DOE/PC/89664-T1

FINAL

TECHNICAL PROGRESS REPORT

For the period:

January 1, 1995, through March 31, 1995

Prepared for:

Rosebud SynCoal Partnership
Advanced Coal Conversion Process Demonstration
Colstrip, Montana

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Prepared by:

Rosebud SynCoal Partnership
Billings, Montana

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Table of Contents

1.0 INTRODUCTION AND PURPOSE

This report describes the technical progress made on the Advanced Coal Conversion Process (ACCP) Demonstration Project from January 1, 1995, through March 31, 1995. The ACCP Demonstration Project is a U.S. Department of Energy (DOE) Clean Coal Technology Project. The Cooperative Agreement defining this project is between DOE and the Rosebud SynCoal Partnership. In brief, Western Energy Company, which is a coal mining subsidiary of Entech, Inc., Montana Power Company's (MPC's) non-utility group in Colstrip, Montana, was the original proposer for the ACCP Demonstration Project and Cooperative Agreement participant. To further develop the ACCP technology, Entech created Western SynCoal Company. After the formation of the Rosebud SynCoal Partnership, Western Energy Company formally novated the Cooperative Agreement to the Rosebud SynCoal Partnership to facilitate continued participation in the Cooperative Agreement. The Rosebud SynCoal Partnership is a partnership between Western SynCoal Company and Scoria, Inc., a subsidiary of NRG Energy, Inc., Northern States Power's non-utility group.

This project demonstrates an advanced, thermal, coal upgrading process, coupled with physical cleaning techniques, that is designed to upgrade high-moisture, low-rank coals to a high-quality, low-sulfur fuel, registered as the SynCoal® process. The coal is processed through three stages (two heating stages followed by an inert cooling stage) of vibrating fluidized bed reactors that remove chemically bound water, carboxyl groups, and volatile sulfur compounds. After drying, the coal is put through a deep-bed stratifier cleaning process to separate the pyrite-rich ash from the coal.

The SynCoal® process enhances low-rank, western coals, usually with a moisture content of 25 to 55 percent, sulfur content of 0.5 to 1.5 percent, and heating value of 5,500 to 9,000 British thermal units per pound (Btu/lb), by producing a stable, upgraded, coal product with a moisture content as low as 1 percent, sulfur content as low as 0.3 percent, and heating value up to 12,000 Btu/lb.

The 45-ton-per-hour unit is located adjacent to a unit train loadout facility at Western Energy Company's Rosebud coal mine near Colstrip, Montana. The demonstration plant is sized at about one-tenth the projected throughput of a multiple processing train commercial facility.

2.0 PROJECT PROGRESS

2.1 SIGNIFICANT ACCOMPLISHMENTS

Rosebud SynCoal Partnership's ACCP Demonstration Facility entered Phase III, Demonstration Operation, in April 1992 and operated in an extended startup mode through August 10, 1993, when the facility became commercial. The Rosebud SynCoal Partnership instituted an aggressive program to overcome startup obstacles and now focuses on supplying product coal to customers. Significant accomplishments in the history of the SynCoal® process development are shown in Appendix A. Table 2.1 lists the significant accomplishments for the year to date.

Table 2.1. Significant Accomplishments for First Quarter, 1995

Period	Significant Accomplishments
January 1995	• Conducted testburns with an additional industrial user • Tentatively scheduled two additional testburns during February • Re-established deliveries to Continental Lime in Townsend, Montana; however these deliveries were suspended after 13 days
February 1995	• Continued testburn with an industrial user • Supplied a short test at a small utility plant • Tentatively scheduled two additional testburns during March
March 1995	• Supported a testburn with an industrial user • Supplied a short test at a small heat plant • Record monthly sales volume of 28,548 tons or 118 percent of original design performa

2.2 PROJECT PROGRESS SUMMARY

During this reporting period, the primary focus for the ACCP Demonstration Project was to expand SynCoal® market awareness and acceptability for both the products and the technology. The ACCP Project team continued to focus on improving the operation, developing commercial markets, and improving the SynCoal® products. The use of covered hopper cars has been successful and marketing efforts have focused on using this technique. Operational improvements are currently aimed at developing fines marketing systems, increasing throughput capacity, decreasing operating costs, and developing standardized continuous operator training programs.

The inert gas system which was installed in 1994, continues to display operational problems which are being addressed, including rebuilding the compressor. Some observations indicate that the inert gas is not working as well as the CO_2 previously used. Testing is ongoing to determine the maximum effectiveness of the inert gas.

The main process heat exchanger has not been operating at full efficiency and will be replaced during the next scheduled outage

Engineering design and cost estimates are underway for construction of a truck loadout for the SynCoal® product at the ACCP plant.

Testing has begun for ground stabiliziation of SynCoal® for an industrial customer to blend with their bagged mineral product.

During this reporting period, the plant processed approximately 112,725 tons of raw coal, and the facility's operating availability increased to about 77 percent. The raw coal feed increased to 68.8 tons per hour for the quarter and the plant achieved a 102% feed capacity factor. Totally to date, about 670,360 tons of raw coal have been fed to the process. For the first quarter of 1995, about 112,725 tons of raw coal have been fed to the process, producing about 57,756 tons of course product and 12,401 tons of fines. Approximately 337,762 tons have been shipped to date with 68,223 tons being shipped in 1995.

Modifications and maintenance work required the following actions during the First Quarter of 1995.

- Replaced burned explosion door on 2nd stage cyclone
- Replace screen cloth on screens for enhanced infeed system screening effiiency
- Repair fan motor on first stage of dryer
- Fan bearings on K-26 were replaced
- Corrected natural gas supplier pressure problems and plugged regulator
- Repair an original expansion joint on first stage duct
- Begin construction of tipple dust collection and loadout
- Install and commission product sampler on belt C-9-08
- Repair dryer bed cracks

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint. The typical product analyses are shown Section 4 of this report.

During the next reporting period, the focus will continue on operating the ACCP Demonstration plant to support testing and market development; serving nearby end users of the SynCoal® product and establishing more industrial customers; scheduling additional testburns and securing additional industrial contracts; continuing regular truck deliveries of SynCoal® fines to Ash Grove Cement to allow alternative testing with their railroad cars; securing additional covered hopper cars to accelerate testing and market/distribution developments; and conducting followup testburns.

3.0 PROCESS DESCRIPTION

In general, the ACCP is a thermal conversion process that uses combustion products and superheated steam as fluidizing gas in vibrating fluidized bed reactors. Two fluidized stages are used to thermally and chemically alter the coal, and one water spray stage followed by one fluidized stage is used to cool the coal. Other systems that service and assist the coal conversion system include:

- Coal Conversion;
- Coal Cleaning;
- Product Handling;
- Raw Coal Handling;
- Emission Control;
- Heat Plant;
- Heat Rejection; and
- Utility and Ancillary.

