk than producing and commercially using a material defined as a carcinogen years after its introduction into commerce. Coal liquefaction operations, at this time, treat process and product materials as potential carcinogens.

4. Microbial mutagenesis assays have suggested that SRC II high-boiling "heavy" liquids and other high-boiling coal liquids have mutagenic potency considerably greater than crude petroleum and

from 4 to 100 times (depending upon assay system) greater than shale oils derived from surface retorting. Light fractions of SRC II are without mutagenic effect. This would suggest, if there is a correlation between microbial mutagenesis and carcinogenesis for complex mixtures such as coal liquids, that high-boiling coal liquids may pose some carcinogenic hazard. Recent experiments involving chemical fractionation, coupled to microbial mutagenesis assays with concomitant tentative identification of mutagenic compounds/compound classes suggest that mutagenicity for this material is effected by a discrete number of compounds. If this is the case, and if the microbial mutagenesis/carcinogenesis correlation holds true for SRC II heavy distillate, it is possible that process changes may ameliorate carcinogenic risk.

5. Workers at the Institute, West Virginia, coal liquefaction facility developed skin cancer at a higher incidence than the general population. However experience to date at the SRC pilot plant in Fort Lewis, Washington, operational since 1975, suggests no unusual or readily apparent health effects in the work force. The Fort Lewis facility has had, since its startup, a state-of-the-art industrial hygiene and worker education program, which may account for its present health record.

In summary, it would appear, based on early data, that coal liquefaction poses some hazard to worker and environmental health. The hazards involved are in the process of definition at this time but appear to be similar to risks incurred in production, transport, and end use of other materials in present commercial use. The possibility of ameliorating one source of chronic risk (carcinogenic materials) exists and should be analyzed prior to commercialization of the coal liquefaction processes presently under consideration by DOE.

Appendix VI-D

GENERIC PROBLEM AREAS IN COAL LIQUEFACTION (50)

- INSTRUMENTATION AND CONTROL
- ESTIMATES AND CORRELATIONS OF STREAM PROPERTIES
- MATERIALS AND COMPONENTS
- GASIFICATION
- GAS CLEANUP AND RECYCLE
- HEAT RECOVERY
- HEALTH AND SAFETY CONSIDERATIONS
- WASTE TREATMENT

PROBLEM AREAS IN COAL LIQUEFACTION

DIRECT AND TWO-STAGE PROCESSES

- SLURRY PUMP
- SLURRY PREHEATER
- REACTOR FLOW DISTRIBUTION
- HIGH PRESSURE SLURRY LETDOWN VALVE
- SOLID-LIQUID SEPARATION
- VACUUM COLUMN
- GASIFIER
- LOW-TEMPERATURE CARBONIZER
- HEAT RECOVERY

PROBLEM AREAS – PYROLYSIS AND HYDROPYROLSIS

- PRESSURIZED DRY COAL FEED SYSTEM
- FEEDING CAKING COALS TO REACTORS
- PROCESS HEAT SUPPLY TO REACTORS
- HEAT RECOVERY AT HIGH TEMPERATURES
- REMOVAL OF SOLIDS FROM GASES

PROBLEM AREAS – INDIRECT LIQUEFACTION

- GASIFIER AND GAS CLEANUP
- FLUID BED REACTOR SCALEUP

Appendix VII-A

New Mexico Standards of Performance for Gasification Plants (109)

The New Mexico Standards of Performance for Gasification Plants include standards for particulate matter, gaseous sulfur compounds (SO_2, H_2S, CS_2, and COS), organics/hydrocarbons, hydrogen cyanide, ammonia and hydrogen chloride/hydrochloric acid. Details of these regulations are discussed below.

Particulate Emission Standards as they apply to gassification plants are:

1. *Maximum emissions - general*——0.03 gr/scf exit gas
2. *Maximum emissions - gas burning boilers in conjunction with gasification plants*——0.03 lb/MM Btu heat input to boilers (lower heating value)
3. *Maximum emissions - boilers operated in conjunction with gasification plants and firing more than one fuel*
   a. If more than one fuel is fired simultaneously in a boiler, the boiler shall be considered as two or more units, each firing the equivalent amount of fuel with the appropriate heat content separately but having a common stack for determination of allowable emissions. Allowable emissions shall be calculated according to the following formula:

   $$E_T = E_oQ_o + E_cQ_c + E_gQ_g$$

   where E_T is the total allowed emission in pound per given period of time;

