

LMFS-94-15
UPGRADED NORTH DAKOTA LIGNITE PRODUCTION
OF TEST QUANTITIES

CONTRACTOR: Energy & Environmental Research Center

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CONTRACT AMOUNT: \$30,000

Project Schedule - 4 Months

Contract Date - 6/30/94

Start Date - 6/30/94

Completion Date - 11/1/94

Project Deliverables

Status Report - 9/1/94 ✓

Final Report - 11/1/94 ✓

OBJECTIVE / STATEMENT OF WORK

The objective of this project was to produce two one-ton test quantities of upgraded lignite. Combustion performance of the two upgraded lignite test materials was evaluated by Babcock & Wilcox under project LMFS-94-12. The target markets for upgraded lignite are power plants in Minnesota and Wisconsin, where coal blending is being used to meet air emission standards. The upgraded lignite could be used in these markets to replace high sulfur/high Btu coal.

This project was done at the Energy & Environmental Research Center (EERC) at the University of North Dakota in Grand Forks. Participants in this project included Knife River Coal Mining Company, Cooperative Power Association, United Power Association, The Falkirk Mining Company, The North American Coal Corporation, the U.S. Department of Energy Morgantown Energy Technology Center, and the North Dakota Industrial Commission.

STATUS

Two upgraded lignite test samples were produced. One of the one-ton samples was produced from lignite provided by the Beulah Mine of Knife River Coal Mining Company. The other one-ton sample was provided by The Falkirk Mine of The Falkirk Mining Company.

The Beulah mine coal was crushed to minus 1/4 -inch X 16-mesh and then cleaned using the EERC pilot-scale dense-media bath. Approximately 5970 lbs of sized Beulah mine lignite was processed at a specific gravity between 1.21 and 1.23; the average coal feed rate was approximately 295 lb/hr. About 75% of the cleaned coal was thermally dried. Dried clean coal (2440 lb), wet clean coal (1176 lb) and unprocessed coal fines (514 lb) were combined with a binder. The binder was a mixture of activated starch derived from animal-grade feed wheat and shredded newspaper. The clean lignite binder was pressed into briquettes using a 15 ton Komarek-Greaves double-roll briquetting press. The briquettes were air-dried to less than 10% moisture, stored in 55-gallon drums and shipped to Babcock & Wilcox. The upgrading scheme used for the Beulah Mine lignite was developed under Project FY94-XV-53.

Approximately 5950 lbs of the Falkirk mine lignite was received, crushed and screened into minus 1/4 -inch x 20-mesh and minus 20-mesh fractions. The 1/4 -inch x 20-mesh fraction was cleaned using the EERC pilot-scale dense-media bath. The cleaned coal was dried to reduce moisture content. A portion of the dried coal was saved and a portion pulverized to 0.01-inch. The pulverized lignite was then slurried and processed through the EERC hot-water drying process development unit (HWD-PDU). The HWD-PDU was operated at 40/60 wt % coal/water slurry, at a feed rate of 575 lb/hr and a temperature of 572°F. The hot-water dried coal was recovered using a manually operated Shriver 36-inch recessed-plate filter press which has 12 ft³ filter cake capacity and 269 ft² of filtration area. Approximately 2820 lb of hot-water dried lignite and 330 lb of dried cleaned lignite were blended with a binder. The binder consisted of pre-gelatinized, cationic potato starch. The material was pressed, dried, stored and shipped in a manner similar to that used for the Beulah mine material.

Analyses of the upgraded lignite from the Beulah and Falkirk mines are reported and compared to the target specifications for upgraded lignite in the following table.

<u>Property</u>	<u>Units</u>	<u>Upgraded Beulah</u>	<u>Upgraded Falkirk</u>	<u>Target Specification</u>
Type of Material		Briquettes	Briquettes	Lumps or Briquettes
Size Consists	inches	1 ¹ / ₄ x 1 ¹ / ₄ x ⁷ / ₈	1 ¹ / ₄ x 1 ¹ / ₄ x ⁷ / ₈	1 X 0
Moisture Content	wt % a.r.	8.90	14.30	10
Ash	"	5.58	5.54	7.6
Volatile Matter	"	47.07	43.01	44.2
Fixed Carbon	"	38.44	37.47	38.5
Heat Content	Btu/lb a.r.	9,845	9,571	10,800
Sulfur Content	wt % a.r.	0.45	0.56	0.7
Sulfur Emissions	lb SO ₂ /MBtu	0.91	1.16	1.2
Na ₂ O	wt % in Ash	3.5	0.2	4.2
Bulk Density	lb/ft ³	32	31	45-50

Compressive strength, drop-shatter and tumble resistance, water reabsorption and equilibrium moisture tests were done on upgraded briquettes. On soaking in water for 30 minutes, the Beulah briquettes reabsorbed 47 wt. % moisture and the Falkirk reabsorbed 3 wt, % moisture. Equilibrium moisture contents of the two briquette samples were 19 wt. % and 17 wt.%, respectively. The upgraded Beulah and Falkirk test quantities produced under this program met most of the target specifications for upgraded lignite. Process optimization, binder/agglomeration and moisture reabsorption studies are recommended. Preliminary economic evaluations should be done as process data becomes available.