3.1 ORIGINAL DESIGN PROCESS DESCRIPTION

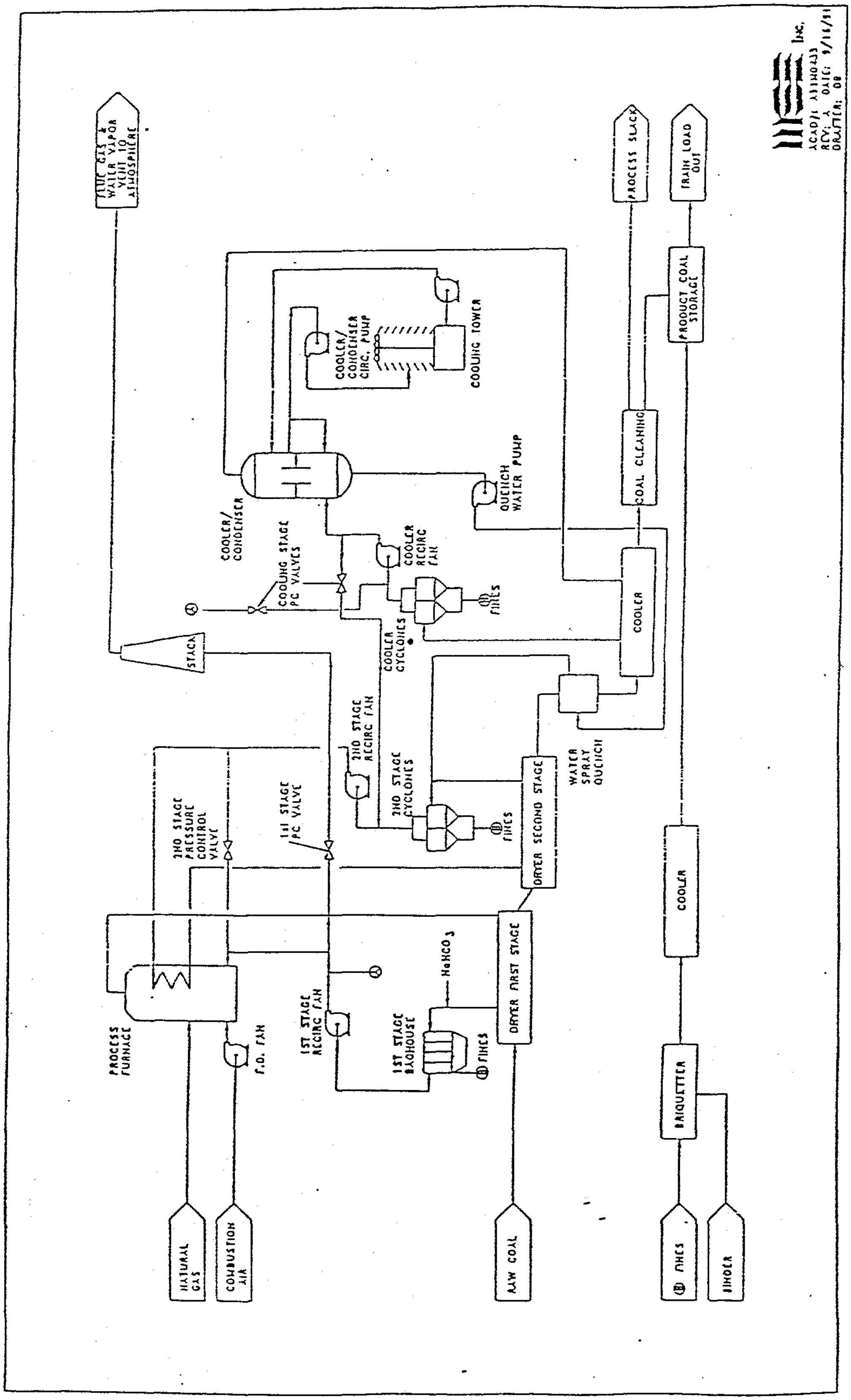
The designed central processes are depicted in Figure 3.1 on the proceeding page. The following discusses plant design aspects and expected results. Modifications and operating results are summarized in Section 3.2.

Coal Conversion

The coal conversion is performed in two parallel processing trains. Each train consists of two, 5-feet-wide by 30-feet-long vibratory fluidized bed thermal reactors in series, followed by a water spray section, and a 5-feet-wide by 25-feet-long vibratory cooler. Each processing train is fed up to 1,139 pounds per minute of 2-by-½ inch coal.

In the first-stage dryer/reactors, the coal is heated by direct contact with hot combustion gases mixed with recirculated dryer makegas, removing primarily surface water from the coal. The coal exits the first-stage dryer/reactors at a temperature slightly above that required to evaporate water. After the coal exits the first-stage dryer/reactor, it is gravity fed to the second-stage thermal reactors, which further heats the coal using a recirculating gas stream, removing water trapped in the pore structure of the coal and promoting chemical dehydration, decarbonylation, and decarboxylation. The water, which makes up the superheated steam used in the second stage, is actually produced from the coal itself. Particle shrinkage that occurs in the second stage liberates ash minerals and passes on a unique cleaning characteristic to the coal.

Figure 3.1



NATURAL GAS
COMBUSTION AIR
RAW COAL
BRIQUETTER
COOLER
DRYER FIRST STAGE
DRYER SECOND STAGE
PROCESS FURNACE
F.D. FAN
1ST STAGE BAGHOUSE
1ST STAGE RECIRC FAN
2ND STAGE RECIRC FAN
2ND STAGE CYCLONES
WATER SPRAY QUENCH
STACK
COOLER CYCLONES
COOLER RECIRC FAN
COOLING STAGE PC VALVES
COOLER/CONDENSER
QUENCH WATER PUMP
COOLING TOWER
COAL CLEANING
PRODUCT COAL STORAGE
PROCESS STACK
TRAIN LOAD OUT

As the coal exits the second-stage thermal reactors, it falls through vertical quench coolers where process water is sprayed onto the coal to reduce the temperature. The water vaporized during this operation is drawn back into the second-stage thermal reactors. After water quenching, the coal enters the vibratory coolers where the coal is contacted by cool inert gas. The coal exits the vibratory cooler(s) at less than 150°F and enters the coal cleaning system. The gas that exits the vibratory coolers is dedusted in a twin cyclone and cooled by water sprays in direct contact coolers before returning to the vibratory coolers. Particulates are removed from the first-stage process gas by a pair of baghouses in parallel. The second-stage process gas is treated by a quad cyclone arrangement, and the cooler-stage process gas is treated by a twin cyclone arrangement.

Three interrelated recirculating gas streams are used in the coal conversion system; one each for the thermal reactor stages and one for the vibratory coolers.

Gases enter the process from either the natural gas-fired process furnace or from the coal itself. Combustion gases from the furnace are mixed with recirculated makegas in the first-stage dryer/reactors after indirectly exchanging some heat to the second-stage gas stream. The second-stage gas stream is composed mainly of superheated steam, which is heated by the furnace combustion gases in the heat exchanger. The cooler gas stream is made up of cooled furnace combustion gases that have been routed through the cooler loop.

A gas route is available from the cooler gas loop to the second-stage thermal reactor loop to allow system inerting. Gas may also enter the first-stage dryer/reactor loop from the second-stage loop (termed makegas) but without directly entering the first-stage dryer/reactor loop; rather, the makegas is used as an additional fuel source in the process furnace. The second-stage makegas contains various hydrocarbon gases that result from the thermal conversions associated with the mile pyrolysis and devolatilization The final gas route follows the exhaust stream from the first-stage loop to the atmosphere.

Gas exchange from one loop to another is governed by pressure control on each loop, and after startup, will be minimal from the first-stage loop to the cooler loop and from the cooler loop to the second-stage loop. Gas exchange from the second-stage loop to first-stage loop (through the process furnace) may be substantial since the water vapor and hydrocarbons driven from the coal in the second-stage thermal reactors must leave the loop to maintain a steady state.

In each gas loop, particulate collection devices that remove dust from the gas streams protect the fans and, in the case of the first-stage baghouses, prevent any fugitive particulate discharge. Particulates are removed from the first-stage process gas by a pair of baghouses in parallel. The second-stage process gas is treated by a quad cyclone arrangement, and the cooler-stage process gas is treated by a twin cyclone arrangement.

Coal Cleaning

The coal entering the cleaning system is screened into four size fractions: plus ½ inch, ½ by ¼ inch, ¼ inch by 8 mesh, and minus 8 mesh. These streams are fed in parallel to four, deep-bed stratifiers (stoners) where a rough specific gravity separation is made using fluidizing air and a vibratory conveying action. The light streams from the stoners are sent to the product conveyor, and the heavy streams from all but the minus 8 mesh stream are sent to fluidized bed separators. The heavy fraction of the minus 8 mesh stream goes directly to the waste conveyor. The fluidized bed separators, again using air and vibration to effect a gravity separation, each split the coal into light and heavy fractions. The light stream is considered product, and the heavy or waste stream is sent to a 300-ton, storage bin to await transport to an off-site user or alternately back to a mined out pit disposal site. The converted, cooled, and cleaned SynCoal® product from coal cleaning enters the product handling system.

Product Handling

Product handling consists of the equipment necessary to convey the clean, granular SynCoal® product into two, 6,000-ton, concrete silos and to allow train loading with the existing loadout system. Additionally, the SynCoal® fines collected in the various stage particulate collection systems are combined, cooled, and transferred to a 300-ton storage silo designed for truck loadout to make an alternative product.

Raw Coal Handling

Raw coal from the existing stockpile is screened to provide $1^1/_2$ by-$^3/_8$ inch feed for the ACCP process. Coal rejected by the screening operation is conveyed back to the active stockpile. Properly sized coal is conveyed to a 1000-ton, raw coal, storage bin which feeds the process facility.

