PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Environmental & Water Resources

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EVALUATION OF MERCAP™ FOR POWER PLANT MERCURY CONTROL

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Description

Objective

The objective of this project is to demonstrate the performance of MerCAP™, a technology that uses a fixed sorbent downstream of wet and dry scrubbers for removing mercury from coal combustion flue gas. MerCAP™ technology has been successfully tested in small-scale units installed at Great River Energy's Stanton Station and at Southern Company Services' Plant Yates Unit 1. This study will verify the performance of the technology at a larger scale and over a longer period of gas exposure and will provide data required for assessing the feasibility and estimating the costs of full-scale implementation. It will also provide information about optimal operating conditions for different flue gas conditions, the effectiveness of sorbent regeneration, and the ability of the gold sorbent to hold up to flue gas over an extended period.

Background

The general concept for MerCAP™ is to place fixed structure sorbents into a flue gas stream to adsorb mercury and then, as the sorbent surfaces becomes saturated, regenerate the sorbent and recover the mercury. Results from modeling studies and field testing of a single-plate, gold-coated MerCAP™ probe by the Electric Power Research Institute (EPRI) have indicated that high mercury removals can be achieved over relatively short plate lengths at very high flue gas velocities. Since the gold sorbent can efficiently capture elemental mercury, whereas existing wet or dry flue gas desulfurization (FGD) units are better suited to capture oxidized mercury, a promising initial retrofit application of the MerCAP™ technology is for "polishing" of elemental mercury downstream of FGD devices. Small-scale tests have also indicated that gold-coated plates can be thermally or chemically regenerated without degradation of the adsorption capacity. The system is very flexible via alteration of plate length, spacing, and flue gas flow rate. Disposal of mercury-contaminated sorbents is minimized.

Summary

The URS Group is conducting tests at two host power plants to evaluate gold MerCAP™ performance downstream of two different FGD devices over an extended period of flue-gas exposure. At Unit 10 of Great River Energy's Stanton Station, which has burned a North Dakota lignite coal and a Powder River Basin (PRB) sub-bituminous coal, an array of gold-coated MerCAP™ plates has been incorporated into the outlet plenum of one compartment (6 MWe) of the baghouse downstream of a spray dryer FGD. The outlet duct was split into four

COST

Total Project Value
$1,725,716

DOE/Non-DOE Share
$1,113,216 / $612,500

PERIOD OF PERFORMANCE

September 2003 to
September 2006

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parallel sections and a slightly different MerCAP™ configuration was placed in each section. Plate spacings of 1-inch and ½-inch were employed and, in some cases, the plates were pre-treated by acid-washing to remove impurities from the gold surfaces. Acid-washing and thermal treatment were both tested as a means of removing the collected mercury from the plates and regenerating the gold surfaces for further use. At Southern Company Services' Plant Yates Unit 1, which burns an Eastern bituminous coal, an array of gold-coated structures will be configured in a 2,800 actual cubic foot per minute (acfm) slipstream (1 MWe) receiving flue gas immediately downstream of a full-scale wet FGD absorber.

Accomplishments

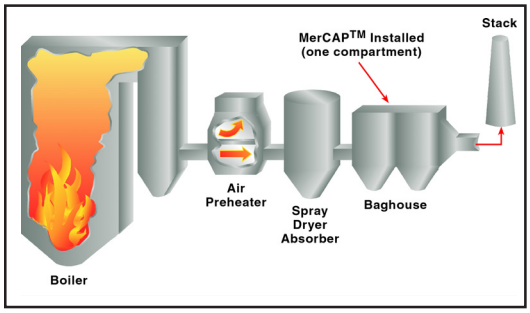
- MerCAP™ technology has been in continuous operation for over 5,300 hours at Stanton Station. The first 1,700 hours of service were with ND lignite coal and the remaining service hours with PRB coal. Mercury removal efficiencies with acid pre-treated plates and 1-inch spacing have averaged 30-35% during this time period.
- Acid pre-treated plates removed mercury more efficiently than untreated plates; regeneration via acid-washing also improved the mercury removal performance of the plates. Tighter plate spacing (½-inch vs. 1-inch) also improved mercury removal performance.
- MerCAP™ substrates were subjected to three thermal regeneration cycles with no measurable negative impact on the mercury capture performance; removal efficiencies actually increased slightly after each regeneration cycle.

Planned Activities

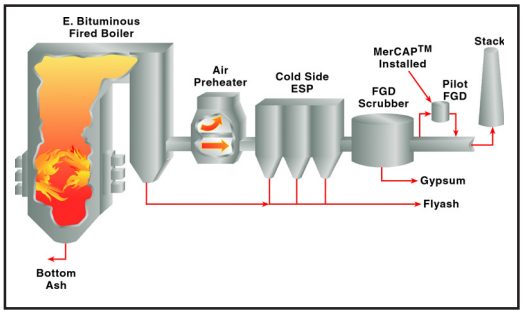
- Testing at Stanton Station will be completed. An additional series of Ontario Hydro measurements will be made to verify the performance and accuracy of the mercury continuous emissions monitor (CEM) utilized during periodic performance evaluations.
- The MerCAP™ reactor for Plant Yates Unit 1 will be installed and mercury measurements will be made over a 6-month period.

Issues

Lower fuel sulfur levels associated with PRB fuel have required less reagent slurry injection into the spray dryer FGD than for lignite. However, the higher flue gas temperatures associated with low rates of slurry injection seem to adversely affect the mercury capture efficiency of the gold sorbent. The relationship of plant slurry feed rates and spray dryer outlet temperatures to MerCAP™ performance is being further investigated. During both thermal and chemical regeneration, only a fraction of the mercury theoretically collected on the plates was recaptured. Reasons for this discrepancy are also being investigated.



Schematic of flue gas treatment system at Stanton Station.



Schematic of MerCAP™ installation at Plant Yates.