EPA

ENVIRONMENTAL REVIEW of SYNTHETIC FUELS

INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY

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INTRODUCTION

In response to the shift in the U S energy supply priorities from natural gas and oil to coal, the Environmental Protection Agency (EPA) has initiated a comprehensive assessment program The program will evaluate the environmental impacts of synthetic fuel processes with a high potential for commercial application It is directed by the Fuel Process Branch of EPA's Industrial Environmental Research Laboratory in Research Triangle Park, NC (IERL-RTP)

The primary objectives of the EPA Synthetic Fuels Environmental Assessment/Control Technology Development Program are 1) to define the environmental and health effects of multimedia discharge streams and 2) to define control technology needs for an environmentally sound synthetic fuels industry The synthetic fuels from coal technologies being studied in this program include low/medium Btu gasification, high-Btu gasification and liquefaction To achieve the program's overall objectives, the EPA has defined six major task areas current process technology background, environmental data acquisition, current environmental background, environmental objectives development, control technology assessment, and technology and/or commercial development The contractors involved in the program, their EPA Project Officers, and the duration of each effort are tabulated on page 6

This is the fourth in a series of periodic reviews of recent activities in EPA's synthetic fuels program Activities of EPA contractors are covered in sections on current process technology background, environmental data acquisition, and control technology assessment Highlights of major symposia, a calendar of upcoming meetings and a list of major publications provide up-to-date information on national and international developments in synthetic fuels technology Comments or suggestions which will improve the content or format of these reviews are welcome Such comments should be directed to the EPA or Radian Corporation personnel identified on page 12 of this review

CURRENT PROCESS TECHNOLOGY BACKGROUND

General Topics

Environmental Assessment Reports (EAR's)—EAR's provide the EPA Administrator and Program Offices with comprehensive technical bases for the development of technology-specific standards EAR's include the following

- Description of the technology
- Summary of uncontrolled multimedia emissions
- Identification and analysis of control alternatives
- Analysis of the impact of both uncontrolled and controlled emissions
- Summary of available data
- Identification of additional data needs

Several organizations are currently preparing EAR's of various synthetic fuels technologies Brief descriptions of these efforts are given in the following paragraphs Detailed summaries will be presented in subsequent issues of the "Environmental Review of Synthetic Fuels" as the completed EAR's become available

Low/Medium-Btu Gasification

Wellman-Galusha Gasification Systems—Radian Corporation, as part of its environmental assessment of low/medium-Btu gasification technology, is preparing an EAR for air-blown Wellman-Galusha gasification systems

Information used in preparing the EAR is being obtained from Radian's low-Btu data base, the results of tests conducted by a variety of organizations at low-Btu gasification facilities, and contacts with process vendors and industry

Material and energy balances are being calculated for different combinations of coal feedstocks and product gas specifications Coal feedstocks include low- and high-sulfur bituminous, lignite, and anthracite The three product gas specifications are

- Combustion products meeting existing NSPS for direct coal combustion
- Combustion products meeting proposed NSPS for direct coal combustion
- "Very clean," essentially sulfur-free, gas

Plant capacities examined range from 17 to 88 MJ/s (60 to 300 x 10^6 Btu/hr) of low-BtU gas ,

Uncontrolled plant effluents are identified from the results of detailed material and energy balances A simplified ambient air disperson model is then used to evaluate the environmental impacts of gaseous emissions In addition, multimedia emissions (controlled and uncontrolled) are compared with federal, state, and local regulations Potential control alternatives are identified

The report is scheduled for publication in the Spring of 1979

High-Btu Gasification

Lurgi Gasification Systems—TRW, Inc , is preparing an EAR of Lurgi high Btu gasification systems The basic data and information required for the EAR are currently being extracted from TRW's high-Btu data base This data base is summarized in a recently completed document entitled "Environmental Assessment Data Base for High-Btu Gasification Technology " (For a detailed description of this report, see the Reports Summary section in this issue of the "Environmental Review of Synthetic Fuels ")

Liquefaction

Solvent Refined Coal (SRC) Systems—Hittman Associates, Inc , is preparing an EAR of SRC systems As a prerequisite to the report preparation, all environmental assessment information relevant to SRC systems is being collected The information will be analyzed and reviewed for its inclusion in the EAR

ENVIRONMENTAL DATA ACQUISITION

General Topics

Control Assay Development (CAD)—Catalytic, Inc , is developing methods for performing laboratory scale screening tests on process waste samples The screening tests will be used to define the applicability of various pollution control technologies The methods, collectively known as Control Assay Development (CAD), apply to aqueous, gaseous, and solid wastes By analyzing the effectiveness of the control technologies employed, CAD can assess the potential treatability of waste streams and determine the need for specific control technology studies

The strategy of CAD uses the phased approach concept developed by IERL RTP for environmental assessment (EA) programs Applied to EA, Level 1 is a screening phase to identify problem streams and set priorities for more intensive Level 2 data collection Level 1 CAD also examines some of the more conventional control technologies to determine their effectiveness in removing pollutants Potentially applicable control technologies will be selected for more rigorous Level 2 CAD treatability studies If none of the unit operations employed in Level 1 effect sufficient removal of pollutants, other technologies normally reserved for special applications will be used Evaluation of CAD treatment will be based on EPA environmental goals Chemical, physical, and biological assays will be performed using the appropriate IERL-RTP protocols