Emission Control

Sulfur dioxide emission control philosophy is based on injecting dry sorbents into the ductwork to minimize the release of sulfur dioxide to the atmosphere. Sorbents, such as trona or sodium bicarbonate, are injected into the first-stage gas stream as it leaves the first-stage dryer/reactors to maximize the potential for sulfur dioxide removal while minimizing reagent usage. The sorbents, having reacted with sulfur dioxide, are removed from the gas streams in the particulate removal systems. A 60-percent reduction in sulfur dioxide emissions should be realized.

The coal cleaning area fugitive dust is controlled by placing hoods over the sources of fugitive dust conveying the dust laden air to fabric filter(s). The bag filters can remove 99.99 percent of the coal dust from the air before discharge. All SynCoal® fines will report to the fines handling system and ultimately the SynCoal® fines stream.

Heat Plant

The heat required to process the coal is provided by a natural gas-fired process furnace, which uses process makegas from the second-stage coal conversion as a supplemental fuel. This system is sized to provide a heat release rate of 74 MM Btu/hr. Process gas enters the furnace and is heated by radiation and convection from the burning fuel.

Heat Rejection

Most heat rejection from the ACCP is accomplished by releasing water and flue gas into the atmosphere through an exhaust stack. The stack design allows for vapor release at an elevation great enough that, when coupled with the vertical velocity resulting from a forced draft fan, dissipation of the gases will be maximized. Heat removed from the coal in the coolers is rejected using an atmospheric-induced, draft cooling tower.

Utility and Ancillary Systems

The coal fines that are collected in the conversion, cleaning, and material handling systems are gathered and conveyed to a surge bin. The coal fines are then agglomerated and returned to the product stream.

Inert gas is drawn off the cooler loop for other uses. This gas, primarily nitrogen and carbon dioxide, is used for other baghouse pulse. The makeup gas to the cooler loop is combustion flue gas from the stack. The cooling system effectively dehumidifies and cools the stack gas making the inert gas for the system. The cooler gas still has a relatively high dew point (about 90°F). Due to the thermal load this puts on the cooling system, no additional inert gas requirements can be met by this approach.

The common facilities for the ACCP Demonstration include a plant and instrument air system, a fire protection system, and a fuel gas distribution system.

The power distribution system includes a 15 kV service; a 15 kV/5 kV transformer; a 5 kV motor control center; two, 5 kV/480 V transformers; a 480 V load distribution center; and a 480 V motor control center.

The process is semi-automated, including dual control stations, dual programmable logic controllers, and distributed plant control and data acquisition hardware. Operator interface is necessary to set basic system parameters, and the control system adjusts to changes in the process measurements.

3.1.1 ORIGINAL EQUIPMENT

The originally designed and installed major equipment for the ACCP Demonstration Facility is shown in Table 3.1 on the following page.

Table 3.1. Advanced Coal Conversion Process Major Plant Equipment - As Constructed

System Description	Equipment Vendor	Type
Thermal Coal Reactors/Coolers	Carrier Vibrating Equipment, Inc.	PE
Belt Conveyors	Willis & Paul Group	MH
Bucket Elevators	FMC Corporation	MH
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC
Coal Screens	Hewitt Robbins Corporation	MH
Loading Spouts	Midwest International	MH
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH
Silo Mass Flow Gates	SEI Engineers, Inc.	MH
Vibrating Bin Dischargers	Carman Industries, Inc.	MH
Vibrating Feeder	Kinergy Corporation	MH
Drag Conveyor	Dynamet	DH
Process Gas Heater	G.C. Broach Company	PE
Direct Contact Cooler	CMI-Schneible Company	PE
Particulate Removal System	Air-Cure Howden	EC
Dust Collectors	Air Cure Environmental, Inc.	EC
Air Compressors/Dryers	Colorado Compressor, Inc.	CF
Diesel Fire Pumps	Peerless Pump Company	CF
Forced Draft Fans	Buffalo Forge Company	PE
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE
Electrical Equipment-4160	Toshiba/Houston International Corporation	CF
Electrical Equipment-LDC	Powell Electric Manufacturing Company	CF
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF
Main Transformer	ABB Power T&D Company	CF
Control Panels	Utility Control & Equipment Corporation	CF
Control Valves	Applied Control Equipment	CF
Plant Control System	General Electric Supply Company	CF
Cooling Tower	The Marley Cooling Tower Company	PE
Dampers	Effox, Inc.	PE
Dry Sorbent Injec. System	Natech Resources, Inc.	EC
Expansion Joints	Flexonics, Inc.	PE
MH - Materials Handling PE - Process Equipment EC - Emissions Control CF - Common Facilities CC - Coal Cleaning DH - Dust Handling		

3.2 AS-BUILT PROCESS DESCRIPTION

The ACCP facility has been modified as necessary during start-up and operation of the ACCP Demonstration Project. Equipment has been improved; additional equipment installed; and new systems designed, installed, and operated to improve the overall plant performance. Those adjustments are listed below and on the following pages.

Coal Conversion System

In 1992, several modifications were made to the vibratory fluidized bed reactors and processing trains to improve plant performance. An internal process gas bypass was eliminated, and the seams were welded out to reduce system leaks. Also, the reactor bed deck holes were bored out in both the first-stage dryer/reactor and the vibratory coolers to increase process gas flow.

The originally designed, two-train, fines conveying system could not keep up with the fines production. To operate closer to design conditions on the thermal coal reactors and coolers, obtain tighter control over operating conditions, and minimize product dustiness, the ACCP plant was converted to single train operation to reduce the overall fines loading prior to modifying the fines handling system during the outage of the summer 1993. One of the two process trains was removed from service by physically welding plates inside all common ducts at the point of divergence between the two process trains. This forced process gases to flow only through the one open operating process train.

In addition to the process train removal, the processed fines conveying equipment was simultaneously modified to reduce required throughput on drag conveyors. This was accomplished by adding a first-stage screw conveyor and straightening and shortening the tubular drag conveyors.

The ACCP design included a briquetter for agglomeration of the process fines. However, initial shakedown of the plant required the briquetting system be completely operational. Since the briquetting operation was delayed to focus on successfully operating the plant, the process design changes included fines disposal by slurrying them to an existing pit in the mine. During 1992, a temporary fines slurry disposal system was installed. The redesigned process fines conveying and handling system was commissioned. Design of a replacement fines conveying system is now complete and delivering to a truck loadout slurry or briquetter.

The main rotary airlocks were required to shear the pyrite and "bone" or rock that is interspersed with the coal; however, the design of the rotary airlocks was insufficient to convey this non-coal material. Therefore, the drive motors were retrofitted from 2 to 5 horse power for all eight process rotary airlocks. Also, an electrical current sensing circuit that reverses the rotary lock rotation was designed, tested, and applied to the rotary airlocks. This circuitry is able to sense a rotor stall and reverse the motor to clear the obstruction before tripping the motor circuit breaker.

The original plant startup tests also revealed explosion vent discrepancies in all areas, thus preventing extended operation of the plant. The design development for the vents was a cooperative effort between an explosion vent manufacturing company and the ACCP personnel and resulted in a unique explosion vent sealing system which was completed during 1993. The new explosion vent design was implemented during 1993 and has been performing well since.

Coal Cleaning

The coal entering the cleaning system is screened into four size fractions: plus ½ inch, ½ by ¼ inch, ¼ inch by 8 mesh, and minus 8 mesh. These streams are fed in parallel to four, deep-bed stratifiers (stoners) where a rough, specific, gravity separation is made using fluidizing air and a vibratory conveying action. The light streams from the stoners are sent to the product conveyor, and the heavy streams from all but the minus 8 mesh stream are sent to fluidized bed separators. The heavy fraction of the minus 8 mesh stream goes directly to the waste conveyor. The fluidized bed separators, again using air and vibration to effect a gravity separation, each split the coal into light and heavy fractions. The light stream is considered product, and the heavy or waste stream is sent to a 300-ton, storage bin to await transport back to the mined out pit disposal site. The dried, cooled, and cleaned product from coal cleaning enters the product handling system. Modifications were made in 1992 that allows product to be sent to the waste bin with minimal reconfiguration.

