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"Impacts of Lignite Properties on Powerspan's NOx Oxidation System"

Submitted by: EERC
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PARTICIPANTS

Sponsor		Cost Share
U.S. DOE		$132,800
Minnkota Power Cooperative		$198,485
Powerspan		$ 19,280
NDIC		$260,420
	Total Cost	$610,985

Project Schedule – 7 Months
Contract Date – 6/19/07
Start Date – 6/1/07
Completion Date – 12/31/07

Project Deliverables
Status Reports:
10/31/07 (✓)
Draft Final Report: 12/31/07 (✓)
Final Report: 2/28/08 (✓)

OBJECTIVE / STATEMENT OF WORK:
Demonstrate the Powerspan system's ability to reduce nitrogen oxides and other pollutants from the flue gas of lignite combusted in the Milton R. Young Station Unit 1 boiler. The effects of high-sodium lignite on the quartz electrodes in the Power Span system will be examined.

STATUS

July 1 – September 30, 2007.
Slipstream reactor system operation was initiated in early July and the system continues to operate reliably. Sets of two sample electrodes were removed from the reactor for analysis at 2-week intervals. Early findings indicate recommended modifications to the existing test plan for the remainder of the test plan. Standard sample testing was modified to wash one of the sample electrodes with water and allow it to dry before testing in Powerspan's laboratory reactor. The other sample electrode will be tested with the ash accumulation layer intact. Nitrogen oxide conversion performance will be recorded for both electrodes. Upon completion of Powerspan's laboratory testing, the electrodes will be sent to the EERC for analysis where both electrodes and the ash will be analyzed.

Final Report
Powerspan's multipollutant control process called electrocatalytic oxidation (ECO) technology is designed to simultaneously remove SO2, NOx, PM2.5, acid gases, SO3, Hg, and other metals from the flue gas of coal-fired power plants. A challenging characteristic of selected North Dakota lignites is their high sodium content. Suring high-sodium lignite combustion and gas cooling, the sodium vaporizes and condenses to produce sodium- and sulfur-rich aerosols. Based on past work, it was hypothesized that the sodium aerosols would deposit on and react with the silica electrodes and react with the electrodes, resulting in the formation of sodium silicate. The deposit and reacted surface layer would then electrically alter the electrode, thus impacting its dielectric properties and NOx conversion capability.

An electrocatalytic oxidation (ECO) reactor slipstream was designed by Powerspan and the EERC. The slipstream system was installed by the EERC at Minnkota Power Cooperative's Milton R. Young Station Unit 1 downstream of the electrostatic precipitator. The system operated for 107 days, starting on July 3, 2007. A pair of electrodes were extracted and replaced on a biweekly basis and tested. The results indicated that the system was adversely affected by accumulation of the aerosol materials on the electrode. NOx conversion by ash-covered electrodes was significantly reduced; however, with electrodes that were rinsed with water, the NOx conversion efficiency recovered to nearly that of a new electrode. In addition, the visual appearance of the electrode after washing did not show evidence of a cloudy reacted surface by appeared similar to an unexposed electrode. Sodium and sulfur are the main culprits in fouling of the electrodes.

Conclusions:

1) Sodium-rich aerosols and small ash particles accumulated and become bonded on the surface of the silica electrodes.
2) Ash accumulations adversely affected the NOx conversion.
3) The adverse impact occurs within a 2-week time period.
4) The ash accumulations are readily removed with a water wash, and the electrodes are not permanently affected by the ash.
5) The Powerspan ECO technology may prove to be viable if the ash accumulation can be kept to a minimum.

Based on the results obtained in the work, it appears that the ECO technology has potential for inclusion in new power plant design and construction but is significantly impacted by the sodium-rich ash. Sodium reduction upstream of the reactor and aggressive ECO reactor cleaning methods are possible methods that will enable the ECO technology to maintain the expected 90% NOx removal efficiency.