FY05-LIII(53)-140
"Activated Carbon Production from North Dakota Lignite"

Submitted by: Energy & Environmental Research Center
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PARTICIPANTS

Sponsor	Cost Share
BNI Coal	$ 250,000
DOE	$ 270,000
NDIC	$ 250,000
Total Cost	$ 770,000

Project Schedule - 9 Months

Contract Date – June 10, 2005
Start Date – June 14, 2005
Completion Date – ~~May 1, 2006~~
Extended to – ~~September 30, 2006~~
– ~~January 31, 2007~~
– ~~October 31, 2007~~
– May 31, 2008

Project Deliverables

Contract Signed: ✓
Quarterly Reports:
10/1/05(✓);
1/1/06(✓); 4/1/06(✓)
Final Report: ~~10/31/07( )~~
5/31/08(✓)

OBJECTIVE / STATEMENT OF WORK:

Determine the feasibility of developing a commercial activated char (AC) production process using lignite. The project would: 1) examine viable options for producing AC sorbents from lignite; 2) scale-up the carbon activation process of lignite from laboratory fixed-bed to pilot-scale production; 3) determine the surface area, physiochemical surface characteristics, and flue gas surface interactions of prepared carbons and compare to bench-scale and other carbons; and 4) develop a design for commercial implementation of an AC production facility in North Dakota.

Status

July 1 – September 30, 2005 Status Report
A bench-scale rotary kiln was made fully operational followed by shakedown carbonization tests using Center mine lignite. Shakedown tests preliminary results indicate production of good intermediate char, although best conditions will be defined in future tests.

October 1 – December 21, 2005
Two types of Hagel lignite coal were sized to nominal -1/8 inch + 10-mesh material. Carbonation was carried out on a semi-continuous basis. Steam activation of carbonized lignite was investigated. Mercury capture results in a pilot scale ESP with subbituminous coal flue gas using Center Mine lignite and DARCO carbon were compared.

January 1 – March 31, 2006
Additional testing was conducted to evaluate the properties of the activated carbon samples generated from North Dakota lignite. The mercury capturing performance was evaluated and compared to the DARCO carbon. The carbon was evaluated for iodine number. A feasibility study including process design, equipment selection, and component layout have been for an activated carbon production plant near a North Dakota power plant.

April 1 – June 30, 2006
Development of a test matrix for preparing a new batch of coal in the rotary kiln for pilot-scale testing on a combustor equipped with an electrostatic precipitator, evaluation of sorbent performance, and a market assessment.

July 1 – September 30, 2006
Activities included production of activated carbon in the rotary kiln for process optimization, bench-scale mercury capture tests by North Dakota lignite-derived activated carbon, pilot-scale testing of activated carbon on a combustor equipped with an electrostatic precipitator, evaluation of sorbent performance, and a market assessment.

October 1 – December 31, 2006
Samples of North Dakota carbon sorbent were enhanced for mercury control testing in the pilot-scale particulate test combustor (PTC). Three sorbents are being prepared and will be tested next quarter.

January 1 – March 31, 2007
Additions to the scope of work were prepared. The tasks include: production of activated carbon in a pilot-scale multiple-hearth furnace; enhanced sorbent formulation and pilot-scale testing for mercury capture performance; and carbon resource assessment.

April 1 – June 30, 2007
The additions to the scope of work will be reported under a new contract with the NDIC. Activities under the current scope of work will include a review of the market assessment and preparation of the draft final report.

July 1 – September 30, 2007
A review of the market assessment was started. Parts of the draft final report are being prepared.

October 1 – December 31, 2007
The research plan described in the scope of work was completed. The draft final report is being prepared and will be completed in the next quarter.

Final Report
Activated carbon was produced from lignite coal in both laboratory-scale fixed-bed reactors and in a small pilot-scale rotary kiln. The activated carbon production process involved two main steps: 1) carbonization – driving out moisture and volatiles to obtain the fixed carbon portion of the coal and 2) activation – partial gasification with steam or carbon dioxide to open the pore structure and increase the surface area. The laboratory-scale tests were conducted to determine the optimum process conditions for activated carbon production and to guide the pilot-scale optimization process conditions. The EERC was successfully able to upgrade the laboratory-scale activated carbon production system to a pilot-scale rotary kiln system. Pilot-scale tests were conducted in a continuous rotary kiln system to determine the optimum process parameters for the production of activated carbon. The EERC conducted a series of optimization tests for both carbonization and steam activation processes in both laboratory-scale fixed-bed reactors and in the pilot-scale rotary kiln system. The conceptual design feasibility study addressed the possibility of using local North Dakota lignite to produce powdered activated carbon. Plant production, annual operating cost and sales adjusted for maintenance downtime, and financing were used to determine a simple annual return on investment. The activated carbon produced from Center, North Dakota would represent a

viable and competitive product. Future work should include pilot-plant demonstrations to confirm all technical assumptions as well as provide samples for customer development.