   E_o is the allowed emission from oil in lb/MM Btu's;
   E_c is the allowed emission from coal in lb/MM Btu's;
   E_g is the allowed emission from gas in lb/MM Btu's;
   Q_o is the heat released by the oil based on the higher heating value in Btu's per period of time;
   Q_c is the heat released by the coal based on the higher heating value in Btu's per period of time;
   Q_g is the heat released by the gas based on the lower heating value in Btu's per period of time.

   b. In addition to the limitations in 3a, the total allowable emissions of particulates two microns equivalent aerodynamic diameter or less shall be calculated according to:

   $$E_f = 0.40\ E_c\ (Q_o + Q_c + Q_g)$$

   where E_f is the total allowed emission of fine particulates in pounds per given period of time, and all other terms remain as defined above.
4. All emissions to the atmosphere shall be through stacks at least ten diameters in length and equipped with adequate platforms and sampling ports for accurate sampling.
5. Fugitive Dust. It shall be prohibited to cause or allow any material to be handled, transported, stored or disposed of or a building or road to be used, constructed, altered or demolished without taking reasonable precautions to prevent particulate matter from becoming airborne.
6. *Maximum emissions coal briquet forming facilities*
   a. 0.03 gr/scf exit gas
   b. All particulate matter emissions shall be limited to stack outlets within technical feasibility.

Sulfur Emission Standards——for coal gasification facilities, where 'Feed' means those materials which enter directly into the manufacture of synthetic natural gas, and includes, but is not limited to, coal, tars, oils, and naphtha.

1. *Maximum SO_2 emissions–gas-burning boilers*——0.16 lb/MM Btu heat input (lower heating value) to all boilers
2. *Maximum sulfur emissions*——0.008 lb/MM Btu heat input (higher heating value) in feed introduced to plant
3. *Hydrogen sulfide (H_2S) - carbon disulfide - carbon oxysulfide: maximum emissions*
   a. 100 ppm (by vol.) in effluent gas, any combination of H_2S, carbon disulfide, and carbon oxysulfide.
   b. 10 ppm (by vol.) maximum H_2S component in combined effluent gas.

Organic/Hydrocarbon Emission Standards——for gasification plants include storage, handling, pumping, safety relief valves, and blowdown systems. These standards are stated such that no person owning or operating a gasification plant shall:

1. Place, store or hold in any stationary tank or container (except waste water treatment basins, ponds, clarifiers, and settlers) any phenols or any organic compound having a Reid vapor pressure of 1.5 psia or greater, unless the tank or other container is designed, equipped and maintained with:
   a. A floating roof, consisting of a pontoon-type, double-deck roof or internal floating cover which rests on the surface of the liquid contents and is equipped with a closure seal or seals to close the space between the roof or cover edge and tank wall;
   b. A vapor recovery system consisting of:
      i. A vapor gathering system capable of collecting the organic compound vapors and gases discharged; and
      ii. A vapor disposal system capable of processing the organic vapor and gases so as to prevent their emission to the atmosphere; or
   c. Any other device which is at least as efficient to prevent vapor or gas loss to the atmosphere.
2. Place, store or hold in any stationary tank or container (except waste water treatment basins, ponds, clarifiers, and settlers) any phenols or any organic compound having a Reid vapor pressure of 1.5 psia or greater without the tank or other container gauging and sampling devices being gas tight, except when gauging or sampling is taking place;
3. Load or unload into any tank, truck or trailer any phenols or any organic compound having a Reid vapor pressure of 1.5 psia or greater unless:
   a. The loading facility is equipped with:
      i. A loading arm having a vapor collection adapter to force a vapor tight seal between the adapter and the hatch and having a means of collecting the vented vapors and preventing their emission to the atmosphere; or
      ii. Any other device which is at least as efficient to prevent vapor or gas loss to the atmosphere; and
   b. A means is provided to prevent liquid organic compound drainage from the loading device when it is removed from the hatch of any tank, truck, or trailer or to accomplish complete drainage before its removal.
4. Use a pump or compressor which handles any phenols or any organic compound; having a Reid vapor pressure of 1.5 psia or greater, unless the pump or compressor is equipped with mechanical seals or other devices of equal or greater efficiency to prevent liquid or vapor losses;
5. Install safety relief valves, except valves installed on gas streams containing steam, product gas, nitrogen or oxygen unless they are connected to a blowdown system; and
6. Operate a blowdown system without disposing of the gases in a manner which will prevent hydrocarbon emissions to the atmosphere. If combustion is the means of disposal, it shall be by smokeless flare or similar means to achieve complete combustion.