Product Handling

Work is continuing on testing and evaluating technologies to enhance product stabilization and reduce fugitive dustiness. During 1992, a liquid carbon dioxide storage and vaporization system was installed for testing product stability and providing inert gas for storage and plant startup/shutdown. During the Fourth Quarter of 1994, an additional inert gas system was installed.

The clean product coal is conveyed into two, 5,000-ton capacity, concrete silos which allow train loading with the existing loadout system. This capacity is due to the relatively low SynCoal® density.

During the first quarter of 1995 an automatic sampler was installed on belt C-9-8 to obtain representative daily production samples.

Raw Coal Handling

Raw coal from the existing stockpile is screened to provide 1¼-by-½ inch feed for the ACCP process. Coal rejected by the screening operation is conveyed back to the active stockpile. Properly sized coal is conveyed to a 1,000-ton, raw coal, storage bin which feeds the process facility.

Emission Control

It was originally assumed that sulfur dioxide emissions would have to be controlled by injecting chemical sorbents into the ductwork. Preliminary data indicated that the addition of chemical injection sorbent would not be necessary to control sulfur dioxide emissions under the operating conditions. A mass spectrometer was installed to monitor emissions and process chemistry; however, the injection system is in place should a higher sulfur coal be processed or if process modifications are made and sulfur dioxide emissions need to be reduced.

The coal-cleaning area's fugitive dust is controlled by placing hoods over the fugitive dust sources conveying the dust laden air to fabric filter(s). The bag filters appear to be effectively removing coal dust from the air before discharge. The Department of Health and Environmental Sciences completed stack tests on the east and west baghouse outlet ducts and the first-stage drying gas baghouse stack in 1993. The emission rates of 0.0013 and 0.0027 (limit units of 0.018 grains/dry standard cubic feet) (gr/dscf) and 0.015 gr/dscf (limit of 0.031), respectively, are well within the limits stated in the air quality permit.

A stack emissions survey was conducted in May 1994. The survey determined the emissions of particulates, sulfur dioxide, oxides of nitrogen, carbon monoxide, total hydrocarbons, and hydrogen sulfide from the coal dryer stack. The principal conclusions based on averages are:

- The emissions of particulate matter from the dryer stack were 0.0259 gr/dscf (2.563 pounds per hour). (Limit: 0.031 gr/dscf.)

- The emissions of nitrogen oxides were 4.50 pounds per hour (54.5 parts per million). (Limit: 7.95 lb/hr estimated controlled emissions, and 11.55 lb/hr estimated uncontrolled emissions based on vendor information.)

- The emissions of carbon monoxide were 9.61 pounds per hour (191.5 parts per million). (Limit: 6.46 lb/hr estimated controlled emissions, and 27.19 lb/hr estimated uncontrolled emissions based on vendor information.)

- The emissions of total hydrocarbons as propane (less methane and ethane) were 2.93 pounds per hour (37.1 parts per million).

- The emissions of sulfur dioxide were 0.227 pounds per hour (2.0 parts per million). (Limit: 7.95 lb/hr estimated controlled emissions, and 20.27 lb/hr estimated uncontrolled emissions for sulfur oxides.)

- The emissions of hydrogen sulfide were 0.007 pounds per hour (0.12 parts per million).

Heat Plant

The heat required to process the coal is provided by a natural gas-fired process furnace, which uses process makegas from coal conversion as fuel. The vibration problems and conversion system problems discussed previously initiated removing and redesigning the process gas fans shaft seals to limit oxygen infiltration into the process gas. This system provides a maximum heat release rate of up to 74 MM Btu/hr depending on the feed rate.

Heat Rejection

Heat removed from the coal in the coolers is rejected indirectly through cooling water circulation using an atmospheric-induced, draft-cooling tower. A substantial amount of the heat added to the system is actually lost by releasing water vapor and flue gas into the atmosphere through an exhaust stack. The stack allows for vapor release at an elevation great enough that, when coupled with the vertical velocity resulting from a forced draft fan, maximized dissipation of the gases. The evaluation from 1993 indicated the problem could be resolved by producing additional makeup water to the system. A 2-inch valve was installed on the cooling water line to the cooling tower to provide the necessary makeup water.

Utility and Ancillary Systems

The fines handling system consolidates the coal fines that are produced in the conversion, cleaning, and material handling systems. The fines are gathered by screw conveyors and transported by drag conveyors to a bulk cooling system. The cooled fines are stored in a 250-ton capacity bin until loaded into pneumatic trucks for off-site sales.

When off-site sales lag production, the fines are mixed with water in a specially designed tank and slurried back to the mine pit.

An inert gas system cools, dehumidifies, compresses, and dries stack gas. The inert gas, which contains mainly nitrogen and carbon dioxide, is used by the first-stage baghouse cleaning blowers and is also used as a blanket gas in the product and fines storage silos. The makeup gas to the cooler loop is combustion flue gas from the stack. The cooling system effectively dehumidifies and cools the stack gas making the inert gas for the system. The cooler gas still has a relatively high dew point (about 90°F). Due to the thermal load this puts on the cooling system, no additional inert gas requirements can be met by this approach.

The common facilities for the ACCP include a plant and instrument air system, a fire protection system, and a fuel gas distribution system.

The power distribution system was upgraded by installing an uninterruptible power supply (UPS) during 1993. The UPS system does not keep the plant running if there is a problem; however, it does keep the control system, emergency systems, and office lights operating.

The process is semi-automated including dual control stations, dual programmable logic controllers, and distributed plant control and data acquisition hardware. Graphic interface programs are continually being modified and upgraded to improve the operator interface and provide more reliable information to the operators and engineers.

3.2.1 MODIFIED OR REPLACED EQUIPMENT

Facility modifications and maintenance work to date have been dedicated to obtaining an operational facility.

The modifications to the original system performed for the year to date (with modifications during this reporting period shown in bold print) are listed below.

<u>**First Quarter 1995**</u>

Conversion System

- **Replaced burned explosion door on 2nd stage cyclone**
- **Repair fan motor on first stage of dryer**
- **Repair on original expansion joint on first stage duct**
- **Repair dryer bed cracks**

Raw Coal Handling

- **Replace screen cloth on screens for enhanced infeed system screening efficiency**

Product Handling

- **Begin construction of tipple dust collection and loadout**
- **Product sampler on C-9-08 installed and commissioned**

General

- **Natural gas supplier pressure problems and plugged regulator corrected**

Table 3.2 shows the equipment that has either been modified or replaced from plant startup. If replacement was required, the new equipment is listed.

Table 3.2. Advanced Coal Conversion Process Modified Major Plant Equipment

System Description	Equipment Vendor	Type	Modified No/Yes	Replaced With
Thermal Coal Reactors/Coolers	Carrier Vibrating Equipment, Inc.	PE	/✓	
Belt Conveyors	Willis & Paul Group	MH	/	
Product Sampler	Inner Systems	MH	Added	
Bucket Elevators	FMC Corporation	MH	/	
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC	/	
Coal Screens	Hewitt Robbins Corporation	MH	/✓	
Loading Spouts	Midwest International	MH	/	
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH	/	
Silo Mass Flow Gates	SEI Engineers, Inc.	MH	/	
Vibrating Bin Dischargers	Carman Industries, Inc.	MH	/	
Vibrating Feeder	Kinergy Corporation	MH	/	
Drag Conveyor	Dynamet	DH	/✓	PFHS
Screw Conveyor	Farm Aid Equipment Company	MH	Added	PFHS
Processed Fines Handling Sys.				
Bucket Elevators	Continental Screw Conveyor Corp.	DH	Added	
Screw Conveyors	Continental Screw Conveyor Corp.	DH	Added	
Drag Conveyors	AshTech Corporation	DH	Added	
Processed Fines Cooler	Cominco Engineering Services, Ltd.	DH	Added	
Slurry Tank Agitator	Chemineer, Inc.	DH	Added	
Slurry Tank	Empire Steel Manufacturing Co.	DH	Added	
Slurry and Pit Pumps	Goulds Pumps/Able Technical	DH	Added	
Processed Fines Load Out Bin	P & S Fabricators	DH	Added	
Process Gas Heater	G.C. Broach Company	PE	/	
Direct Contact Cooler	CMI-Schneible Company	PE	/✓	
Particulate Removal System	Air-Cure Howden	EC	/✓	
Dust Collectors	Air Cure Environmental	EC	/	
Air Compressors/Dryers	Colorado Compressor, Inc.	CF	/✓	
Diesel Fire Pumps	Peerless Pump Company	CF	/	
Forced Draft Fans	Buffalo Forge Company	PE	/✓	
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE	/	
Electrical Equipment-4160	Toshiba/Houston International Corp.	CF	/	
Electrical Equipment-LDC	Powell Electric Manufacturing Corp.	CF	/	
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF	/	
Uninterruptible Power Supply	Best Power Technologies Company	CF	Added	

Table 3.2. Advanced Coal Conversion Process Modified Major Plant Equipment (cont'd.)

