Field Test Program for Long-Term Operation of a COHPAC® System for Removing Mercury from Coal-Fired Flue Gas

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ABSTRACT

Injection of sorbents upstream of a COHPAC® baghouse for mercury removal showed promising results during a short-term evaluation conducted in 2001. However, to truly begin estimating the long-term mercury removal capability and the impact on plant operating equipment of this technology, a much longer-term evaluation is essential. The Department of Energy National Technology Laboratory (NETL), Southern Company, and EPRI funded a follow-on program to evaluate sorbent injection for mercury control for a year of continuous operation.

The test was conducted at Alabama Power Company's Plant Gaston Unit 3. The overall objective was to evaluate the long-term effects of sorbent injection on mercury capture and COHPAC® performance. Data from the testing will be used to determine:

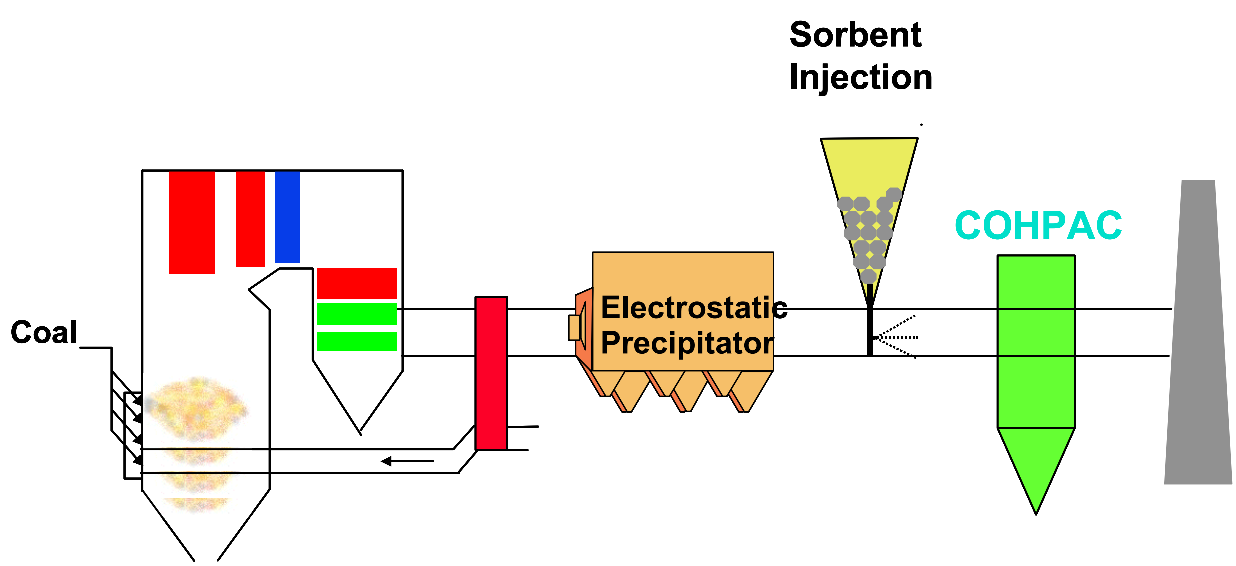
1. Air-to-cloth ratio;
2. Advantages/disadvantages of high-permeability fabrics; and
3. Design criteria and costs for new TOXECON™ systems.

INTRODUCTION

Injecting a sorbent such as powdered activated carbon into the flue gas represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers. The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with the mercury attached is then collected by the existing particle control device, either an electrostatic precipitator (ESP) or fabric filter (FF). Over the past several years, the results from numerous full-scale evaluations of activated carbon injection (ACI) for mercury removal indicate that activated carbon is a viable technology for mercury control on coal-fired power plants (Durham, et al., 2003, Bustard, et al., 2001).

For some plants, one of the disadvantages of injecting activated carbon is its impact on the salability or reuse of ash. Tests have shown that the activated carbon interferes with chemicals used in making concrete. One straightforward, cost-effective approach to achieving high mercury removal without contaminating the fly ash is the use of the EPRI COHPAC® (COHPAC) and TOXECON™ (TOXECON) processes that are currently commercially available. COHPAC is an EPRI-patented concept that places a high air-to-cloth ratio baghouse downstream of an existing ESP to improve overall particulate collection efficiency. The process becomes TOXECON when a sorbent such as activated carbon is injected upstream of the baghouse located downstream of an ESP (Figure 1). With this configuration, the ash collected upstream of the carbon injection remains acceptable for sale (typically >99% of the ash.) The downstream baghouse provides an effective mechanism for the activated carbon to have intimate contact with vapor-phase mercury, resulting in high levels of mercury control at relatively low sorbent injection rates.

Figure 1. Configuration Combining ACI and a Secondary Fabric Filter.



The advantages of the TOXECON configuration are:

- Sorbents are mixed with a small fraction of the ash (nominally 1%), which reduces the impact on ash reuse and waste disposal.
- Full-scale field tests have confirmed that fabric filters require only 10–20% of the sorbent required by ESPs to achieve similar removal efficiencies.
- Capital costs for COHPAC are less than other options such as replacing the ESP with a full-sized baghouse or larger ESP.
- COHPAC requires much less physical space than either a larger ESP or full-size baghouse system.
- Outage time can be significantly reduced with COHPAC systems in comparison to major ESP rebuilds/upgrades.