CAD is designed to be conducted in the field using small scale pollution control systems housed in a mobile laboratory The control systems are sized to process sufficient sample quantities to determine both chemical and physical parameters and health and ecological effects About 0 20 m^3 (53 gal) of an aqueous stream and about 28 m^3 (1,000 ft^3) of a gaseous stream will be required Samples of liquids, gases, and solids generated by CAD testing will be collected, "fixed," and shipped to an off-site laboratory for analysis using the IERL-RTP Level 1 EA procedures

Procedures for wastewater screening tests are further along in development The methodology was described in a previous edition (see the "Environmental Review of Synthetic Fuels," Volume 1, Number 3) CAD as applied to air and solid wastes is discussed below

Procedures for air screening tests include unit operations for removal of particulates and inorganic gaseous species The screening apparatus is a series of cyclones, filters, canisters, and impingers

Few options are available for the safe disposal of sludge, ash, char, and other solid materials Incineration, fixation or encapsulation, and land filling are the primary methods Incineration processes include high temperature thermal destruction, pyrolysis, and wet air oxidation Investigation is underway to determine the extent to which these operations can be practically included as Level 1 CAD protocols

Chemical fixation or encapsulation techniques are designed to alter the characteristics of waste solids to minimize or eliminate leaching at landfill disposal sites Because of the proprietary nature of fixation/encapsulation processes, it would be necessary to provide suitable samples to a process vendor in order to develop data for this type of solids disposal approach It is anticipated that chemical fixation/encapsulation will not be included as part of the Level 1 CAD test procedures

Leaching tests are normally long term in nature, beyond the time frame of Level 1 CAD studies However, investigation is underway to determine if standard techniques can be modified for use as CAD screening tests Before CAD methodologies are finally adopted, the specific test procedures will be tested in the laboratory using synthetic feeds This verification step will ensure that procedures are comprehensive and clearly written, the apparatus is easily assembled, operated and cleaned, equipment sizes have been properly specified, and the operations are consistent with the CAD design objectives

Low/Medium-Btu Gasification

Sampling Efforts Completed at Commercial Gasification Facility—In early 1978, Radian Corporation completed a 2-week sampling effort at a commercial low-Btu gasification facility Constructed as part of the Department of Energy's (DOE's) Gasifiers in Industry Program, the facility uses an air-blown, atmospheric pressure Wellman-Galusha gasifier to convert approximately 0 25 kg/s (1 ton/hr) of low-sulfur anthracite coal to 5 2 MJ/m^3 (140 Btu/scf) fuel gas Samples of 12 streams were obtained

- Coal Feed
- Gasifier Inlet Air
- Coal Hopper Vent Gas
- Pokehole Gas
- Dry Gasifier Ash
- Ash Sluice Water
- Plant Makeup Water
- Gasifier Cooling-Jacket Water
- Raw Gas to the Cyclone
- Product Gas From the Cyclone
- Cyclone Dust
- Test Burners Combustion Gases

In addition, process gas chromatographs were used to monitor continuously the product gas for sulfur species, light hydrocarbons, and ammonia

The first phase of sample analysis included several screening tests These were spark source mass spectrometry for trace elements, gas chromatography/mass spectrometry and low resolution mass spectrometry for organics, and biological tests The results of these tests are now being evaluated to identify the need for additional, more specific analyses

If a second phase of analyses (specific analyses for trace elements and/or organics) are needed, they would be completed in early 1979 A final report summarizing all test results from both phases should be available in the spring of 1979

Source Test and Evaluation Program—A test program will be conducted by Radian Corporation on a Wellman-Galusha gasifier producing low-Btu gas for an iron ore pelletizing operation The gasifier and pelletizer are being operated by the Bureau of Mines and a consortium of steel companies on U S Bureau of Mines property at Fort Snelling, Minnesota Results of the test program, which will provide an environmental and health assessment of a Wellman-Galusha gasifier, will appear in an environmental assessment source test and evaluation report (EA STER)

The combustion characteristics of Wellman-Galusha product gas will be investigated using a test burner Both product gas and combustion products will be monitored continuously by six on site chromatographs Fixed gases, C_1 C_6 hydrocarbons sulfur species, and ammonia will be measured The continuous monitoring data will be collected during test runs on four types of coals bituminous, semi-bituminous, subbituminous, and lignite

More extensive sampling will be conducted during two test runs, one on a subbituminous coal and one on lignite Samples of all major process and waste streams will be obtained The waste stream data will provide the basis for an environmental and health assessment The process data will be the basis for design and operation of environmental control equipment in similar applications

The continuous monitoring phase of the program began in November More extensive sampling was conducted in December

Results from Phase I Testing at Overseas Gasifier—Radian is continuing a series of environmental tests of the Lurgi gasification facility (Kosovo Kombine) at Obilic, Yugoslavia The plant is conceptually very similar to several proposed U S plants, thus process and environmental data relevant to the proposed U S commercial-scale processes can be gathered

