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June 29, 2004

Honorable Michael Leavitt, Administrator
U.S. Environmental Protection Agency
EPA Docket Center (Air Docket)
Mail Code: 6102T, Room B-108
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Attention Docket ID No. OAR-2002-0056

Dear Administrator Leavitt:

The Institute of Clean Air Companies (ICAC) is the national trade association of companies that supply air pollution control and monitoring technology. Our members include nearly eighty leading suppliers of air pollution control and monitoring technologies for stationary sources. These companies operate and provide environmental solutions for affected industries as well as employment opportunities across the U.S.

The Institute congratulates EPA's efforts to propose a much-needed rule that provides for the reduction of mercury emissions from coal- and oil-fired electric generating facilities in order to protect public health. The Institute has a few observations concerning the proposed Utility Mercury Reduction Rule specifically concerning the performance of control technologies, technology guarantees, commercial availability, control costs, by-product disposal, and availability of construction resources. The Institute has submitted two separate sets of comments addressing mercury control and measurement technologies.

The Institute recommends that EPA pursue a regulatory framework that fully encompasses the capability and capacity of the air pollution control and measurement industry to achieve substantial reductions in mercury emissions, and then, provide regulatory flexibility to enable the most cost effective application of a range of technologies. Based on our thorough understanding of technology capabilities and the capacity of our industry to supply these technologies, we believe

that a 50 to 70 percent reduction in current mercury emissions is feasible by 2008 to 2010. As a result, emissions would be reduced to a maximum of 14 to 24 tons. We note that compliance flexibility would enable a cap based on a 70 percent reduction, with some units able to achieve reductions of 90 percent and greater, and some units as low as 50 percent. Setting an appropriately stringent cap and then providing compliance flexibility would moderate any performance differences at individual units due to differences in coal, equipment, and flue gas characteristics. However, giving priority to compliance flexibility over the adequate consideration of a feasible emission cap, such as occurred in this proposed rule, fails to address the public health issues.

The attached ICAC comments provide both general and detailed comment that support the development of a mercury control rule with greater benefits.

We look forward to working with EPA on this important issue and invite you and your staff to contact me if you have any questions.

Sincerely,

A handwritten signature in blue ink, appearing to read "David C. Foerter".

David C. Foerter
Executive Director, ICAC

Enclosure a/s

GENERAL COMMENT

The rapid development of mercury control technologies over the last several years has produced a number of technologies that are available for the implementation of a national mercury control regulation for coal- and oil-fired power plants. A large number of laboratory tests and full-scale demonstrations have been conducted that provide information on the effectiveness of controls for various coal types and control configurations. Despite the current lack of a national control requirement for mercury, a number of options are commercially available while others are still in the development and testing phases.

Past experience with technology development for other pollutants (SO₂, NO_x, and PM) as well as other source categories such as mobile sources, suggests that delaying the regulation of mercury emissions from power plants would serve to delay the development of innovative control technologies. Research and development efforts are unlikely to be sustained at a vigorous level in the absence of regulatory or other drivers capable of creating a viable market for advanced control technologies. Larger markets provide more incentives for the development of technologies as well as foster competition between vendors that produces more innovative and cost effective solutions for affected sources. Smaller markets such as those that may be developed with the implementation of State regulations (e.g. Massachusetts, Connecticut, Wisconsin, New Jersey, North Carolina) are beneficial to the air pollution control industry but will be less effective in developing healthy markets than a timely implemented national program.

With the implementation of a national program, multiple control options including precombustion, combustion and post combustion technologies will contribute to meeting the required emission reductions. Coal cleaning as well as coal switching are examples of options that have the potential to reduce mercury emissions prior to fuel combustion.

Based on the recent test results, significant amounts of mercury can be removed through the use of existing controls. Existing control installations such as fabric filters, electrostatic precipitators, SO₂ scrubbers, and selective catalytic reduction (SCR) are currently achieving an estimated 36% reduction in mercury emissions even though these processes were not originally designed nor optimized for mercury capture. This is based on EPA's information collection request findings that an estimated 75 tons of mercury was contained in coal burned by power plants while 48 tons were emitted out of the stack. The current level of co-benefit control varies significantly with some combinations of control devices and coal types achieving as much as 90% removal and others not demonstrating any co-benefit control. With the implementation of mercury regulation beyond incidental co-benefit levels of control, a number of options for optimization of existing controls will be implemented to provide cost effective reductions in a short period of time.

