

FY95-XVIII-57
PRODUCTION OF ENHANCED PHYSICALLY CLEANED LIGNITE

CONTRACTOR: Grand Forks Activation Technologies

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PARTICIPANTS

| <u>Sponsor</u> | <u>Cost Share</u> |
|--|-------------------|
| Knife River Corporation | \$15,000 |
| Grand Forks Activation Technologies/DOE-SBIR | \$70,000 |
| ND Industrial Commission | <u>\$85,000</u> |
| Total | \$170,000 |

Project Schedule - 2 Years

Contract Date - 1/5/95
Start Date - 1/5/95
Completion Date - 2/29/96

Project Deliverables

Status Report - 3/31/95 ✓
Status Report - 6/30/95 ✓
Final Report - 9/22/97 ✓

OBJECTIVE / STATEMENT OF WORK

The objective of this study is to demonstrate that ultra-clean Beulah Mine lignite can be produced. Ultra-clean lignite would have emissions below 0.5 lbs of SO₂/MMBtu if used in a fluid bed combustor and below 1.2 lb of SO₂/MMBtu if used in a PC-fired or spreader stoker combustor. The project consists of three major tasks: 1) coal preparation and physical cleaning, 2) combustion testing, and 3) ash evaluation.

STATUS

Run-of-mine (ROM) Beulah lignite was crushed, screened and processed by water-based coal cleaning techniques. Physical coal cleaning by dense media separation and a Deister shaking table were evaluated. A combination of physical cleaning and chemical cleaning was done using dense media separation and ion exchange. Physical cleaning was done on 1/2 " by 3/8", 3/8" by 1/4", 1/4" by 20-mesh, and 20-mesh by 100-mesh fractions. Chemical cleaning by ion exchange testing was done on the 1/4" by 20-mesh physically cleaned fraction. Physical cleaning on a Deister shaking table was evaluated on a 20-mesh by 100-mesh fraction. Float-sink washability at 1.3, 1.4, and 1.6 specific gravity using true specific gravity (Certigrav) solutions was done on a 1/4" by 20-mesh fraction.

A number of different samples were subjected to Ca-sludge ion exchange and sulfuric acid treatment to lower sodium content. It was found that Ca-sludge did not significantly ion exchange into or replace sodium in lignite even in the presence of carbonic acid (solubilized carbon dioxide). Sodium reductions of nominally 28% were accomplished for lignite particles less than 3/8" using a dilute acid spray followed by a water rinse. If the acid spray was followed by a water rinse containing calcium-rich sludge, a nominal 38% reduction of sodium was observed.

Washability Study Results (1/4" by 20-mesh)
Moisture Free Basis

| <u>Fraction</u> | <u>wt%</u> | <u>Ash</u> <u>Wt%</u> | <u>Sulfur</u> <u>wt%</u> | <u>Heating Value</u> <u>Btu/lb</u> | <u>SO₂</u> <u>lbs/MMBtu</u> |
|-----------------|------------|--------------------------|-----------------------------|---------------------------------------|---|
| Feed | 100.00 | 10.56 | 1.23 | 10,896 | 2.26 |
| 1.3 Float | 70.28 | 7.12 | 0.71 | 11,371 | 1.25 |
| 1.4 Float | 22.48 | 12.23 | 0.96 | 10,690 | 1.80 |
| 1.6 Float | 5.06 | 24.93 | 1.89 | 8,876 | 4.26 |
| 1.6 Sink | 2.18 | 55.46 | 18.68 | 4,033 | 92.64 |
| Closure | | 97% | 107% | | |

Physical cleaning was done on 1/4" by 20-mesh fine fractions in a pilot-scale dense-media cone separator. Three trial runs were made. Each run was set to duplicate a 1.2 to 1.3 specific gravity separation.

Dense Media Separation Results - Fine Fraction (1/4" by 20-mesh)
Moisture Free Basis

| <u>Fraction</u> | <u>wt%</u> | <u>Ash</u> <u>Wt%</u> | <u>Sulfur</u> <u>wt%</u> | <u>Heating Value</u> <u>Btu/lb</u> | <u>SO₂</u> <u>lb/MMBtu</u> |
|-----------------|------------|--------------------------|-----------------------------|---------------------------------------|--|
| Feed | 100.00 | 10.64 | 1.31 | 10,787 | 2.44 |
| <u>Trial 1</u> | | | | | |
| Float | 61 | 7.77 | 0.79 | 11,129 | 1.42 |
| Tailings | 28 | 17.92 | 2.39 | 9,835 | 4.86 |
| <u>Trial 2</u> | | | | | |
| Float | 55 | 7.91 | 0.70 | 11,083 | 1.26 |
| Tailings | 45 | 15.02 | 1.89 | 10,198 | 3.71 |
| <u>Trial 3</u> | | | | | |
| Float | 67 | 10.64 | 0.76 | 10,903 | 1.39 |
| Tailings | 29 | 25.18 | 1.26 | 8,894 | 3.38 |

Physical cleaning was also done on 1/2" by 3/8" and 3/8" by 1/4" coarse fractions in the pilot-scale dense media cone separator.

Dense Media Separation Results - Coarse Fractions
Moisture Free Basis

| <u>Fractions</u> | <u>Ash</u> <u>wt%</u> | <u>Sulfur</u> <u>wt%</u> | <u>Heating Value</u> <u>Btu/lb</u> | <u>SO₂</u> <u>Lbs/MMBtu</u> |
|---------------------|--------------------------|-----------------------------|---------------------------------------|---|
| <u>1/2" by 3/8"</u> | | | | |
| Feed | 11.38 | 1.40 | 10,777 | 2.59 |
| Float | 7.73 | 0.83 | 11,284 | 1.47 |
| Sink | 17.17 | 1.92 | 10,001 | 3.84 |
| <u>3/8" by 1/4"</u> | | | | |
| Feed | 10.84 | 1.14 | 10,767 | 2.12 |
| Float | 8.10 | 0.86 | 11,167 | 1.54 |
| Sink | 16.89 | 1.73 | 10,043 | 3.44 |