TOXECON II™ AND HIGH-TEMPERATURE REAGENTS OR SORBENTS FOR LOW-COST MERCURY REMOVAL

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This three-site project is part of an overall program funded by the Department of Energy's National Energy Technology Laboratory (NETL) and industry partners to obtain the necessary information to assess the feasibility and costs of controlling mercury from coal-fired utility plants. Host sites included in this program are Entergy's Independence Station, and MidAmerican's Louisa and Council Bluffs Stations. TOXECON II™ evaluations are ongoing at Independence Station. High temperature sorbents were tested at Louisa Station and are planned for testing at Council Bluffs.

Field testing began in the fall of 2005 and will be completed in 2007. A summary of results from TOXECON II™ testing at Independence will be presented during this NETL meeting.

Successful demonstration of the TOXECON II™ technology is of interest to DOE and industry because it should allow high mercury removal while providing a mechanism to separate most of the fly ash from mercury-laden sorbents with minimal capital investment. This is accomplished by installing a sorbent injection grid between particulate collection fields in the ESP, allowing sorbent-free ash to be collected in the upstream fields. The sorbent and remaining ash is collected in the downstream fields.

Testing is underway at Entergy's 842 MW Independence Steam Electric Station, Unit 2. Independence fires Powder River Basin (PRB) coal and is equipped with a high-SCA cold-side electrostatic precipitator (ESP) for particulate emissions control. During most of the full-scale testing at Independence, activated carbon was injected inside the ESP after the first two collection fields. Mercury removal was also characterized at two other injection locations: upstream of the ESP and between the third and fourth collection fields. The ESP for Unit 2 has four boxes. The inlet and outlet ducts for each box are split into two separate ducts. Injection grids were installed in one-half of one box to treat one-eighth of the total flue gas flow.

Four powdered activated carbon (PAC) sorbents were evaluated during the parametric tests: DARCO® Hg, DARCO® Hg-LH, DARCO® E-10 and DARCO® E-11. Little difference in the mercury removal performance of the four materials was noted. Additionally, injection concentrations of more than 5 lb/MMacf were required to achieve 80% mercury removal. At other ESP sites firing PRB coal, such as Ameren's Meramec Station, 80% mercury removal has been achieved with 2 to 3 lb/MMacf DARCO® Hg-LH injected upstream of the ESP.

Subsequent testing at Independence with the injection grids placed upstream of the ESP resulted in greater than 80% at 1 to 2 lb/MMacf.

Based on results from the parametric tests, DARCO® Hg-LH was chosen for testing during a 30-day continuous injection period. The long-term testing data indicate that the removal rate varied with unit load, increasing as the load decreased and decreasing as the load increased.

The lower-than expected mercury removal in the TOXECON II™ configuration compared to upstream injection, and the inconsistent results between high and low-load suggested poor carbon distribution within the ESP. Physical and CFD models of the injection lances and ESP were prepared and analyzed to characterize the distribution. Both models suggested poor carbon distribution from the top to the bottom of the injection lances, with more than 30% of the carbon exiting the lowest injection nozzle. The results also indicated that the carbon was not achieving good coverage at all load conditions.

The injection nozzles on the lances tested at Independence were placed perpendicular to the flue gas flow. The distance the carbon travels from the injection lance is a function of the flue gas flow. The carbon travels further toward the adjacent lance at low load when the flue gas velocity is low than at high load when the flue gas velocity is higher. Both CFD and physical models indicate that the carbon did not completely cover the area between the lances. The physical model showed that most of the carbon traveled less than 12-inches towards the adjacent lance at high load conditions. Since the lances were placed nominally 33-inches apart and the distance from the injection grid to the downstream collection plates was limited, some of the flue gas was not treated with activated carbon. This is likely the cause of the difference in the measured mercury removal across the ESP at high load compared to low-load.

The sorbent injection system has been redesigned to provide more uniform carbon distribution at all load conditions. The new grid will be installed in preparation for additional testing in 2007.