BACKGROUND

In 2001, a short-term test of ACI upstream of COHPAC was conducted on half of Alabama Power's E.C. Gaston Station Unit 3 (Bustard, et al., 2001). Figure 2 presents the results from the parametric tests, which evaluated mercury removal at different ACI concentrations. The tests showed that 90% mercury removal could be achieved at relatively low injection concentrations (<3lbs/MMacf); however, they also showed that baghouse cleaning frequency increased proportionally with injection rate. Based on these results, a two-week injection test was conducted at an injection concentration of 1.5 lbs/MMacf, which was the highest injection rate possible without significantly impacting cleaning frequency. Figure 3 presents inlet and outlet mercury concentrations, boiler load, and carbon injection rate for a portion of the two-week test. Also shown in this graph are the results from Ontario Hydro mercury measurements, which confirmed the accuracy of the mercury analyzer measurements.

Figure 2. Mercury Removal with Activated Carbon Injected Upstream of COHPAC at Alabama Power Plant Gaston, Spring 2001.

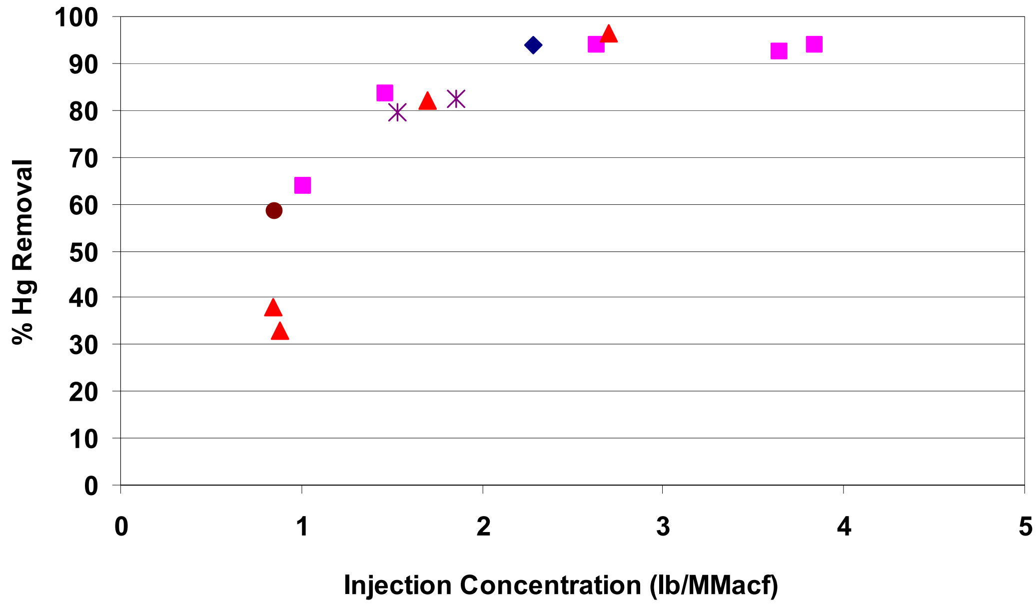
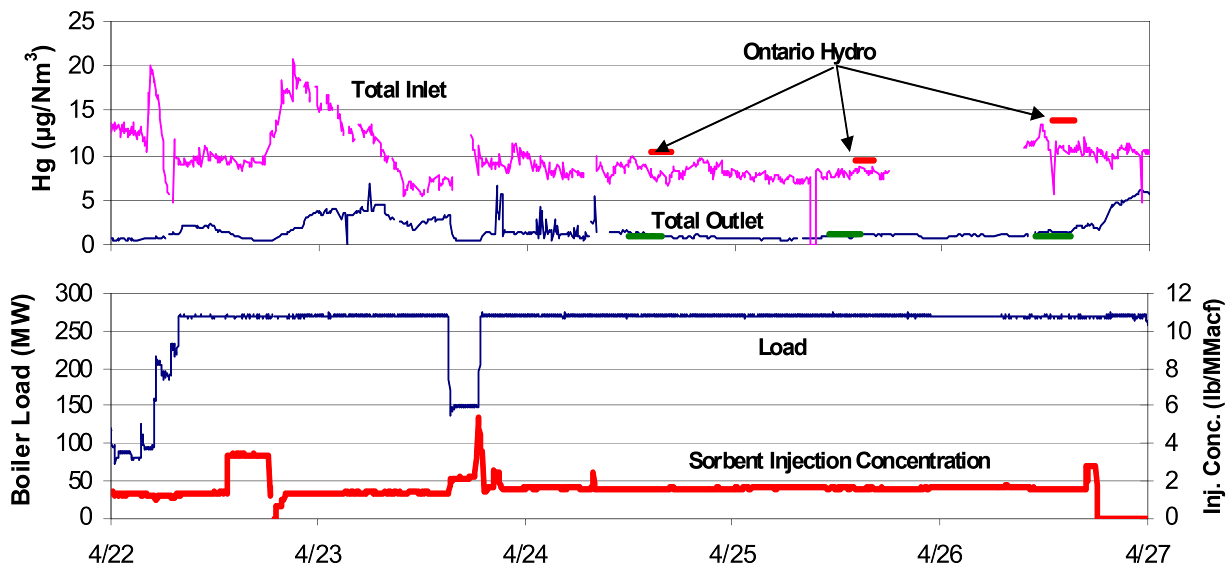


Figure 3. Inlet and Outlet COHPAC Mercury Concentrations, Boiler Load and ACI, Plant Gaston, 2001.



