PROJECT facts

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

Environmental and Water Resources

11/2006

EVALUATION OF MERCAP™ FOR POWER PLANT MERCURY CONTROL

Background

Several technologies are under development for removing mercury from power plant flue gas streams. The mercury control via adsorption process (MerCAP™) relies on fixed structure sorbents positioned in the flue gas stream to adsorb mercury and then, as the sorbent becomes saturated, regenerate the sorbent and recover the mercury. Results from modeling studies and field testing of a single-plate, gold-coated MerCAP™ 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 via formation of a gold/mercury amalgam on the sorbent surface, 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 systems. Pilot-scale tests have also indicated that gold-coated plates can be thermally or chemically regenerated with minimal degradation in mercury adsorption capacity.

Primary Project Goal

During two six-month extended field tests, URS will evaluate gold MerCAP™ performance downstream of a: (1) spray dryer adsorber and fabric filter (SDA/FF) configuration at Great River Energy's Stanton Station Unit 10; and (2) jet bubbler reactor (JBR) wet FGD system at Georgia Power's Plant Yates Unit 1. These tests will provide information about optimal operating conditions for different flue gas conditions, the effectiveness of sorbent regeneration, and the durability of gold sorbents over an extended time period. MerCAP™ technology has been successfully tested in small-scale units installed at the host sites. Results from the full-scale extended field tests will provide data required for assessing the feasibility and costs of a full-scale MerCAP™ application.

Objectives

- At Stanton Station Unit 10, an array of gold-coated MerCAP™ plates was incorporated into the outlet plenum of one compartment (6 MWe) of the FF downstream of the SDA. The outlet duct was split into four parallel sections to evaluate slightly different MerCAP™ configurations. Plate spacings of 1-inch and ½-inch were employed and, in some cases, the plates were pre-treated with acid to remove impurities from the gold surfaces.
- At Plant Yates Unit 1, an array of gold-coated MerCAP™ plates has been 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 system. Field testing of the MerCAP™ technology is currently ongoing at this low-sulfur Eastern bituminous coal-fired unit.

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PERIOD OF PERFORMANCE

09/26/2003 to 09/30/2006

COST

Total Project Value
$1,725,716

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

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- Chemical (i.e., acid) and thermal treatment are being evaluated as potential sorbent regeneration techniques.
- During each six-month demonstration, small-scale tests are being conducted using a 40-acfm slipstream probe device ("Mini-MerCAP™ probe") to evaluate the mercury removal efficiency of the gold-coated MerCAP™ plates following repeated regeneration cycles.

Accomplishments

Following more than 6,000 hours of continuous operation, the MerCAP™ demonstration at Stanton Station Unit 10 concluded in March 2005. The first 1,700 hours of service evaluated MerCAP™ performance with North Dakota lignite coal and the remaining service hours evaluated MerCAP™ performance with Powder River Basin (PRB) subbituminous coal. The tests compared untreated and acid-treated gold-coated MerCAP™ plates to assess relative performance. Mercury removal decreased from approximately 95 percent to 45 percent during the first 25 hours of service. At the conclusion of field testing, mercury removal averaged 30-35 percent across the acid-treated MerCAP™ plates and 10-30 percent across the untreated plates.

In January 2005, the untreated MerCAP™ substrates were regenerated via acid treatment. Following regeneration, mercury removal increased from 12-30 percent to 58 percent for ½-inch plate spacing and from 10-18 percent to 52 percent for 1-inch plate spacing.

Acid pre-treated plates removed mercury more efficiently than untreated plates; regeneration via acid treatment also improved the mercury removal performance of the plates. In addition, tighter plate spacing (½-inch vs. 1-inch) improved the mercury capture efficiency of the MerCAP™ technology. MerCAP™ plates were also subjected to three thermal regeneration cycles, after which, mercury removal increased slightly.

Planned Activities

- Completion of the final site report for Stanton Station Unit 10 that will include: (1) a discussion of the relationship between SDA operating conditions and MerCAP™ performance; (2) an assessment of sorbent durability; (3) complete analysis of the thermal and chemical regeneration processes; and (4) an economic assessment of full-scale MerCAP™ installation costs.
- Continuous operation of the MerCAP™ technology over a six-month period at Plant Yates Unit 1.

Duct Section	Substrate	Plate Spacing	Installation Date	Average Mercury Removal
Duct 1	Acid-treated	1"	8/22/04	30-35%
Duct 2	Untreated	1"	11/18/04	10-18%
Duct 2	Acid-treated	1"	1/25/05	52%
Duct 3	Untreated	½"	11/18/04	12-30%
Duct 3	Acid-treated	½"	1/25/05	58%
Duct 4	Baseline	N/A	N/A	0%

MerCAP™ Performance Summary for Stanton Station Unit 10