Hydrogen Cyanide Emission Standards——for gasification facilities are:

1. *Maximum Emission*——10 ppm (by vol.) HCN in effluent gas

Ammonia Emission Standards

1. No person owning or operating a gasification plant shall place, store or hold in any stationary tank or other container any ammonia unless the tank or other container is:
   a. A pressure tank capable of maintaining working pressures

sufficient to prevent loss of ammonia to the atmosphere.
b. Equipped with other equally effective control equipment to prevent loss of ammonia to the atmosphere.
2. *Maximum Emission*——25 ppm (by vol.) NH_3 in effluent gas

Hydrogen Chloride/Hydrochloric Acid Emission Standards——for coal gasification facilities are:
1. *Maximum Emission*——5 ppm (by vol.), any combination of hydrogen chloride and hydrochloric acid in effluent gas

Appendix VII-B

PROPOSED PRIORITY I POLLUTANTS FOR COAL CLEANING PROCESSES (288)

Elements	Specific Pollutant Limitations** A	B	C	D	E	F	G
Aluminum							
Antimony		X					
Arsenic		X			X		X
Barium		X			X		X
Beryllium			X				X
Boron		X					X
Bromine		X					
Cadmium					X	X	X
Calcium		X					
Carbon							
Cerium							
Cesium							
Chlorine		X					X
Chromium		X*			X		X
Cobalt		X*					
Copper		X*					X
Fluorine		X					
Gallium							
Germanium							
Indium							
Iodine		X					
Iron					X		X
Lanthanum							
Lead					X		X
Lithium							
Magnesium							
Manganese		X			X		X
Mercury			X		X	X	X
Molybdenum		X					
Nickel		X					X
Niobium							
Nitrogen							
Oxygen							
Phosphorus							X
Potassium							
Rubidium							
Selenium					X		X
Silicon							
Sodium							
Strontium							
Sulfur							
Tellurium		X					
Thorium							
Tin							
Titanium		X					
Uranium		X					
Vanadium		X					
Zinc		X			X		X
Zirconium		X					

Groupings	Specific Pollutant Limitations** A	B	C	D	E	F	G
Alkalinity							X
Ammonia		X					X
Cyanide		X			X	X	X
Chlorides					X		
Nitrates					X		X
Sulfides							
Sulfates					X		
SO_x	X	X					
NO_x	X	X					
Total Suspended Solids (TSS)							
Total Dissolved Solids (TDS)					X		
Chemical Oxygen Demand							
Total Suspended Particulates (TSP)	X			X			
Carbon Dioxide		X					
Carbon Monoxide	X	X					
Hydrocarbons	X						
Photochemical Oxidants	X						
Oil and Grease							X
Phenols		X			X		X
Organic Sulfur Compounds							
Organic Nitrogen Compounds							
Polycyclic Organic Materials (POM's)							
Carbon Chloroform Extract (CCE)					X		

* Column headings are defined as follows:

A. National Primary and Secondary Ambient Air Quality Standards
B. OSHA Standards for Workroom Air Contaminants
C. National Emission Standards for Hazardous Air Pollutants
D. New Stationary Source Performance Standards (Coal Preparation Plants)
E. Drinking Water Regulations (EPA and PHS)
F. EPA Toxic Pollutant Effluent Standards (Proposed)
G. EPA Water Quality Criteria (Proposed-not regulations)

** Metal fume standard.

Appendix VII-C

1990 SYNFUELS PLANT DEPLOYMENT

(055)

	EASTERN STATES	WESTERN STATES	ENERGY OUTPUT 10^9 Btu/DAY	10^6 BDOE
COAL-TO-SNG	7	6	3250	0.5
PEAT-TO-SNG	2	—	500	0.1
COAL-TO-FUEL GAS	5	—	500	0.1
OIL SHALE-TO-SNG	1	—	250	0.05
OIL SHALE-TO-OIL	2	5	—	0.35
COAL-TO-LIQUIDS	5	6	—	0.55
COAL-TO-COMBINED CYCLE (Barrels of Oil Displaced)	14	6	2000	0.4
OTHER POWER PLANT DISPLACEMENTS				0.35
BIOMASS				0.1
UNCONVENTIONAL GAS				0.75
			TOTAL	3.25