NETL TEST PROGRAM

The results from the first field test program at Gaston provided a good indication of the capabilities (high mercury removal) and limitations (high cleaning frequency) of the TOXECON technology for controlling mercury. However, the tests were performed for a limited amount of time (< 200 hours of continuous operation) and did not allow for a thorough operational analysis of the use of this technology for mercury control. In the fall of 2002, ADA-ES, Inc., was selected by the Department of Energy's National Energy Technology Laboratory (NETL) to continue to mature the technology by conducting a long-term test program of ACI technology on a coal-fired boiler equipped with a COHPAC baghouse at the Gaston Station. Under the contract, ADA-ES worked in partnership with DOE/NETL, Southern Company, and EPRI. Technical and cost-share financial support were provided by EPRI, Southern Company, Hamon Research-Cottrell, Ontario Power Generation, TVA, Duke Power, Arch Coal, and ADA-ES.

The overall objectives of this yearlong mercury control program were to provide data to assess the operational impacts to COHPAC and the ability to effectively control mercury over varying operational and seasonal conditions. This program had four specific tasks:

1. Design and installation of an activated carbon injection system capable of continuous operation for up to one year.
2. Installation of a mercury analyzer capable of long-term, continuous operation. This analyzer is referred to as a Semi-Continuous Emissions Monitor (S-CEM).
3. Evaluation of long-term performance of carbon injection upstream of COHPAC for mercury control. This task had two separate test periods:
    a. The first test (approximately six months) was conducted using the existing set of bags.
    b. The second test (approximately six months) was conducted on a set of new "high-perm" bags.
4. Perform short-term tests of different sorbents and sorbent suppliers.

A key parameter evaluated in this test program was the fabric used to make the filter bags. The OEM fabric for the four existing COHPAC baghouses in the U.S. (Gaston Units 2 and 3 and TXU's Big Brown Units 1 and 2) was a 2.7 denier Ryton™ felt. Denier is a measure of the linear density of a fiber and provides an indication of the cross section or thickness of the fibers.

Since 1998, EPRI has invested significant resources to develop a high-permeability (high-perm) fabric that has inherently higher permeability and therefore lower operating pressure drop. The most successful high-perm fabric has been one made with a 6 or 7 denier instead of 2.7 denier felt. After a year of operation at Big Brown, residual drag of the high-perm fabric was half that of the 2.7 denier fabric (Bustard, et al., 1997). This fabric reduced pressure drop at Big Brown and because of this the plant has switched to ordering high-perm fabric for all bag replacements.

This fabric was of interest at Gaston because the major impact on COHPAC from the earlier short-term sorbent injection testing was an increase in cleaning frequency, or equivalently pressure drop. This high-perm fabric may provide a way to reduce the impact of increased mass loading on pressure drop and allow for either higher injection rates or less performance degradation over time.

The majority of the testing occurred under Task 3, where a six-month test was conducted on two different fabrics. For each of the bag types, three test periods were planned:

1. **Baseline:** Testing in this period was dedicated to understanding baghouse operation and mercury removal with no carbon injection.
2. **Optimization:** The tests in 2001 showed that carbon injection directly impacted baghouse cleaning frequency (Bustard et al., 2001). This period was included to find a carbon injection scheme that achieved the highest mercury removal within the operational limits of the system.
3. **Long-Term Testing:** Operate continuously at optimized injection conditions.

Description of the Test Site

The E.C. Gaston Electric Generating Plant, located in Wilsonville, Alabama, has four 270-MW balanced draft and one 880-MW forced draft coal-fired boilers. All units fire a variety of low-sulfur, washed, Eastern bituminous coals.

The primary particulate control equipment on all units are hot-side ESPs. Units 1 and 2 and Units 3 and 4 share common stacks. In 1996, Alabama Power contracted with Hamon Research-Cottrell to install COHPAC downstream of the hot-side ESP on Unit 3. This COHPAC system was designed to maintain Unit 3 and 4's stack opacity levels below 5% on a six-minute average.

The COHPAC system is a hybrid pulse-jet type baghouse, designed to treat flue gas volumes of 1,070,000 acfm at 290˚F (gross air-to-cloth ratio of 8.5 ft/min with on-line cleaning). The COHPAC baghouse consists of four (4) isolatable compartments—two compartments per air-preheater identified as either A- or B-side. Each compartment consists of two bag bundles, each having a total of 544 23-foot-long, polyphenylene sulfide (PPS) felt filter bags, 18 oz/yd^2 nominal weight. This results in a total of 1,088 bags per compartment, or 2,176 bags per casing. The evaluation was conducted on one-half of the gas stream, nominally 135 MW. The side chosen for testing was B-side. A-side was monitored as the control unit.

The hot-side ESP is a Research-Cottrell weighted wire design. The specific collection area (SCA) is 274 ft^2/1,000 acfm. Depending on the operating condition of the hot-side ESP, nominally 97 to 99+% of the fly ash is collected in the ESP. The remaining fly ash is collected in the COHPAC system. Hopper ash from both the ESP and baghouse are sent to a wet ash pond for disposal. Leaching tests conducted on the ash/activated carbon mixture were acceptable.

