

LRC-XII-46
ADDITIVE EVALUATION FOR EMISSION CONTROL
AND MITGATION OF BOILER FOULING AND SLAGGING

CONTRACTOR: The North American Coal Corporation

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PARTICIPANTS

<u>Sponsor</u>	<u>Cost Share</u>
The North American Coal Corporation	\$27,729
ND Industrial Commission	<u>27,000</u>
Total	\$54,729

Project Schedule – 3 Months

Contract Date – 8/6/93
Start Date – 8/6/93
Completed – 2/25/94

Project Deliverables

Final Report – 2/25/94 ✓

OBJECTIVE / STATEMENT OF WORK

The purpose of this proposal is to evaluate the addition of proprietary chemical compounds to the lignite fuel and/or gas stream to reduce SO₂ and NO_x emissions. The Clean Air Act Amendment of 1990 (CAAA) will force many utilities to reevaluate their strategies for meeting emission of SO₂ and NO_x from coal-fired power plants. The installation of scrubbers to meet the emission limits is a high capital cost option of questionable efficiency. A significant opportunity exists for the commercial demonstration of cost-effective control technologies that meet the emission standards imposed by the CAAA.

STATUS

Lignite from the Freedom Mine near Beulah, North Dakota, was used in a series of pilot-scale combustion tests to evaluate SO₂ and NO_x emission control of proprietary provided by Praxis, Inc. Combustion tests were done the week of October 11-15, 1993, at the Energy & Environmental Research Center (EERC) at the University of North Dakota in Grand Forks, North Dakota. Representatives of Praxis Inc. and The North American Coal Corporation observed the tests. Analysis of the Freedom Mine lignite used in the tests is shown in the following table.

**Analysis of the Freedom Mine Lignite
(As-fired 10/11/93)**

	(wt%)
Proximate Analysis	
Moisture	30.20
Volatile Matter	30.61
Fixed Carbon	30.62
Ash	8.57

Ultimate Analysis	
Hydrogen	3.06
Carbon	44.66
Nitrogen	0.56
Sulfur	0.87
Oxygen	12.08
Ash	8.57
Moisture	30.20

Heating Value 7,407 Btu/lb.

Sulfur Input 2.34 SO₂/MMBtu

Ash Input 11.57 Ash/MMBtu

(As-Received 8/26/93)

Sulfur Forms	(wt%)
Sulfatic	0.03
Pyritic	0.43
Organic	0.33

Ash Properties

Ash Analysis	(wt% as analyzed) (wt% SO ₃ – Free)	
SiO ₂	25.00	31.44
Al ₂ O ₃	10.75	13.52
Fe ₂ O ₃	13.37	16.82
TiO ₂	0.23	0.29
P ₂ O ₅	0.62	0.78
CaO	17.45	21.95
MgO	6.65	8.37
Na ₂ O ₃	5.17	6.15
K ₂ O	0.25	0.32
SO ₃	20.49	-----

The materials safety data sheet (MSDS) provided with the proprietary additive indicated bentonite clay (a mixture of common aluminosilicates) and teratasodium pyrophosphate ($\text{Na}_4\text{P}_2\text{O}_7$). The MSDS also indicated a small amount of crystalline quartz (SiO_2). Thermogravimetric analyses (TGA) of the proprietary additive under oxygen and argon atmosphere indicated essentially identical weight loss curves. The TGA shows approximately 7.5% weight loss at 100 degrees C, an additional 1-2% loss at between 260 and 355 degrees C and a continual weight loss of 8.7% until a temperature of 716 degrees C.

The combustion test furnace at EERC operates at 75 to 85 lb./hr of coal feed. The furnace was equipped to feed the additive at the various rates in the postcombustion and precombustion zones. Similarly, same ports were located throughout the system.

Based on flue gas and fly ash analysis, the various proprietary additives evaluated did not substantially reduce SO_2 or NO_x emission. It is recommended that further additive development should be done to establish mechanisms involving oxidation of SO_2 to SO_3 .