Plant emission streams are being identified and characterized in Phase I of the test program Results obtained from Campaign 1 of Phase I are described below

Process data gathered during Campaign 1 indicated the following average properties for the lignite coal fed to the gasification section

- Heating value – 15 MJ/kg (6500 Btu/lb).
- Moisture – 24 percent (wt)
- Ash – 15 percent (wt)
- Total sulfur – 1 1 percent (wt)

Approximately 20 percent of the sulfur fed to the gasifier in the coal was retained in the ash The product medium-Btu gas produced during Campaign 1 was about 66 volume percent H_2, 16 5 volume percent CO, and 13 7 volume percent CH_4 The remaining constituents were primarily N_2 and CO_2 The calculated heating value of the product gas was about 16 MJ/Nm^3 (410 Btu/scf)

The table below shows the composition of two plant wastewater streams A comprehensive summary of the results of Phase I of the Kosovo test program (Campaigns 1, 2 and 3) is scheduled for publication in the summer of 1979 Phase II testing, which will be directed toward measuring the emission levels of specific major and minor pollutants, is scheduled to start after the completion of the Phase I tests

WASTEWATER PROPERTIES

Parameter (mg/l)	Generator Section Wastewater*	Phenosolvan Effluent Water
pH	11 4-12 1	9 2-9 4
Susp Solids	180-590	150-190
Diss Solids	1100-2100	880-1300
COD	0 8-150	3100-3300
Permanganate Value	16-69	5400-7600
Phenols	–	170-270
CN^-	0 01 max	0 02
Cl^-	20-70	16-120
$SO_4^=$	320-670	100-110
CNS^-	0 01-0 03	3
F^-	0 6-1 2	Trace
NO_3^-	4-6	11-12

*Water used for ash quenching and particulate (coal and ash dust) control

High-Btu Gasification

Test Program Development—In the area of test program development, TRW has developed a detailed list of specific data requirements for the HYGAS coal gasification pilot plant To fill these data needs, a series of five sample acquisitions has been proposed Up to nine process and discharge streams would be sampled during each sample acquisition Analytical techniques to be used include gas chromatography, spark source mass spectrometry, and atomic absorption spectroscopy Bioassay testing will also be performed The TRW test plan was coordinated with a comprehensive testing program which has been developed for the HYGAS facility by the Institute of Gas Technology and Carnegie-Mellon University

CONTROL TECHNOLOGY ASSESSMENT

General Topics

High Temperature Gas Cleanup Using Iron Oxide—Catalytic, Inc , has started bench scale tests to examine the degree of pollutant removal achieved by contacting simulated coal conversion gases in a fixed iron oxide sorbent bed The testing will be done using an existing setup at an Air Products & Chemicals, Inc , laboratory Two gas mixtures, approximating coke oven and Lurgi raw gases, will be studied Pollutant removal efficiencies will be determined under different test conditions Sorbent regeneration and sulfur recovery studies will be also conducted The data obtained will be used to make a preliminary engineering assessment of the iron oxide process

Material Balance Studies—Catalytic, Inc , has started material balance studies to assess environmental aspects and control needs of product/by-products recovery and upgrading processes The major emphasis in Catalytic's study is on technology for improving the quality of liquid coal conversion products and by-products such as naphtha, tars, tar oils, fuel oils, and crude phenols

Naphtha is produced from both coal gasification and liquefaction processes It can be processed to make benzene or gasoline blending components At least three potential processing schemes are available Benzene can be produced by the Houdry Litol process or by an alternate process which involves hydrotreating and extraction using tetraethylene glycol The Litol process, which has been used in the coke oven industry since 1964, is a catalytic process by which naphtha can be refined and dealkylated to produce high quality benzene Gasoline blending components can be produced from naphtha by hydro-treating to remove sulfur and nitrogen followed by catalytic reforming All these processes will be investigated

Coal liquids in the 450-620 K (350-650°F) boiling range will require mild hydrotreatment to remove nitrogen to make them suitable for No 2 fuel oil applications Tars, tar oils and +620 K (+650°F) heavy fuel oils, however, will require severe and expensive hydrotreatment to be environmentally acceptable fuels Hydrocracking of tars and tar oils followed by catalytic reforming is an alternate process to make high octane gasoline

TECHNOLOGY AND/OR COMMERCIAL DEVELOPMENT

International Coal Gasification Project—The European Economic Community and India have agreed to support a joint coal gasification project The joint venture will aim to improve the efficiency of coal utilization in thermal power stations Other goals include a reduction in capital costs and petroleum fuels consumption The project will be managed by the state-owned Bharat Heavy Electricals, Ltd , of India

West Germany Gasification Pilot Plant—Rheinische Braunkohlenwerke (Rheinbraun) has built a 0 81 kg/s (77 ton/day) lignite gasification facility at Wachtberg The unit operates at temperatures up to 1373 K (2012°F) at 1 1 MPa (11 atm) If the pilot plant satisfies Rheinbraun's expectations, a commercial-scale gasification plant will be built in the 1980's