Activated Carbon Injection Equipment

The carbon injection system, shown in Figure 4, consists of a bulk-storage silo and twin blower/feeder trains each rated at 750 lb/hr. Activated carbon is delivered in bulk pneumatic trucks and loaded into the silo, which is equipped with a bin vent bag filter. From the two discharge legs of the silo, the reagent is metered by variable speed screw feeders into eductors that provide the motive force to carry the reagent to the injection point. Regenerative blowers provide the conveying air. A PLC system is used to control system operation and adjust injection rates. Abrasion-resistant piping carries the reagent from the feeders to distribution manifolds located on the ESP inlet duct, feeding the injection probes. Each manifold supplied up to six injectors.

Figure 4. Carbon Injection Storage Silo and Feeder Trains Installed at Gaston, 2003–2004.

Original Bag Tests (April–November 2003)

Baseline Original Bags

Baseline testing began on March 28, 2003, shortly after the unit was brought on line after a planned outage. It was immediately obvious that baghouse performance and baseline mercury removal were very different from what was seen during the 2001 tests.

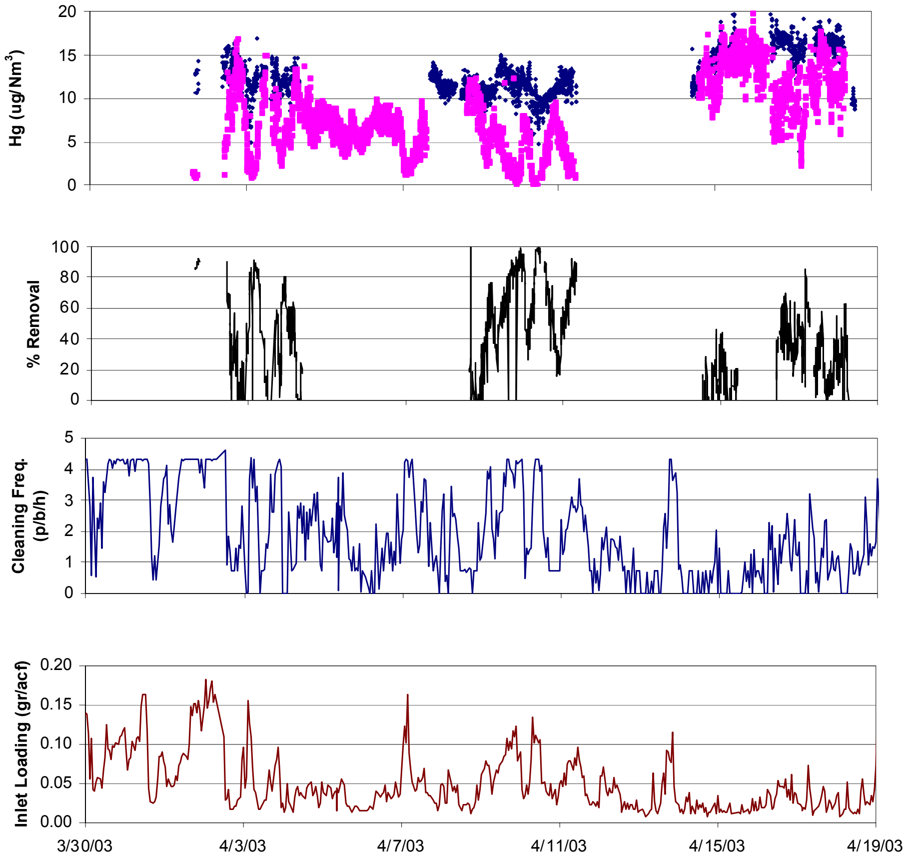
Vapor-phase total mercury was measured at the inlet and outlet of the 3B COHPAC with a semi-continuous emission monitor (S-CEM). One S-CEM instrument was used to measure mercury from both locations, alternating between the two. The mercury analyzer was in operation 24 hours per day, seven days per week.

Figure 5 presents mercury concentrations, mercury removal, cleaning frequency, and inlet mass loading for a portion of the baseline test. Cleaning frequency was much higher than expected, and was above the target maximum allowable cleaning frequency of 1.5 pulses/bag/hour (p/b/h) that was used during the two-week test in 2001. As can be seen in Figure 5, there were times when the baghouse was cleaning continuously at 4.4 p/b/h.

In the earlier tests, there was virtually no mercury removal at baseline conditions. In these tests mercury removal varied between 0 and 90%, as shown in Figure 5, and removal was dependent on inlet mass loading.

Several groups evaluated these different operating conditions, including Hamon Research-Cottrell and Southern Company, and concluded that the baghouse was operating as well as could be expected with the existing conditions, but that the inlet mass loading exiting the hot-side ESP had increased substantially since the previous tests. Hot-side ESP performance was also evaluated and the conclusion was that the ESP was operating within design conditions for the type of ash being collected and without any flue gas conditioning. However, the inlet loading was greater than the design conditions for the COHPAC baghouse.

Figure 5. Mercury Concentrations, Inlet Mass Loading, and Cleaning Frequency for Unit 3B COHPAC During Baseline Operation in Spring 2003.