Main Transformer	ABB Power T&D Company	CF	/	
Control Panels	Utility Control & Equipment Corp.	CF	/	
Control Valves	Applied Control Equipment	CF	/	
Plant Control Systems	General Electric Supply Company	CF	/✓	
Cooling Tower	The Marley Cooling Tower Company	PE	/✓	
Dampers	Effox, Inc.	PE	/	
Dry Sorbent Injec. System	Natech Resources, Inc.	EC	/	
Expansion Joints	Flexonics, Inc.	PE	/✓	
MH - Materials Handling PE - Process Equipment EC - Emissions Control CF - Common Facilities CC - Coal Cleaning DH - Dust Handling				

4.0 TECHNICAL PROGRESS

4.1 SYNCOAL® SALES/SHIPMENTS

Table 4.1 lists the customers by category and the total sales by month and quarter.

Table 4.1 SynCoal® Sales

CUSTOMER TYPE/ NAME	SYNCOAL® PRODUCT	JANUARY SALES	FEBRUARY SALES	MARCH SALES	TOTAL SALES
INDUSTRIAL					
Ash Grove Cement	Regular	1,503	938	951	3,392
Ash Grove Cement	Fines	1,674	1,975	1,508	5,157
Bentonite Corporation	Regular	1,033	936	1,018	2,987
Packaging Corporation	Regular	0	0	641	641
University of North Dakota	Regular	0	0	92	92
Holnam Cement	Regular	1,714	2,033	-460	3,287
Continental Lime	Regular	1,160	0	0	1,160
UTILITY					
Colstrip Units 3 and 4	DSE Conditioned	0	0	24,799	24,799
Fremont Utilities	Regular	0	465	0	465
Corette Plant	DSE Conditioned	10,881	15,363	0	26,244
TOTAL TONS		17,965	21,710	28,548	68,223

4.2 FACILITY OPERATIONS/PLANT PRODUCTION

Table 4.2 summarizes the ACCP Demonstration Facility's operations and plant production levels that have been achieved throughout this reporting period and the facility's lifetime to date.

The following calculations were used in Table 4.2:

- Period Hours = Days in Reporting Period x 24 Hours/Day
- Availability Rate = Operating Hours/Period Hours x 100
- Average Feed Rate = Tons Fed/Operating Hours
- Monthly Capacity Factor = Tons Processed/Rated Design Capacity (37,500 tons/month)
- Forced Outage Rate = Forced Outage Hours/(Forced Outage Hours + Operating Hours) x 100

The difference between the feed coal and the amount of clean coal produced is due to water loss; samples removed for analysis; and processed fines, which are captured in the dust handling system and returned to the mine for disposal. Very little dust is actually lost to the atmosphere.

Table 4.2 ACCP Demonstration Project Monthly Operating Statistics*

Month	Operating Hours	Availability Rate	Planned Maint. Hours	Forced Outage Hours	Forced Outage Rate	Feed Tons	Ave. Feed Rate	Feed Capacity Factor	Total Ship-ments	Ending Inventory
Jan. '95	503	68%	0	241	32%	31,726	66.3	83%	17,965	5,096
Feb. '95	525	78%	0	147	22%	38,325	73.0	111%	21,710	5,469
Mar '95	637	86%	79	28	4%	42,674	67.0	112%	28,548	5,800
1st Quarter 1995 Summary	1,665	77%	79	416	20%	112,725	68.8	102%	68,223	5,800
LTD Totals	12,842		7,275			670,360	52.14		337,762	

*An internal audit revealed discrepancies in some of the tonnages which were noted in the monthly reports. The totals reported in this report reflect the actual numbers.

A general material and energy balance around the ACCP is shown in Figure 4.1 from testing conducted in May, 1994. The description is for a typical coal that was tested and processed through the ACCP Demonstration Facility. An energy conversion of 87.1 percent is depicted. Loss of moisture up the stack accounts for the weight difference of input versus output.

Figure 4.1. Material and Energy Balance

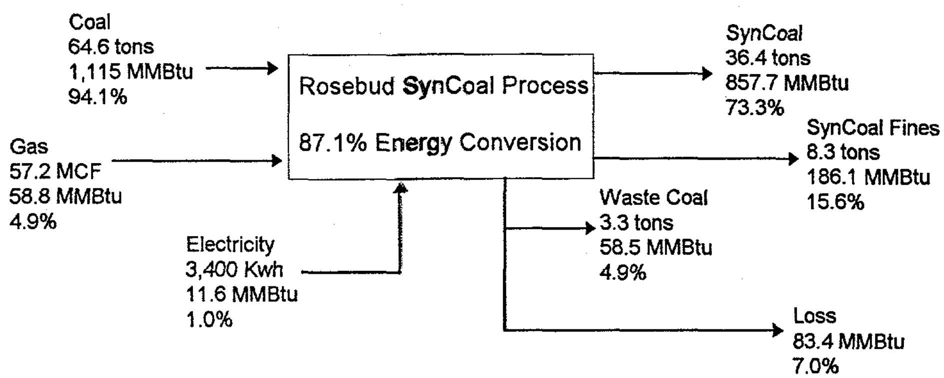


Table 4.3 provides mass and energy balance information for the first quarter of 1995. This information is based upon total quantities into and out of the demonstration process facility. The known weight loss is the water removed from the raw coal. The unknown weight loss is all the other losses not measured. All energy losses are identifed as unknown. Overall, 80.2% of the energy input was converted to saleable products. Figure 4.2 depicts this information in a more graphic form. There is an excessive unexplained material and energy loss.

Figure 4.2. First Quarter Material and Energy Balance

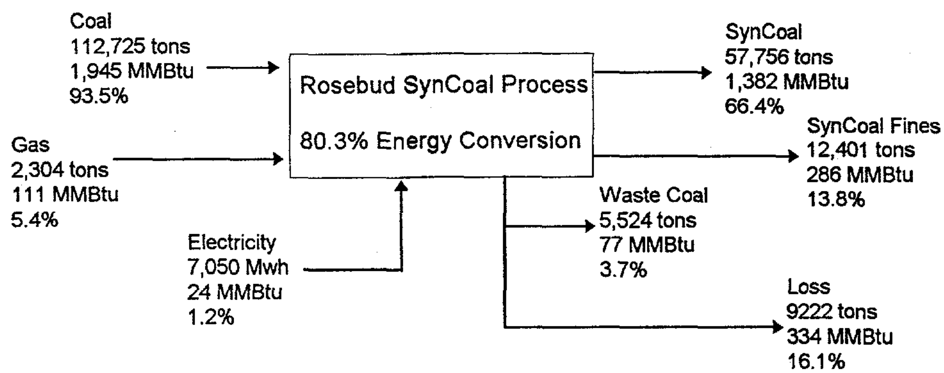


Table 4.3 Mass and Energy for First Quarter of 1995

	INPUT			OUTPUT				
	Raw Coal	Natural Gas	Electricity MWh	SynCoal Tons	SynCoal Fines Tons	Waste Tons	Known Loss Tons	Unknown Loss Tons
Tons	112,725	2,304	7,050	57,756	12,401	5,524	27,822	9,222
%	100%			51.2%	11.0%	4.9%	24.9%	8.0%
MMBtu	1,944,732	111,358	24,037	1,382,217	286,587	77,336	-	333,987
%	93.5%	5.4%	1.2%	66.4%	13.8%	3.7%	0.0%	16.1%
Btu/lb	8,626			11,903	11,549	7,000		18,551
% Moisture	26.09%			1.93%	3.19%	1.4%		
% Ash	9.41%			9.16%	10.05%			

4.3 FACILITY TESTING

The facility testing to date has focused on controlling spontaneous combustion of the cleaned coal product. No tests were completed during the First Quarter of 1995.