Coal-based Fertilizer Project Begun in India—The first of three Koppers-Totzek gasifiers was put into operation at the Talcher fertilizer plant in India in early summer for the production of ammonia and urea The total output of ammonia and urea is expected to be 300,000 and 500 000 Mg/yr (330,000 and 550,000 tons/yr), respectively, once the remaining two gasifiers go onstream The gasifiers were designed by Fertilizer India Ltd New Delhi

Coal Fines Tests Successful at Conoco's Westfield Plant—Encouraging results were achieved in recent DOE sponsored tests with coal fines at Conoco Development Company's Westfield pilot plant The capability of the slagging Lurgi gasifier to handle both "sized" coal and coal "fines" is a finding which improves the economic and environmental outlook for converting Eastern U S coals to substitute natural gas The clean air standards have prevented utilities from using high sulfur, highly caking coals The use of both sizes of coal simulates run-of-mine coal, making it feasible to use Eastern U S coals with Westfield technology The process is claimed capable of gasifying all of the caking bituminous coals east of the Mississippi River, including Ohio No 9 This means that substitute natural gas could be produced close to major gas markets in the Eastern U S , and existing pipelines could be utilized for transportation

Horizontal Drilling Aids In-Situ Gasification—Lawrence Livermore Laboratories, of Livermore California, has successfully drilled a horizontal hole into the bottom of a 7 6 m (25 ft) coal seam in the Powder River Basin of Wyoming The total length of the hole is 230 m (750 ft) with the horizontal section about 60 m (200 ft) long This marks the first step in a new gasification experiment being conducted for DOE

The horizontal hole will link three 0 2 m (8 in) vertical holes One hole is for steam and oxygen injection and the other two serve as exits for the gas from the burning coal This is the first time the horizontal drilling method has been used in the United States, although it was pioneered in the U S S R during the 1950's Beginning in June 1979, 30 m (100 ft) of the coal seam will be gasified in a 40-day test

Mobil Process for Gasoline Production—The conclusion of a study conducted by Mobil Oil Corporation is that the Mobil methanol conversion process is cheaper and produces a higher quality fuel than the Fischer Tropsch synthesis The study, conducted under a $200,000 contract with DOE, showed that gasoline produced by Fischer Tropsch synthesis would require additional refining to meet U S standards The Mobil process gasifies coal and uses a proprietary catalyst to convert the methanol to gasoline and water The Fischer-Tropsch process uses a different catalyst to convert the gas to several hydrocarbon products, one of which is gasoline

Joint Venture in Coal Gasification—Dravo Corporation and Consolidated Natural Gas Company (both of Pittsburgh) are planning a joint venture to provide coal-based industrial fuel gas to Consolidated's industrial customers in Ohio Pennsylvania, and West Virginia The newly formed company, Industrial Fuel Gas Company, will build own, and operate coal gasification plants producing low- or medium-Btu gas The new gasification plants will be located on or near user plant sites A single gasifier unit can be built in about 18 months at a cost of approximately $4 million (including environmental controls) The gasifier will have a capacity of 18 MW (1 5 billion Btu/day) As additional power is needed, more gasifiers can be installed at incremental costs

Honeycombed Nickel Catalysts for Coal Gasification Reactions—Experiments being conducted at Brigham Young University (BYU) for DOE indicate that honeycombed nickel catalysts are more active in coal gasification reactions than nickel pellets or other more compact configurations Researchers at BYU report that monolithic honeycombed catalysts produce 50 percent more methane (volume basis) than do nickel pellets and that the size of a commercial coal gasification reactor could be reduced by 40 percent using the honeycombed catalyst

Natural Gas Industry's Gasification Projects—The U S natural gas industry is making a new effort to become involved in coal gasification The decision for greater involvement is based on estimates of future needs for synthetic gas and petrochemical feedstocks According to estimates by the American Gas Association (AGA) 44 gasification plants will be needed in the U S by the year 2000

A consortium of American Natural Gas Resources Company and four other gas transmission companies has requested Federal Energy Regulatory Commission (FERC) approval for a $1 4 billion commercial-scale plant Construction could begin by April 1979 near Bismarck, North Dakota The plant is designed to produce pipeline quality gas with a heating value almost the same as natural gas

El Paso Natural Gas (EPNG) is planning a similar project and has outlined additional sponsors to share the estimated $1 25 billion cost EPNG's project would be built near Gallup, New Mexico and would produce 94 m^3/s (288 million ft^3/day) of pipeline gas DOE is sponsoring three smaller projects now in the design and engineering phase These include the HYGAS process, the slagging Lurgi process, and the COED/COGAS process being developed by Procon, Conoco, and ICGG (Illinois Coal Gasification Group), respectively

DOE and GRI Agree to Gasifier Shutdown—DOE and the Gas Research Institute (GRI) have decided to shut down the steam iron coal-to-hydrogen gasifier located adjacent to the HYGAS facility in Chicago The hydrogen plant was being operated by the Institute of Gas Technology and has operated only 2 days since completion in 1976 The unit was designed to produce 0 015 m^3/s (45,000 ft^3/day) of hydrogen but never produced more than 0 001 m^3/s (3,000 ft^3/day) DOE is considering placing the facility on standby for potential use in future coal gasification projects