Optimization Original Bags

Because of the highly variable baseline conditions and the already poor performance of the baghouse, the ability to inject activated carbon was severely limited. To overcome this, an injection scheme was implemented that balanced the need to decrease carbon injection during times when inlet loading to the baghouse was high and increase carbon injection when inlet loading and mercury removal was low. The approach and performance goals of this modified injection scheme were to:

- Use the output signal from the BHA particle detector installed at the inlet to the baghouse as a feed forward signal for controlling carbon injection;
- Inject activated carbon at a rate capable of maintaining mercury removal at or above 80%; and
- Implement the capability to automatically either lower or stop carbon injection when inlet mass loading was causing the baghouse to be at or near continuous cleaning.

After several weeks of testing, a set of optimized settings was established and they are presented in Table 1. When inlet loading was less than 0.07 gr/acf, injection rate was set to either 16 or 20 lbs/h (0.52 or 0.66 lbs/MMacf). Depending on baghouse performance, these were the highest injection rates possible without causing the baghouse to be in a continuous clean. When inlet loading was higher, between 0.07 and 0.14 gr/acf, the injection rate was lowered to 10 lbs/h (0.35 lbs/MMacf). When inlet loading was greater than 0.14 gr/acf, the baghouse was often in a state of continuous cleaning and carbon injection was turned off. Removal efficiency was not significantly impacted at the lower rates because the natural loading and mercury removal efficiency was higher.

Table 1. Optimized Activated Carbon Injection Settings (Original Bag Test).

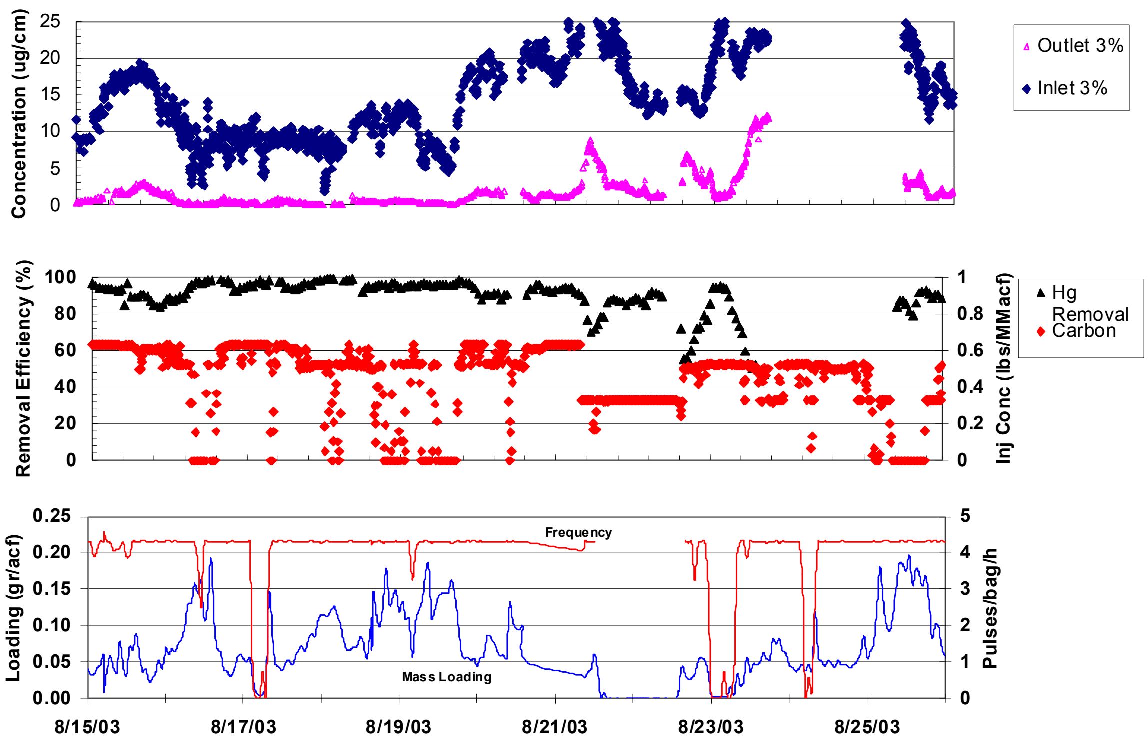
Inlet Loading (gr/scf)	Inlet Loading (gr/acf)	Injection Concentration (lbs/MMacf)	Carbon Injection Rate (lbs/h)
<0.1	~0.07	0.52 or 0.66	16 or 20
<0.2	~0.14	0.35	10
>0.2	~0.14	0	0

Long-Term Original Bags

Activated carbon was injected into the COHPAC baghouse nearly continuously from June 26 through November 25. During most of this time, the carbon injection control system was operating at the optimized setting shown in Table 1 to minimize impact on baghouse cleaning frequency while injecting sufficient carbon to maintain 80%.

Figure 6 presents a snapshot of data during the long-term test. Inlet and outlet total vapor-phase mercury, calculated mercury removal, carbon injection concentration, baghouse cleaning frequency, and inlet mass loading are presented. During this period inlet mass loading varied from 0.03 gr/acf to 0.19 gr/acf and carbon injection concentration can be seen to adjust to these changes. The baghouse was in continuous clean, even when carbon injection was turned off. Mercury removal varied between 50 and 98%, with an overall average of 90%.