4.4 PRODUCT TESTING

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint but has not been acceptable from a physical standpoint due to instability (spontaneous heating) and dustiness. The typical product analyses are shown in Table 4.4 . A series of tests (described in Section 5.0) were conducted throughout 1992 and 1993 to develop a method to increase the product stability. There were no product tests conducted during the First Quarter of 1995.

Table 4.4 Raw Feed Coal Analyses

MONTH	TONNAGE	% MOISTURE	% ASH	% SULFUR	BTU/LB	SO2/MMBTU
January	31,726	26.25	8.38	0.67	8,696	1.55
February	38,325	26.10	9.62	0.75	8,614	1.75
March	42,674	25.96	10.00	0.85	8,583	1.97

Table 4.5 Product Analyses

Sample ID	Coal Type	% Moist.	% Ash	% Sulfur	Btu/lb	LBS SO_2 /MMBtu
January, 1995						
Avg	As-Produced Product	1.50	9.15	0.54	11985	0.90
Std	As-Produced Product	0.25	0.32	0.03	40	0.04
Min	As-Produced Product	1.25	8.44	0.50	11885	0.83
Max	As-Produced Product	2.27	9.90	0.59	12054	0.98
February, 1995						
Avg	As-Produced Product	1.51	8.91	0.54	11988	0.91
Std	As-Produced Product	0.26	1.71	0.06	72	0.11
Min	As-Produced Product	1.05	0.00	0.48	11774	0.81
Max	As-Produced Product	2.34	9.77	0.75	12128	1.25
March, 1995						
Avg	As-Produced Product	1.64	11.01	0.90	11733	1.55
Std	As-Produced Product	0.52	1.51	0.24	195	0.42
Min	As-Produced Product	1.08	8.44	0.41	11446	0.69
Max	As-Produced Product	4.44	13.28	1.25	12058	2.18
Quarterly Average						
Avg	**As-Produced Product**	**1.56**	**10**	**0.69**	**11883**	**1.17**
Min	**As-Produced Product**	**1.05**	**0**	**0.41**	**11446**	**0.69**
Max	**As-Produced Product**	**4.44**	**13.28**	**1.25**	**12128**	**2.18**

Sample ID	Coal Type	% Moist.	% Ash	% Sulfur	Btu/lb	LBS SO_2 /MMBtu
January, 1995						
Avg	As-Shipped Regular SynCoal	1.88	8.98	0.57	11910	0.96
Std	As-Shipped Regular SynCoal	0.77	0.38	0.07	122	0.11
Min	As-Shipped Regular SynCoal	1.19	8.26	0.47	11224	0.79
Max	As-Shipped Regular SynCoal	6.74	9.92	0.81	12061	1.37
February, 1995						
Avg	As-Shipped Regular SynCoal	1.76	9.31	0.56	11926	0.95
Std	As-Shipped Regular SynCoal	0.50	0.41	0.09	99	0.15
Min	As-Shipped Regular SynCoal	1.18	8.65	0.47	11471	0.79
Max	As-Shipped Regular SynCoal	4.18	10.42	0.83	12068	1.40
March, 1995						
Avg	As-Shipped Regular SynCoal	2.11	9.14	0.66	11880	1.11
Std	As-Shipped Regular SynCoal	0.85	0.57	0.13	153	0.22
Min	As-Shipped Regular SynCoal	1.34	6.07	0.45	11109	0.76
Max	As-Shipped Regular SynCoal	7.08	10.22	1.09	12078	1.85
Quarterly Average						
Avg	**As-Shipped Regular SynCoal**	**1.93**	**9.16**	**0.6**	**11903**	**1.02**
Min	**As-Shipped Regular SynCoal**	**1.18**	**6.07**	**0.45**	**11109**	**0.76**
Max	**As-Shipped Regular SynCoal**	**7.08**	**10.42**	**1.09**	**12078**	**1.85**
January, 1995						
Avg	As-Shipped Fines	3.18	9.42	0.79	11596	1.37
Std	As-Shipped Fines	0.60	0.52	0.20	113	0.35
Min	As-Shipped Fines	1.45	8.38	0.00	11354	0.00
Max	As-Shipped Fines	4.22	10.85	1.24	11996	2.18

Sample ID	Coal Type	% Moist.	% Ash	% Sulfur	Btu/lb	LBS SO_2 /MMBtu
February, 1995						
Avg	As-Shipped Fines	3.32	10.00	0.79	11532	1.37
Std	As-Shipped Fines	0.30	0.68	0.14	122	0.24
Min	As-Shipped Fines	2.87	8.71	0.56	11135	0.97
Max	As-Shipped Fines	4.25	11.58	1.24	11718	2.20
March, 1995						
Avg	As-Shipped Fines	3.08	10.47	0.94	11536	1.63
Std	As-Shipped Fines	0.35	0.74	0.18	157	0.32
Min	As-Shipped Fines	2.06	8.76	0.54	11160	0.91
Max	As-Shipped Fines	4.46	12.15	1.43	12070	2.52
Quarterly Averages						
Avg	**As-Shipped Fines**	**3.19**	**10.05**	**0.85**	**11549**	**1.48**
Min	**As-Shipped Fines**	**1.45**	**8.38**	**0.00**	**11135**	**0.00**
Max	**As-Shipped Fines**	**4.46**	**12.15**	**1.43**	**12070**	**2.52**

4.5 TESTBURN PRODUCT

First Quarter of 1995

University of North Dakota (U.N.D.) Plant Services, Grand Forks, ND - SynCoal® Test Burn

A SynCoal® product test burn was completed at the U.N.D. Steam Plant beginning on Thursday, March 30, 1995 and lasting until Sunday, April 2, 1995. U.N.D. purchased 92 tons of SynCoal® and planned to blend SynCoal® 1:1 with raw coal to prevent overheating the fire box and damaging the refractory and gates.

Because of the fine sizing of SynCoal® the ratio was decreased to 1:3 and finally 1:5 to allow proper distribution on the grates. When the spreader was unable to distribute the SynCoal®, it would pile on the front of the bed and cause hot spots in the dry ash handling system.

Packaging Corporation of America (PCA), Tomahawk, Wisconsin SynCoal® Test Burn

A 3-day test beginning on March 14, was initiated to determine the handling characteristics of SynCoal® with the existing coal handling system at PCA and the initial performance of SynCoal® in a coal fired cyclone.

Dust problems were encountered as the SynCoal® was unloaded and conveyed into the plant. To alleviate the hazards, a water spray was used at the inclined belt prior to the crusher as well as a vacuum truck at the crusher chute.

It was determined that a pnuematic system would be the best way to handle SynCoal® in which case there would be even less dust present than their current handling system would generate with even the most dustless coals. The SynCoal® reacted consistently and uniformly during large load swings.

Fremont Department of Utilities, Fremont, Nebraska SynCoal® Test Burn

Five covered hopper railcars of SynCoal® (465 tons) were delivered to Fremont Utilities for testing a blend with their current coal supply for a 10-day testing period. The blend they used was 20% SynCoal® and 80% their coal. They experienced very little dust when conveying the blended product into their system. The Btu value of the blend was rated at 8,500 Btu/lb.

5.0 PROCESS STABILITY/PILOT WORK

During the initial plant startup tests which occurred in January through June of 1992, the product was noted to be dusty and susceptible to spontaneous combustion. Stability investigations and dust mitigation tests are on-going to lower costs and continually refine the application and improve product quality. A summary of product stability and dust mitigation testing to date is described below.

5.1 PRODUCT STABILITY

The dried, cooled, and cleaned coal produced to date has exhibited spontaneous heating and combustion. When any significant mass of coal (more than 1 to 2 tons) is exposed to any significant air flow for periods ranging from 18 to 72 hours, the coal reaches temperatures necessary for spontaneous combustion or auto ignition to occur. Spontaneous heating of run-of-mine, low-rank coals has been a common problem but usually occurs after open air exposure periods of days or weeks, not hours. However, dried, low-rank coals have universally displayed spontaneous heating tendencies to a greater degree than raw, low-rank coals.

