Novel Process for Removal and Recovery of Vapor-Phase Mercury

Technical Progress Report
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The purpose of this project is to investigate the application of a sorbent-based process for removing and recovering mercury in the flue gas of coal-fired power plants. The process is based on the sorption of mercury by noble metals and the regeneration of the sorbent by thermal means, recovering the desorbed mercury for recycling. ADA Technologies holds a patent on this process (US 5,409,522) and has tested it under conditions typical of municipal waste incinerators. In this process, the noble metal sorbent is regenerated thermally, and the mercury is recovered for commercial recycle. Consequently, ADA has adopted the name “Mercu-RE” to describe its process.

ADA has been testing its process under conditions typical of coal-fired power plants where the mercury concentration is low (below $10 \mu\text{g}/\text{m}^3$) and little pressure drop can be tolerated. Methods of accommodating the Mercu-RE process to the circumstances and conditions of coal-fired power plants comprise the core of the program.

Overview of Progress

Phase I tasks 1 through 5 were completed as of October 1997. No additional activities have occurred under those tasks. Current period activities are summarized by task:

II-6 Modify 20-acfm Skid

During 4th Quarter FY98, ADA completed the initial checkouts on the 20-cfm treatment skid and delivered the unit to the CONSOL’s R&D facility in Library, PA for testing on coal-combustion flue-gas.

Testing continued in ADA’s laboratories on the scrubber system to capture mercury vapor from the regeneration gas. The treatment skid currently has a refrigerated condenser and mercury trap to recover and capture the mercury during the sorbent regeneration process. ADA is continuing to test a scrubber system that will capture and stabilize the mercury without the need of a condenser. Once optimized, this process will replace the chiller/condenser unit on the skid.

II-7 Establish Routine Operation at Pilot Combustor

The treatment skid was installed and running at CONSOL the first week of August. The CONSOL pilot-scale combustor burns coal from Tuesday through Friday morning on a typical week; thus, the ADA skid logs about 60-hours of time on flue gas per week. During the remainder of the week, the skid runs as if on flue gas, but draws only room air through the sorbent chambers.

At the end of August the skid was shut down to modify the inlet particulate-filter. This filter was plugging more rapidly than in previous tests and it was decided to replace it with a small baghouse filter. The baghouse design is easier to clean and is more representative of the type of particulate control found at utility sites. In September the new filter was installed and the skid was running again. We logged just under 200-hours of time on flue-gas during the 4th quarter.

Thus far, the primary source of data regarding mercury removal efficiency has been iodated-carbon traps. Samples of the flue gas (typically 60 liters) are pulled through these small carbon-filled tubes. The traps collect all forms of mercury, which is subsequently quantified by digestion and analysis of the trap at an analytical laboratory. We began by sampling only the outlet flue-gas (downstream of the sorbent bed) with the hope that the continuous mercury analyzer would be able to quantify inlet mercury levels. However, the mercury analyzer has been unable to reliably measure the low-level inlet stream concentration and we subsequently switched to pulling both inlet and outlet samples using the carbon traps. Because the skid cycles between the two sorbent vessels every 24 hours, sampling is carried out on two consecutive days during the week. In this fashion we obtain inlet and outlet data for each sorbent vessel during the week. As shown in Figure 1, the initial data indicate that both configurations are achieving better than 90% removal of mercury.

Figure 1 - Observed mercury removal efficiency from sorbent skid. Both sorbent configurations are removing over 90% of the incoming mercury.

Aside from the forementioned filter issue, the cycling and operation of the skid has been routine. Figure 2 depicts the temperatures of the two sorbent vessels throughout two days of sorbing and regeneration. The 8-hour regeneration cycle is clearly seen. The

skid has been able to reliably reach regeneration temperatures and there has been no control problems associated with power upsets like seen during Phase 1 of the project.

Figure 2 - Sorbent bed temperature as a function of cycle time.

II-8 Install and Shakedown Pilot System at Utility Site

No work on this task.

II-9 Test Long-Term Performance at Utility Site

No work on this task.

II-10 Prepare Economic Assessment for Full-Scale System

No work on this task.

II-11 Prepare Documents

Monthly reports for June, July and August (status, summary, cost management, milestone schedule) were submitted during the quarter. In July, ADA attended the FETC Advanced Coal-Based Power and Environmental System '98 Conference at Morgantown, WV. ADA reported on the status of this project and discussed related work with FETC staff and other attendees.

Project Plan for Next Quarter

During October and November, ADA will continue to monitor the operation of the treatment skid. Most monitoring is done remotely via telemetry, with monthly travel to the CONSOL site for maintenance and troubleshooting. The goal of the testing at CONSOL is to resolve any operational issues before the unit is shipped to the utility site for more extensive run time. In December operations at CONSOL will wind down and the unit will be prepared for transport to the utility site. Testing and optimization of the mercury capture scrubber will continue at ADA.

Preparations are underway for the relocation of the skid to the utility site. Public Service Electric & Gas (PSE&G), New Jersey, will host the skid at its Hudson Station in Jersey City, NJ. ADA will thoroughly inspect the skid prior to shipping it to Hudson Station. Engineers will examine the sorbent beds and vessel internals to determine if any undue wear has occurred to the system. If testing at CONSOL indicates one sorbent configuration works better than the other (monolith vs. packed bed), the unit will be reconfigured to contain two identical sorbent vessels. For the tests at Hudson Station the skid may also be configured to allow series flow through the two sorbent beds. This configuration will double the on-line throughput of the skid. Regeneration will occur with the system offline from the flue-gas slip stream. This configuration will result in greater overall throughput because the desorption cycle generally takes less time than the adsorption cycle.

As in the operation at CONSOL, the initial activities of this task will be coordinating procedures for the safe installation and operation of the equipment at the host site. ADA and Hudson Station personnel will review operating and safety requirements for the equipment and the site. The unit will be located inside a small trailer while at the plant site to provide weather protection and security. In October, ADA will visit the site to discuss logistics with PSE&G staff. In addition to siting requirements, ADA will be arranging for a local environmental firm to pull samples while the equipment is at the New Jersey site.