Figure 6. Mercury Concentrations, Removal Efficiency, Injection Concentration, Inlet Mass Loading, and Cleaning Frequency for Unit 3B COHPAC During Long-Term Testing, 2003.



Average weekly inlet and outlet mercury concentrations and mercury removal efficiency for the entire long-term test are presented in Table 2. The standard deviation of the average mercury removal efficiency can also be seen in this table. Figure 7 graphically shows daily and weekly averages of inlet and outlet mercury concentrations and mercury removal.

The average inlet mercury concentration for the entire long-term test was 14.3 μg/Nm^3, with daily average concentrations varying between nominally 5.1 to 25.6 μg/Nm^3. The average outlet mercury concentration for the same period was 2.1 μg/Nm^3, with daily average concentrations varying between 0.24 and 6.2 μg/Nm^3.

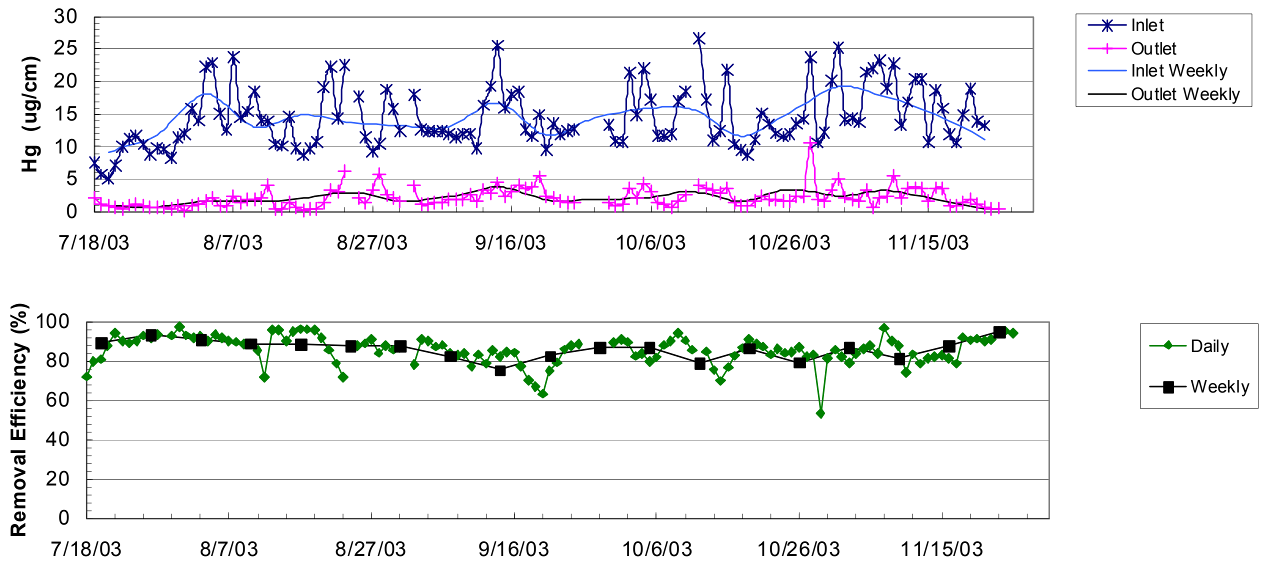
Table 2. Average Weekly Inlet and Outlet Mercury Concentrations and Mercury Removal Efficiency.

Week Starting	Inlet Mercury ($\mu g/m^3$)	Outlet Mercury ($\mu g/m^3$)	Mercury Removal (%)	Standard Deviation Hg Removal
7/20/03	9.2	0.8	91	6.5
7/27/03	11.8	0.8	93	3.6
8/3/03	18.1	1.6	91	4.5
8/10/03	13.0	1.6	87	10.7
8/17/03	14.9	2.0	86	12.0
8/24/03	13.9	2.9	79	6.3
8/31/03	13.2	1.7	87	5.7
9/7/03	13.1	2.3	82	6.3
9/14/03	16.7	3.8	77	10.6
9/21/03	11.8	1.9	83	7.3
9/28/03	11.3	1.1	90	1.6
10/5/03	15.8	2.16	86	6.3
10/12/03	15.8	3.1	80	8.7
10/19/03	11.6	1.6	86	6.2
10/26/03	15.2	3.5	77	14.6
11/2/03	19.2	2.4	87	6.6
11/9/03	17.6	3.2	82	6.5
11/16/03	14.9	1.9	87	7.1
Overall Average	**14.3**	**2.1**	**85.6%**	

Average mercury removal during this four-month period was 85.6%, with a minimum daily average of 63.5% and a maximum daily average of 98.1%. The maximum carbon injection concentration was 0.66 lbs/MMacf, and at times carbon injection was turned off. The average injection concentration over this period was 0.55 lbs/MMacf, which was much lower than what was needed in the 2001 test to obtain similar removal efficiencies (Bustard, et al., 2001).

It is believed that the higher removal efficiencies obtained at lower carbon injection concentrations than predicted in the earlier tests occurred because there was significant carbon on the bags from the higher baseline mass loading entering the baghouse. The COHPAC hopper ash had a relatively high carbon content with LOI between 15 and 30%.

Figure 7. Daily and Weekly Averages of Inlet and Outlet Mercury Concentrations and Mercury Removal from July 19 through November 23, 2003.