Additional process steps and applying additives to the coal both during and after the process are being tested to mitigate this problem.

Butte Pilot Plant Verification Tests

The Butte pilot plant was operated to confirm that the SynCoal® produced by the ACCP was equal in reactivity to that of the pilot plant. The spontaneous heating characteristic was not identified at the pilot stage because product was generated at a comparatively low rate which allowed enough time for the material to passively stabilize before being covered by subsequent layers of SynCoal®.

Oxidation Tests

Tests were performed on a bench-scale to determine the completeness of oxidation, the potential for accelerating the rate of oxidation, and the thermodynamics of oxidation. From these tests, the mass uptake of oxygen was determined, as well as the typical SynCoal® oxidation rate expressions. Once the oxidation test results were calculated, the values were then used to design the stabilization pilot-scale equipment.

Carbon Dioxide Trials

In the literature search on methods for controlling spontaneous combustion, carbon dioxide is described as a method to control spontaneous heating. Testing is on-going to determine the effectiveness of using carbon dioxide to prevent or delay spontaneous heating and to optimize the rate of application. However, the results from testing indicate a two- to four-fold increase in SynCoal® product life. Unfortunately, carbon dioxide is very expensive and not an economical solution to the spontaneous combustion problem.

Pore Blocking Trials

The literature search also indicated several compounds are commercially available to prevent spontaneous combustion by blocking the reactive sites on the surface of coal. Several chemicals were tested on SynCoal® at varying flow rates and concentrations. In addition to spray application tests, a pilot-scale, blender-type of application technique was tested. The trial tests indicated that extremely high chemical applications showed a marginal improvement in product stability.

Blending Trials

Based on a market analysis, it was determined that blending SynCoal® with raw coal may be an effective method of delivering fuel to market. Testing is being performed to determine the effectiveness of blending SynCoal® with raw coal in achieving a stable product, determining the optimum blend ratios, and identifying the resulting fuel characteristics. Preliminary results indicated a significant increase in the life of the SynCoal® product from blending specific quantities of product and raw coal; however, the product was extremely dusty.

Rehydration Testing and Shipping Treated SynCoal®

Based on the blending trials, rehydration is being conducted to determine the effectiveness of using water to control spontaneous combustion and to determine the optimum moisture content and water application method.

Preliminary results indicated an 8- to 16-fold increase in SynCoal® stability. The fuel value of the coal was reduced and visible water vapor was evident upon delivery of the treated product. These aspects are continuing to be evaluated to obtain optimum performance.

Pile Management Testing

Pile management tests were performed to determine whether periodic heat rejection would result in a stabilized product. Based on observations, SynCoal® can be stabilized with pile management over a two-week period. However, large land areas would be required at commercial-scale, and variable weather conditions may affect product quality.

Stabilization Process Step Pilot Testing

After ensuring operability of the equipment, process test variables, including residence time, air flow, material temperatures, feed coal size, and flow rate, were tested. Under operating conditions, the process variables were found to be dependent; therefore, care was required not to operate in a "run-away" mode. Preliminary results indicated that treated SynCoal® can be six times more stable than product just off the process.

Stabilization Process Step Demonstration Design

Based on the successful test results, a full demonstration scale process step was designed for retrofit into the ACCP. Two different designs, a slip stream at 8 tph and a full ACCP throughput 48-tph design, were cost estimated. Complete construction of this plant addition is expected to take 13 months with a full year of process and product testing.

Cooperative Research And Development Agreement (CRADA) For A Joint Rosebud Syncoal Partnership - US DOE PETC Project

In January, 1995, the CRADA agreement was signed. The object of the CRADA is to determine the effects of different drying environments and treatments on low rank-rank coal (LRC) composition and structure. Specific objectives of the agreement are (1) to elucidate the causes of spontaneous heating of dried LRC and to develop preventive measures, and (2) to study the explosibility and flammability limits of upgraded LRC dust. Other participants in this are the AMAX Coal Company and the ENCOAL project which have also experienced the same effects on their upgraded product.

5.2 PRODUCT DUSTINESS

The product is basically dust free when it exits the processing facility due to numerous steps where the coal is fluidized in process gas or air, which removes the dust-size particles. The gas and air entrains any dust that has been produced since the last process step.

Typical to coal handling systems, each handling activity performed on the product coal after the coal leaves the process degrades the coal size and produces some dust. The fall into the product silos, which can be up to 90 feet, can be especially degrading to the coal. Quantifying dustiness of coals is difficult, but once the product coal has passed through the nine transfer points between the process and a rail car, the coal is visibly dustier than run-of-mine coal. The SynCoal® product is actually no dustier than the raw coal; the dust is just more fugitive. Because the SynCoal® product is dry, it does not have any inherent ability to adhere small particles to the coal surfaces. This allows any dust-size particles that are generated by handling to be released and become fugitive.

Transfer points have been modified to reduce impacts, methods of reducing degradation in the silos have been examined, and dust suppression options tested.

SynCoal® Attrition Study and Dust Suppressant Testing

SynCoal® dustiness was reviewed to determine a dust control strategy based on results obtained from attrition testing. Initial tests were accomplished with standard, water-based chemicals, which included surfactant, inorganic salts, and lignosulfonate-based suppressants. None of the products tested at normal economic concentration levels were effective at mitigating SynCoal® dustiness.

After water-based compounds proved to be ineffective for mitigating SynCoal® dustiness, more exotic and expensive compounds were tested and evaluated. These compounds included oil, anionic polymers, latex polymers, and various oil-based emulsions. Oil was found to be an effective though expensive dust suppressant when applied at the required rates; however, due to environmental concerns, oil was removed from consideration. Another effective suppressant that is also environmentally safe is an ionic polymer. However, this chemical is also expensive to apply and impacts the overall process economics. As a result of rail car testing, an effective car topping compound was located. No dust suppressant was found to work adequately on blends.

Zig-Zag Testing

In addition to spray application of chemicals, a pilot-scale, zig-zag blender was tested to apply dust suppressant compounds. The objectives of these tests were to maximize compound efficiency and to ensure spray application test results were not biased by inconsistent coating. The zig-zag blender test confirmed the results obtained by the spray method but indicated that expensive compounds could be substantially diluted with water if a more efficient application technique was used.

Chemically Enhanced Treatment Application

Tests involving adding water to the SynCoal® product in lieu of blending yielded the most promising results. Total inundation of SynCoal® with water reduced the amount of dust liberated at the point of transfer. This technique has allowed the SynCoal® product to be shipped out of the ACCP plant. The negative aspects appear to be a reduced fuel value, difficulties of winter application, and reduced acceptance of visible water vapor liberation upon delivery.

5.3 CONCLUSIONS FROM PROCESS STABILITY TESTING

- Based on the results of carbon dioxide treatment and rehydration trials, the RSCP initiated a program to produce DSE SynCoal® with a 8- to 16-fold stability increase which currently enables shipment to users in the Midwest.
- Stability investigations into coal blending were successful but revealed that the coal may be too dusty to ship.
- DSE-treated SynCoal® can be blended with raw coal without causing dust problems.
- Pore blocking stability investigations proved unsuccessful.
- Ammonium nitrate stability investigations proved unsuccessful.
- Results of air oxidation and pile management tests were positive.

6.0 FUTURE WORK AREAS

Work continues on improving product stability and dustiness. Several unforeseen product issues, which were only identified by the demonstration project operation, have changed the required activities for the ACCP Demonstration Project. Budget modifications will have to be made to the existing contract so as to include the following tasks.

- Identifying efficient and effective handling techniques.
- Demonstrating the benefits of SynCoal® in the smaller, more constrained industrial boilers and older, smaller utility boilers.
- Developing additional methods to reduce the product's spontaneous combustion potential.
- Demonstrating abilities to reduce the production costs.

The Montana Legislature enacted a bill providing an exemption from the Coal Severance Tax for up to 2 million tons of feedstock going to a coal enhancement facility This bill is effective January 1, 1995 and terminates on December 31, 2005.

During the first quarter of 1995 design, procurement and construction of the tipple dust collection and load-out were nearly completed.

The structural design for the truck load-out is substantially complete. This will improve the efficiency of loading pneumatic trucks for transporting SynCoal® to several industrial customers.