Texas A&M Plans Lignite Gasification Pilot Plant—Texas A&M University has fulfilled all administrative permit requirements for an in-situ lignite gasification pilot plant and is awaiting approval from the Texas Railroad Commission The planned installation would be located in Milam County near Rockdale, Texas Plans include an 83 m (273 ft) ignition well (drilled to a 5 m [14 ft] thick lignite seam), and at least one production well Approximately 1360 Mg (1,500 tons) of lignite will be gasified during the 6 weeks after start-up The gas produced will be burned in incinerators

DOE Considers Second Burn Front at Hanna—DOE is considering a second burn front at the Hanna, Wyoming, underground gasifica tion test site Flow tests are now being performed to determine if the coal seam is permeable enough to sustain the gasification burn The extended flow testing is not routine, but is necessary in this case to ensure that seam conditions are suitable for the second burn The first burn front was shut down when gas production dropped off rapidly

Ammonia-From-Coal Demonstration Project—The Tennessee Val ley Authority (TVA) has awarded a $25 6 million contract to Brown and Root, Incorporated, of Houston to engineer, procure, and construct facilities which will gasify sized coal The plant will use the Texaco gasification process to produce synthetic gas from 1 76 kg/s (168 tons/day) of eastern low-sulfur or midwestern high-sulfur coal The gas will be purified and delivered to TVA's ammonia plant at Muscle Shoals, Alabama The gas will be used in the production of 1 42 kg/s (135 tons/day) of ammonia at the retrofitted fertilizer plant The demonstration of the ammonia-from-coal process is scheduled for the early 1980's

Solvent Extraction Process for Gasification—A chemical process for super critical solvent extraction developed nearly 100 years ago is being reconsidered for producing clean fuel or chemical feedstocks from coal Catalytic, Incorporated, of Philadelphia, under contract to the Electric Power Research Institute (EPRI), is conducting an economic analysis of the potential use of coal extracts as fuel Catalytic claims several advantages for the solvent extraction process over conventional coal conversion techniques

Britain's National Coal Board is now using the solvent extraction process in an 83 g/s (11 lb/hr) pilot plant being operated to produce a high quality chemical feedstock The coal and solvent are mixed at a temperature of 672 K (750°F) and pressure of 10 MPa (100 atm) The process uses toluene as a solvent and converts up to 33 percent of the coal processed The products are a hydrogen-rich glassy solid and char residue

The solvent extraction process is especially attractive because, according to Catalytic, no hydrogen is required and energy requirements for compressing the liquid solvent are low In addition, the char residue is readily converted to hydrocarbon oils and chemicals because of its rich hydrogen content and low molecular weight Finally, the extract precipitates out of the solvent at low temperatures, making filtration unnecessary

Testing Improves Gasifier Lifetime—A water-cooled hearth may help extend the life of gasifiers used to produce substitute natural gas from coal Testing at DOE's Grand Forks Energy Technology Center showed that water cooling improves the durability of the heat resistant metal coatings (refractories) of the gasifier hearth Previously the durability of the refractories was limited by corrosion and slag formation The design used at Grand Forks circulates water through the bottom of the hearth to cool the red-hot slag and thereby reduce damage to the bottom of the gasifier The new gasifier was operated successfully for about 25 hours, during which 21,200 m^3 (750,000 ft^3) of medium-Btu gas was produced from 837 Mg (992 tons) of raw North Dakota lignite

Coal Gasification Plant Proposed for Indiana—DOE has received an unsolicited proposal from Wheelabrator-Frye for the construction of a medium-Btu coal gasification plant The plant, which would be operational within 4 years, would produce gas for use in steel mills in the Gary, Indiana, area The cost of the $100 million project is to be split evenly among federal and industrial participants, including National Steel Co and Northern Indiana Public Service Co

Japan Plans Coal Liquefaction Plant in Australia—Japan's Elec tric Power Development Company (EPDC) is considering the construction of a coal liquefaction plant in New South Wales, Australia, through a technology sharing agreement with the New South Wales Electricity Commission (NSWEC) The NSWEC would share its expertise in handling power plant fly ash in return for EPDC's coal liquefaction technology The Japanese company could economize by shipping the liquefied fuel product instead of hugh quantities of raw coal EPDC is a government funded bulk power supplier in Japan

Coal Liquefaction Pilot Plant Gets New Construction Management—Badger Plants, Inc (Cambridge, Mass) has assumed the role of construction manager for an H-Coal liquefaction unit currently being built at Catlettsburg, Ky for DOE Badger Plants has been a major subcontractor on the project, which aims to produce 320 m^3/day (2,000 bbl/day) of liquids from 6 30 kg/s (600 tons/day) of coal

DOE Awards SRC Contracts—DOE has awarded contracts for the preliminary design of full scale commercial solvent refined coal (SRC) plants to Gulf Oil's Pittsburgh and Midway Coal Mining Company (Denver) and Southern Company's Southern Services (Atlanta) The designs will be used by DOE in selecting an SRC technology for demonstration Gulf has developed the slurry recycle liquefaction, or SRC II process Southern Company favors use of the SRC solids process