Low-Load Tests

Throughout these tests, the higher than expected mass loading into COHPAC limited the quantity of carbon that could be injected. Although the test plan and injection logic was altered to accommodate for these real-life conditions, the question of how this information could be used in the design of new TOXECON systems was left virtually unanswered.

One thing that was clear from these tests was that the current air-to-cloth ratio was too high to inject sufficient carbon to achieve 90% mercury control. A new TOXECON baghouse would have to be designed at a lower air-to-cloth ratio. One way to overcome the operating limitations at this site was to operate at low load/lower flow for an extended period. While at these conditions, carbon injection could be increased and performance data could be tracked. The primary objectives of these short tests were to 1) determine the injection concentration necessary to achieve 90% removal and 2) determine the impact of carbon injection on cleaning frequency at this lower air-to-cloth (A/C) ratio. An educated estimate of the ideal air-to-cloth ratio was about 6.0 ft/min.

Southern Company was able to schedule an extended period of low load operation for Gaston Unit 3. Full load at Gaston is nominally 270 MW. At this load, the flow rate into the 3B baghouse is nominally 520,000 acfm. In November 2003, Unit 3 was operated at 195 MW for a 72-hour block of time. The nominal flow at this condition was 375,000 acfm. Table 3 summarizes the differences in key variables at these two load conditions.

Table 3. Flow and air-to-Cloth (A/C) Ratio During Low-Load Test.

Unit 3 Boiler Load (MW)	270	195
~Unit 3B Flow (afcm)	520,000	375,000
~Unit 3B A/C ratio (ft/min)	~8.0	~6.0

Three injection rates were evaluated during the 72-hour test. The first test was conducted at the highest injection rate possible under normal operating conditions, 20 lbs/h. At this rate and the lower flow, the injection concentration was 0.9 lbs/MMacf instead of 0.6 lbs/MMacf. The injection concentrations were then increased up to a maximum of nominally 3.3 lbs/MMacf.

The results from this test, including inlet and outlet mercury concentrations, mercury removal, and cleaning frequency are presented in Table 4. These data more closely matched the results shown in Figure 2 from the 2001 tests. At an injection concentration of 0.9 lbs/MMacf, mercury removal was between 80 and 90%. When injection concentration was increased above 2 lbs/MMacf, mercury removal was well above 90% and there were no episodes when the removal dropped below this level. Cleaning frequency was acceptable at all injection rates.

Table 4. Results Summary from Low-Load Tests, November 2003.

Injection Rate (lb/h)	Injection Concentration (lbs/MMacf)	Inlet Hg Concentration (µg/Nm3)	Outlet Hg Concentration (µg/Nm3)	RE (%)	Cleaning Frequency (pulses/bag/hour)
20	0.9	20.6	3.2	84.2	0.6
45[a]	2.0	22.2	1.0	94.6	0.8
70	3.3	21.4	0.61	97.1	1.4

a. Last 18 hours of 45 lb/h test

High-Perm Bag Tests (December 2003–June 2004)

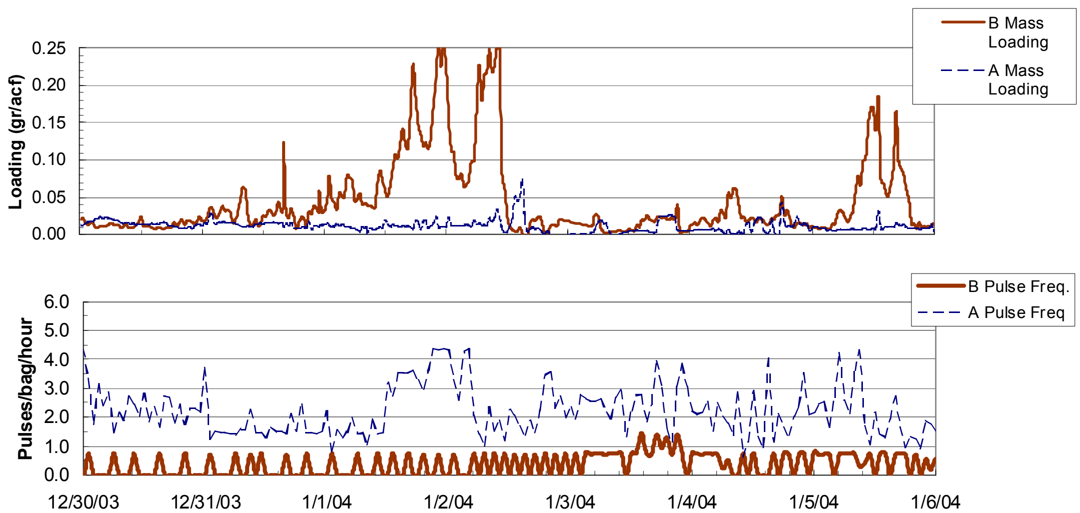
A set (2,300 bags) of high-perm bags was purchased and installed in the B-side baghouse. The differences in design were denier (an indication of fiber diameter; 2.7 versus 7.0 denier) and permeability (nominally 30 versus 130 cfm/ft^2 @ 0.5" H_2O). The primary goals for this test were to:

1. Demonstrate improved pressure drop performance of the high-perm bags; and
2. Increase carbon injection concentration to achieve a higher mercury removal than was possible with the original bags.