A plant outage is being scheduled for the 2nd quarter to replace the Main Process Heat Exchanger. In addition a soot blower, first stage and new cooler fan bearings and lube-oil system for all the fan bearings will be installed as well as the completion of numerous general maintenance items.

Permit modeling efforts are being performed in coordination with Western Energy permitting personnel to bring the Western Energy air quality permit up to date with actual ACCP operational information.

APPENDIX A

Significant Accomplishments from Origination of Project to Date

SIGNIFICANT ACCOMPLISHMENTS
(SINCE CONCEPT INCEPTION)

September	**1981**	Western Energy contracts Mountain States Energy to review LRC upgrading concept called the Greene process.
June	**1982**	Mountain States Energy built and tested a small batch processor in Butte, Montana.
December	**1984**	Initial patent application filed for the Greene process, December 1984.
November	**1984**	Initial operation of a 150 lb/hr continuous pilot plant modeling the Greene drying process at Montana Tech's Mineral Research Center in Butte, Montana.
November	**1985**	Added product cooling and cleaning capability to the pilot plant.
January	**1986**	Initiated process engineering for a demonstration-size Advanced Coal Conversion Process (ACCP) facility.
October	**1986**	Completed six month continuous operating test at the pilot plant with over 3,000 operating hours producing approximately 200 tons of SynCoal®.
October	**1986**	Western Energy submitted a Clean Coal I proposal to DOE for the ACCP Demonstration Project in Colstrip, Montana, October 18, 1986.
December	**1986**	Western Energy's Clean Coal proposal identified as an alternate selection by DOE.
November	**1987**	Internal Revenue Service issued a private letter ruling designating the ACCP product as a "qualified fuel" under Section 29 of the IRS code, November 6, 1987.
February	**1988**	First U.S. patent issued February 16, 1988, No. 4, 725,337.
May	**1988**	Western Energy submitted an updated proposal to DOE in response to the Clean Coal II solicitation, May 23, 1988.
December	**1988**	Western Energy was selected by DOE to negotiate a Cooperative Agreement under the Clean Coal I program.

SIGNIFICANT ACCOMPLISHMENTS (cont'd.)
(SINCE CONCEPT INCEPTION)

May	**1989**	Second U.S. patent issued March 7, 1989, No. 4, 810,258.
June	**1990**	Reach a negotiated agreement with DOE on the Cooperative Agreement, June 13, 1990.
September	**1990**	Signed Cooperative Agreement, after Congressional approval, September 13, 1990.
September	**1990**	Contracted project engineering with Stone & Webster Engineering Corporation, September 17, 1990.
December	**1990**	Formed Rosebud SynCoal Partnership, December 5, 1990.
December	**1990**	Started construction on the Colstrip site.
March	**1991**	Novated the Cooperative Agreement to the Rosebud SynCoal Partnership, March 25, 1991.
March	**1991**	Formal ground breaking ceremony in Colstrip, Montana, March 28, 1991.
December	**1991**	Initiated commissioning of the ACCP Demonstration Facility.
April	**1992**	Completed construction of the ACCP Demonstration Facility and entered Phase III, Demonstration Operation.
June	**1992**	Formal dedication ceremony for the ACCP Demonstration Project in Colstrip, Montana, June 25, 1992.
August	**1992**	Successfully tested product handling by shipping 40 tons of SynCoal® product to MPC's Unit #3 by truck.
October	**1992**	Completed 81 hour continuous coal run 10/2/92.
November	**1992**	Converted to a single process train operation.
December	**1992**	Produced a passivated product with a two-week storage life.
January	**1993**	Produced 200 tons of passivated product that lasted 13 days in the open storage pile.
February	**1993**	The plant had a 62 percent operating availability between January 1 and February 15.

SIGNIFICANT ACCOMPLISHMENTS (cont'd.)
(SINCE CONCEPT INCEPTION)

March 1993 Identified an environmentally compatible dust suppressant that inhibits fugitive dust from the SynCoal® product. Completed annual Mine Safety and Health Administration safety training.

September 1993 Tested nearly 700 tons of BNI lignite as a potential process feedstock achieving approximately 11,000 Btu/lb heating value and substantially reducing the sulfur in the resultant product.

September 1993 Tested over 500 tons of BNI lignite.

June 1993 Initiated deliveries of SynCoal® under long-term contracts with industrial customer.

July 1993 Identified a conditioned method that inhibits spontaneous combustion and dust.

August 1993 State evaluated emissions, and the ACCP process is in compliance with air quality permit. ACCP Demonstration Facility went commercial on August 10, 1993.

September 1993 Stored approximately 9,000 tons of SynCoal® in inerted product silos and stabilized 2,000 to 3,000 tons in a managed open stockpile.

September 1993 Operated at an 84 percent operating availability and a 62 percent capacity factor for the month.

September 1993 Tested nearly 700 tons of BNI lignite as a potential process feedstock achieving approximately 11,000 Btu/lb heating value and substantially reducing the sulfur in the resultant product.

September 1993 Tested over 500 tons of BNI lignite.

October 1993 Processed more coal since resuming operation in August than during the entire time from initial startup with the summer's maintenance outage (approximately 15 months).

October 1993 Tested North Dakota lignite as a potential process feedstock, achieving nearly 11,000 Btu/lb heating value and substantially reducing the sulfur content in the resultant product.

November 1993 Operated at an 88 percent operating availability and a 74 percent capacity factor for the month.

SIGNIFICANT ACCOMPLISHMENTS (*cont'd.*)
(SINCE CONCEPT INCEPTION)

December	**1993**	Shipped 16,951 tons of SynCoal® to various customers.
January	**1994**	Shipped 18,754 tons of SynCoal® to various customers.
January	**1994**	Completed 48 tph stability SynCoal® stabilization process step design.
January	**1994**	Completed stability reactor testing.
February	**1994**	The plant had a 67 percent operating availability.
February	**1994**	Completed 8 tph SynCoal® stabilization process step design.
March	**1994**	Completed a 50/50 SynCoal® blend testburn at MPC's J.E. Corette plant.
April	**1994**	Completed 75/25 SynCoal® blend followup testburn at MPC's J.E. Corette plant.
May	**1994**	Began regular shipments of SynCoal® fines to industrial customers.
May	**1994**	Exceeded proforma average monthly sales levels for the first time since startup.
June	**1994**	Concluded 30 day, 1,000 mile covered hopper rail car test shipment.
June	**1994**	Increased industrial sales to 39 percent of total (7,350 tons of 18,633).
July	**1994**	Supported an additional 30-day testburn at MPC's J.E. Corette plant.
July	**1994**	Continued preparing for annual maintenance and facility improvement outage to begin August 19.
August	**1994**	Began the annual maintenance and facility improvement outage scheduled on August 19.
August	**1994**	Completed a conceptual design incorporating SynCoal® processing at MPC's J.E. Corette plant.
September	**1994**	Completed the annual maintenance and facility improvement outage on September 11.

SIGNIFICANT ACCOMPLISHMENTS (cont'd.)
(SINCE CONCEPT INCEPTION)

September	**1994**	Held an open house and tour on September 20 to raise public and market awareness of SynCoal®.
September	**1994**	Completed conceptual design for an ACCP plant expansion incorporating the process stability step.
October	**1994**	Scheduled testburns with two industrial users for November 1994.
October	**1994**	Tentatively scheduled two small additional testburns during December 1994.
November	**1994**	Conducted testburns with two industrial users.
November	**1994**	Scheduled an additional testburn during December 1994.
November	**1994**	Scheduled to reestablish deliveries to Continental Lime in Townsend, Montana.
December	**1994**	Conducted testburns with one additional user.
December	**1994**	Tentatively scheduled two additional testburns during January 1995.
December	**1994**	Rescheduled to reestablish deliveries to Continental Lime in Townsend, Montana.
January	**1995**	Conducted testburns with an additional industrial user.
January	**1995**	Tentatively scheduled two additional testburns during February
February	**1995**	Continued testburn with an industrial user.
February	**1995**	Supplied a short test at a small utility plant.
February	**1995**	Tentively scheduled two additional testburns during March.
March	**1995**	Supported a testburn with an industrial user.
March	**1995**	Supplied a short test at a small heat plant.
March	**1995**	Record monthly sales volume of 28,548 tons or 118 percent of original design performa.