If construction of the plants is authorized by DOE, Gulf plans to build its facilities near Morgantown, West Virginia Consolidated Na tural Gas is considering the purchase of the expected 14 7 m^3/s (45 million ft^3/day) of by-product methane produced at the plant Southern Services would construct its plant near Owensboro, Kentucky, on property provided by the state

New Process Converts Coal to Liquid Hydrocarbons—A new method for converting coal to liquid hydrocarbons has been developed at the Naval Research Laboratory in Washington, D C The new conversion method, a two-step process, employs milder reaction conditions than conventional techniques First, vulnerable sites in the coal are oxidized to oxygenated compounds This reaction occurs readily at temperatures below 450 K (350°F) and at a pressure of 0 1 MPa (1 atm) In the second step, thermolysis is used to rupture molecules at the oxidation sites For molecules of low molecular weight, this second reaction occurs at 0 7-2 1 MPa (100-300 psi) and 670 K (750°F) Molecular weights of the liquid hydrocarbons produced range between 90 and 210, with yields of up to 35 percent Conventional processes for converting coal to liquids usually require the addition of hydrogen or steam, or removal of some carbon, these processes usually operate at temperatures above 700 K (800°F) and at pressures of up to 14 MPa (2,000 psi)

PROJECT TITLES, CONTRACTORS, AND EPA PROJECT OFFICERS IN EPA'S FUEL PROCESS BRANCH ASSESSMENT PROGRAM

Project Title	Contractor	EPA Project Officer
Environmental Assessment of Low/Medium-Btu Gasification (March 1976-March 1979)	Radian Corporation 8500 Shoal Creek Blvd Austin, TX 78766 (512) 454-4797 (Gordon C Page)	William J Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Environmental Assessment of High-Btu Gasification (April 1977-April 1980)	TRW, Inc 1 Space Park Redondo Beach, CA 90278 (213) 536-4105 (Chuck Murray)	William J Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Environmental Assessment of Coal Liquefaction (August 1976-August 1979)	Hittman Associates 9190 Red Branch Road Columbia, MD 21043 (301) 730-7800 (Wayne Morris)	William J Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Control Technology For Products/By-Products (September 1976-September 1979)	Catalytic Inc 1500 Market Street Center Square West Philadelphia, PA 19102 (215) 864-8104 (A B Cherry)	William J Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Control Technology For Converter Output (January 1977-January 1980)	Hydrocarbon Research, Inc P O Box 6047 134 Franklin Corner Road Lawrence Township, NJ 08648 (609) 896-1300 (John Kunesh)	William J Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Waste Stream Disposal and Utilization (April 1977 April 1980)	Pullman Kellogg Research and Development Center 16200 Park Row Industrial Park Terrace Houston, TX 77054 (713) 493-0291 (Louis Bostwick)	William J Rhodes IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Acid Gas Cleaning Bench Scale Unit (October 1976-September 1981) (Grant)	North Carolina State Univ Department of Chemical Engineering Raleigh, NC 27607 (919) 737-2324 (James Ferrell)	N Dean Smith IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Water Treating Bench Scale Unit (November 1976-October 1981) (Grant)	Univ of North Carolina Department of Environmental Sciences and Engineering School of Public Health Chapel Hill, NC 27514 (919) 966-1052 (Phillip Singer)	N Dean Smith IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851
Pollutant Identification From a Bench Scale Unit (November 1976-October 1981) (Grant)	Research Triangle Institute P O Box 12194 Research Triangle Park, NC 27709 (919) 541-6000 (Forest Mixon)	N Dean Smith IERL-RTP Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-2851

REPORT SUMMARY

Environmental Assessment Data Base For High-Btu Gasification Technology

by

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TRW, Inc.

As part of its EPA sponsored program for the environmental assessment of high-Btu gasification, TRW recently completed a three-volume document entitled "Environmental Assessment Data Base for High-Btu Gasification" (EPA-600/7-78-186a, 186b, and 186c, September 1978) The document summarizes and analyzes existing environmental assessment data and identifies data gaps

Information sources included published and unpublished EPA documents, open literature, process developers, EPA and DOE contractors, and authorities in industry and academic institutions Based on a preliminary review of the collected data, a number of gasification and related processes likely to be employed in commercial substitute natural gas facilities were selected and analyzed in more detail

To permit a systematic data analysis, the high-Btu gasification technology was divided into four "operations" coal preparation, coal gasification, gas purification, and gas upgrading Auxiliary processes for pollution control were grouped into air pollution control processes, water pollution control processes, and solid waste management processes The operations and auxiliary processes were further subdivided into process modules, consisting of nearly interchangeable processes or processes applicable to different operating conditions and input requirements For example, the process modules included in air pollution control are sulfur recovery, tail gas treatment, SO_2 control and/or recovery, incineration, CO, hydrocarbon and odor control, particulate control, gas compression and recycling, and NO_x control

For each process in a module, a data sheet was prepared presenting key information The data sheets allowed comparison between alternate processes in a given module and revealed significant data gaps Data sheets were prepared for 11 gasification processes, 22 gas purification processes, 4 gas upgrading processes, 18 air pollution control processes, 17 water pollution control processes, and 3 solid waste disposal processes