Baseline Tests on High-Perm Bags

The new bags made a significant difference on the cleaning frequency of the B-side baghouse. This is illustrated in Figure 8, which shows inlet mass loading and cleaning frequency for both A- and B-side baghouses. Prior to changing the bags, the Unit 3B baghouse was often in a continuous clean of 4.4 p/b/h, similar to the cleaning frequency trend for the Unit 3A baghouse in Figure 8. Even with a much higher inlet mass loading, B-side baghouse cleaning frequency was very low, at less than 1 p/b/h.

Figure 8. Comparison of 2.7 and 7 Denier Bag Performance on Units 3A and 3B COHPAC, 2004.



Optimization Tests on High-Perm Bags

With lower baseline cleaning frequency after installation of the high-perm bags, it was possible to inject carbon at higher rates. However, inlet mass loading was still higher than design conditions and it was still important that average cleaning frequency be maintained at a reasonable rate. A target maximum cleaning frequency of 1.5 p/b/h was again chosen.

Carbon injection rate was incrementally increased from 20 to 45 lbs/h. Because baghouse cleaning frequency was acceptable, it was possible to inject at a constant rate and not reduce injection when inlet mass loading increased. Average mercury removal for five different injection conditions is shown in Table 5. The average mercury removal was higher in each of the shorter tests than the 85.6% removal that was measured for the four-month carbon injection tests with the original bags. These tests show that there is no difference in the effectiveness of carbon injection for mercury control using either the original bags or the high-perm bags.

Average baghouse cleaning frequency and inlet mass loading are also presented in Table 5. Even with periods of high inlet loading, cleaning frequency was below the target of 1.5 p/b/h.

Because it is expected that cleaning frequency will increase over time, especially as the new bags season, the long-term tests were conducted at an injection rate of 45 lb/h.

For a two-week period with an injection rate of 45 lbs/h (1.3 lbs/MMacf), mercury removal was 92%, with a maximum hourly value of 98% and a minimum hourly value of 80%. Final data from these tests will be presented in August 2004.

Table 5. Average Mercury Removal, Inlet Mass Loading, and Cleaning Frequency with High-Perm Bags.

Injection Rate (lb/h)	Injection Concentration (lbs/MMacf)	RE (%)	Inlet Mass Loading (gr/acf)	Cleaning Frequency (pulses/bag/hour)
20	0.6	87	0.1	0.6
25	0.8	91	0.05	0.7
30	1.0	94	0.06	0.7
35	1.1	93	0.02	0.6
45[a]	1.3[a]	92[a]	0.05[a]	1.0[a]

a. Long-term test—these data are from only the first two weeks at this condition.

Alternative Carbon Tests

Evaluating carbons from different manufacturers is the final testing task of the program. This testing is included to broaden the options of suppliers and sorbents evaluated in this program. An invitation letter was sent to nine different sorbent suppliers asking them if they would like to participate in the Gaston program. Eight different sorbents were selected for testing in June 2004, including carbon from CARBOCHEM, Superior Adsorbent, General Technologies, Donau NORIT Americas, and RWE. Results from these tests will be available in August 2004.

CONCLUSIONS

At the time this paper was written, all but the last couple of weeks of testing was finished. The preliminary conclusions include:

- TOXECON units designed at lower air-to-cloth ratios than COHPAC units are capable of high, 90%, mercury removal. For TOXECON baghouses, it is recommended that the maximum design gross air-to-cloth ratio be 6.0 ft/min.
- Activated carbon injection systems are simple, reliable, and commercially available. The control programs can be easily adapted to varying operating requirements.
- Continuous mercury measurements are challenging but possible. Advancements to the analyzers were made and the analyzers operated 24/7 for nearly 20 months.
- Activated carbon effectively reduced mercury emissions for extended periods over a wide range of operating variables with a COHPAC baghouse.

- At an average injection concentration of 0.55 lbs/MMacf, over a four-month period average mercury removal was 86%.
- For these tests, injection concentration was limited by high, baseline COHPAC cleaning frequency.
- High inlet loading into the COHPAC baghouse contributed to variable baseline mercury removal. It is also believed that these conditions allowed for higher mercury removal at a relatively low carbon injection concentration.

- Replacing the original 2.7 denier bags with 7 denier, high-perm bags, improved the COHPAC's ability to handle periods of high inlet loading.
- Short tests at higher injection rates with the high-perm bags showed that is was possible to achieve greater than 90% average mercury removal. However, mercury removal still varied between 80 and 98% during these periods and higher injection rates would be required to maintain consistent, 90% removal.
- Inlet mercury concentrations varied by a factor of 5, from 6 to 30 $\mu g/Nm^3$. Even with 90% removal, there were times when outlet mercury concentrations were nearly 4.0 $\mu g/Nm^3$, which is higher than proposed emission regulations for bituminous coals.

Test Status

Data from these tests are still be collected and analyzed, including:

- The final weeks of operation of the long-term test with high-perm bags.
- A set of Ontario Hydro mercury measurements was conducted with the high-perm bags in late May. At the same time, outlet particulate emissions were measured. These results will provide important data on the difference in collection efficiency between the two fabrics.
- Ash and coal samples were collected throughout the test. These samples are still being analyzed for mercury content, LOI, and leachability.
- Results from alternative carbon tests will provide information on the capabilities of several commercial activated carbon suppliers.

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