To ensure completeness and accuracy, the process data sheets were reviewed by process developers/licensors and, in some cases, technical experts in EPA laboratories or program offices Responses were received on 25 of the 39 data sheets sent out for review

As part of the data analysis, the various processes in a module were compared from the standpoint of developmental status, suitability for use in SNG facilities, process principles, raw material and utility requirements, costs (where available), process efficiency and reliability, discharge stream characteristics, and other advantages and disadvantages The coal gasification, gas purification, gas upgrading, and pollution control processes considered promising were then examined from the standpoint of their integration into a commercial SNG production facility Gaps and limitations of the available data were summarized Only those unit operations and waste streams judged specific to high-Btu gasification and related operations were addressed Operations such as coal storage, cleaning, and drying, on-site power generation, oxygen production, and raw water and sanitary waste treatment were not considered

The limitations and gaps of the available data fall into two categories (1) total non-existence or unavailability of the data, and (2) available data which lack comprehensiveness or have been obtained under conditions significantly different than those anticipated in an integrated commercial SNG plant in the U S Examples of the gaps in the first category are (1) the lack of detailed information about emissions from decommissioning spent methanation catalysts, (2) the lack of data on combined effluents, and (3) the lack of data on sludges from treatment of combined effluents or from treatment of tar and oily condensates Since no integrated SNG facility currently exists, these types of data are not available from actual operation Even though environmental characteristics of SNG plant wastes can be estimated through engineering studies, only a limited number of such studies have been conducted to date In the case of emissions from catalyst decommissioning, even though some data might exist, such data are proprietary and not publicly available

Examples of the second category of data gaps and limitations are (1) the lack of trace element and organics composition of waste streams, (2) the lack of toxicological and ecological data for waste streams, and (3) the lack of data on the performance of control systems in SNG service In comparison with the very limited amount of data which are available on most gasification processes, considerable data are available on the characteristics of aqueous wastes from the HYGAS and dry ash Lurgi processes These data, however, do not include organic and trace element constituents, bioassay information, and waste treatability Aqueous waste data on hazardous characteristics such as biodegradability, health effects, and potential for bioaccumulation and environmental persistence are also lacking For the Stretford process, limited commercial experience exists with acid gases containing high levels of CO_2 which would be encountered in a SNG plant With the exception of a few pollution control processes (e g , flaring for hydrocarbon and H_2S control, and venturi scrubbing for particulate removal), the various air, water, and solid waste control processes which would be potentially employed at commercial facilities have not been used in coal gasification applications Even for the few processes which have been used for coal gasification, very little data are available on the characteristics of the treated streams and on the performance and costs of these applications

Data gaps in the first category can be partially filled through engineering analysis Since integrated SNG facilities do not exist and the existing pilot plants do not incorporate all the units or design features of a large scale facility, not all of these data can be supplied Many of the gaps in the second category, however, can and should be filled Approaches to be used here include multimedia environmental sampling and analysis of the process/discharge streams at pilot plants and foreign gasification facilities, bench-scale studies, and engineering analysis Some of the unit operations and conditions in the gasification pilot plants are not representative of commercial facilities However, in the absence of such commercial facilities, sampling at the pilot plants represents the best and the only means of acquiring meaningful data on process and waste stream characteristics Such sampling and analysis programs, coupled with related engineering studies and bench-scale testing, can provide valuable and timely input to the evolution of the SNG industry These programs would ensure that (1) environmental considerations are included in the selection of processes, equipment, and waste management options for commercial SNG plants and (2) the drafting of New Source Performance Standards for SNG facilities is based on sound technical and engineering data Several programs are currently underway or planned which involve testing and sampling at pilot

plants, bench scale units, or foreign commercial facilities

Major programs which are expected to generate some of the data needed for high-Btu gasification environmental assessment fall into three categories EPA-sponsored programs, DOE sponsored programs, and privately funded programs Very limited data are available on the privately funded programs Of the EPA programs, the one most directly related to high-Btu gasification is the TRW environmental assessment effort The data base document is the first step in the environmental assessment effort DOE synthetic fuel pilot and demonstration programs include sampling and analysis at various facilities, bench-scale studies for process and environmental data acquisition, and related environmental engineering studies

The preparation of the data base document completes the first phase of the TRW program The second phase of the program, which is already underway, includes the acquisition of data through sampling and analysis of process and waste streams at selected gasification facilities As part of this latter effort, TRW has contacted DOE and private process developers in the U S as well as commercial facilities overseas Initial steps have been taken to develop test programs for selected facilities

MEETING CALENDAR

Environmental Aspects of Fuel Conversion Technology

The Fourth Symposium on "Environmental Aspects of Fuel Conversion Technology " will be held April 17-20, 1979 at the Diplomat Hotel, Hollywood, Florida The purpose of the symposium, sponsored by IERL-RTP, is to discuss environmentally related information on coal gasification and liquefaction More than 300 participants, including process developers, process users, environmental groups, and research scientists, are expected to attend the 4-day symposium General Chairman of the meeting will be William J Rhodes, EPA Program Manager, Synthetic Fuels

The meeting will address multimedia considerations, and presentations will include the results achieved from research and field studies performed at the laboratory, bench, and full scale Background presentations will include IERL-RTP program status and assessment methodology Major emphasis in succeeding sessions will be on presentation of data and evaluation of results obtained from ongoing test programs at gasification and liquefaction sites, as well as evaluations of environmental control technology

Invitations and program announcements will be sent to all addressees who are receiving the "Environmental Review of Synthetic Fuels " There will be a registration fee for the Fourth Symposium on "Environmental Aspects of Fuel Conversion Technology" which includes a copy of preprints of the symposium papers Franklin A Ayer, Research Triangle Institute, P O Box 12194, Research Triangle Park, NC 27709, (919) 541 6260, will again serve as Symposium Coordinator

Third National Conference and Exhibition on Technology for Energy Conservation, January 22-26, 1979, Tuscon, Arizona Contact Bobbie D Zucker, Information Transfer, Inc , 1160 Rockville Pike, Suite 202, Rockville, Maryland 20852

Sixth Energy Technology Conference and Exposition, February 26-28, 1979, Washington, D C Contact Martin Heavner, Government Institutes, Inc , 2733 Bethesda Avenue, Bethesda, Maryland, 20014

Pacific Chemical Conference 1979 38th National Meeting of Chemical Society of Japan and 177th National Meeting of American Chemical Society, April 1-6, 1979, Honolulu, Hawaii Contact A T Winstead, American Chemical Society, 1155 16th Street, NW, Washington, D C , 20036

Tenth Biennial Lignite Symposium, May 1979 (dates not known), Grand Forks, North Dakota Contact Gordon H Gronhovd, Grand Forks Energy Technology Center, P O Box 8213, University Station, Grand Forks, North Dakota, 58202

Sixth National Conference on Energy and the Environment, May 21-24, 1979, Pittsburgh, Pennsylvania Contact Duane G Nichols, Research Triangle Institute, P O Box 12194, Research Triangle Park, North Carolina, 27709

RECENT MAJOR MEETINGS

Fifth Annual International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity

The Fifth Annual International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity was held August 1-3, 1978, in Pittsburgh, Pennsylvania The primary objective of the conference was to review the status of coal conversion technologies The conference was sponsored by the University of Pittsburgh and covered the following topics

- The Status of Flue Gas Desulfurization (FGD)
- Fluidized Bed Combustion (FBC)
- Industrial Fuel Gas
- Commercial Gasifiers
- Demonstration Plants
- Emerging Technologies
- Liquefaction
- Gasification Processes
- Gas Cleanup Systems

Session 1 covered the status of FGD Papers were presented on present and future air regulations, the status of throwaway FGD technology, and the status of SO_x and NO_x regenerable control processes Other papers described the development programs for two SO_x and NO_x removal processes—the Shell Flue Gas Treating Process and the Aqueous Carbonate Process

The topic of Session 2 was fluidized bed combustion (FBC) of coal and industrial fuel gas Papers presented described the state of FBC technology, atmospheric FBC of low quality coals, and the

design of FBC systems to meet environmental standards Carter Oil Company and Memphis Light and Gas Division summarized the status of their respective programs to build and operate commercial scale coal gasification plants These plants would produce a medium-Btu gas for industrial users in the Houston, Texas and Memphis, Tennessee, areas Caterpillar Tractor Company discussed their program for converting their U S plants from natural gas to other fuels (fuel oil coal coal gas) and other sources of energy (electricity) In addition, Koppers Company discussed the feasibility of mixing medium-Btu coal gas with natural gas in existing pipeline systems

Sessions 3 and 4 covered commercial gasifier and demonstration plants Wilputte Corporation gave an operating overview of the 12 small industrial gasifiers at the Holston Army Ammunition plant, Kingsport, Tennessee DOE summarized operating experience and economics for its first two industrial gasifier demonstration plants Papers were presented covering the status of the following programs

- American Natural Gas—Lurgi coal gasification program
- Cogas demonstration program
- HYGAS demonstration program
- SAARBERG-OTTO gasifier program
- Slagging Lurgi demonstration program
- Powerton combined cycle test program
- Steam-iron pilot plant program
- Synthane program
- Westinghouse coal gasification system program

In addition TVA discussed their ammonia-from-coal project and economics on the production of ammonia from coal

Papers describing emerging technologies were also presented during Session 4 These papers included descriptions of the Rocketdyne Gasifier-Flash Pyrolysis program, the Exxon Catalytic gasifier, screw feeding and spraying, and high mass flux gasifiers

Sessions 5 and 6 included simultaneous sessions on coal liquefaction and coal gasification In the liquefaction area, status reports covered a variety of topics, including the SRC II process, the Cresap test facility in West Virginia, and Mobil's methanol to gasoline process A number of papers were also presented covering the technological and economic aspects of commercial coal liquefaction

In the area of coal gasification, status reports summarized the KilnGas coal gasification project and peat gasification Several papers discussed the economics and application of coal gasification Coal gasification product gas cleanup was covered by two papers one on high temperature electrostatic precipitators, the other on the Stretford process for H_2S removal

RECENT MAJOR PAPERS AND PUBLICATIONS

Gasification Technology

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