Mercury specific control technologies such as sorbent injection systems have been demonstrated at full-scale. Multipollutant control approaches as well as other mercury specific technologies have also demonstrated significant progress and will provide additional low cost, innovative approaches to mercury control. A number of these technologies, including sorbent injection systems as well as SCR coupled with wet FGD, have achieved removal rates greater than 90% under certain circumstances.

Under the Section 112 MACT proposal, EPA also made projections for mercury control installations. These projections were based on the assumption that the Clean Air Interstate Rule/Interstate Air Quality Rule (CAIR/IAQR) would not be implemented and the co-benefit control from SO₂ and NO_x control installations would not be realized. Based on the development and enhancement of mercury removal from existing controls, significant reductions in mercury emissions are likely to occur without touching the potential of currently available control technologies. Also under the Section 112 MACT proposal, EPA did not consider ACI technology in the development of the MACT floor as EPA stated that this technology was not demonstrated nor commercially available (U.S. EPA, 2004). Activated carbon injection is commercially available and has been demonstrated on at least four full-sized coal-fired plants to-date with additional full-sized tests scheduled later this year (see details below). Outside of the United States, the Berrenrath 275 MW and the Wachtberg 166 MW plants in Germany operate on carbon injection technology to control mercury. Based on this knowledge, EPA should consider ACI in the development of the MACT floor as it is a viable technology for the electric power sector that has also been proven in other industrial sectors to control mercury emissions. What is contradictory in EPA's analysis is that they used ACI in their cost modeling exercises with the integrated planning model (IPM) but failed to recognize this technology in setting the level of mercury reductions for the MACT requirement.

Based on the current availability of mercury specific control options and the near term development of other promising technologies, EPA's own analysis (ref: Office of Research and Development submittal to the e-docket) has indicated that a reduction of 50-70% of current emission levels in the 2008 to 2010 timeframe is justifiable. This corresponds to annual mercury emissions of between 14-24 tons for the electric power sector. This level of reduction seems even more reasonable considering that EPA estimated that the co-benefit level of mercury emissions cap under the 2003 Clear Skies proposal was initially set at a first phase level of 26 tons of mercury emissions in 2010. The first phase cap is somewhat below EPA's estimated co-benefits estimate of 30 tons, and switching by units to different coal types with lower mercury content would be likely for compliance with mercury control requirements. The current mercury control proposal made under the Clean Air Act, Section 111 provisions would not create markets for technology development nor encourage innovation as the projected mercury cap level was set at the revised co-benefit level that is much higher at 34 tons. Additionally, EPA's

modeling analysis does not consider the low cost reductions that will come from enhancing existing control technologies for greater mercury capture. These innovations will reduce the cost and overall demand for mercury specific reductions. EPA's projections for mercury specific control installations under the Section 111 proposal estimate that only 1 GW, or approximately two of the more than 1000 coal-fired boilers in the U.S., would install mercury control technologies by 2010.

Concerning the regulatory mechanism used for a mercury control program, ICAC would recommend including flexible mechanisms in the regulation that would encourage innovation while providing a clear goal with meaningful reductions. Examples of these types of mechanisms include early reduction incentives, market based approaches, capital recovery programs, plant wide averaging, safety valves or other approaches. These types of incentives combined with concrete goals would encourage technology innovation and reduce impacts on generation mix.

The air pollution control industry already has considerable experience with the implementation of mercury controls for other industrial sectors. Sorbent injection has been commercially proven to augment the removal of mercury in waste-to-energy plants. Experience controlling mercury emissions has been gained in more than 60 US and 120 international waste-to-energy plants which burn municipal or industrial waste or sewage sludge. For the past two decades, sorbent injection upstream of a baghouse has been successfully used for removing mercury from flue gases from these facilities. Other reagents used include activated carbon, lignite coke, sulfur containing chemicals, or combinations of these compounds. The mercury control experience gained from the municipal and industrial waste combustors demonstrates that the air pollution control industry has been able to control mercury in the past and is able to apply their expertise to the electric power sector.

TECHNOLOGIES AND PERFORMANCE

The list of technologies provided below is not intended to be an exhaustive list of the available mercury control technologies as there are many new and emerging technologies not listed. The technologies below are just a sample of the technologies that are currently available or under development but will be available soon.

Sorbent Injection Systems

Injecting a sorbent such as powdered activated carbon, bromine, poly sulfides, or other sorbent into the flue gas represents a relatively simple approach 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) as shown in Figure 1. This combined material, consisting of 99% fly ash and 1% sorbent, is then either disposed of or beneficially used.

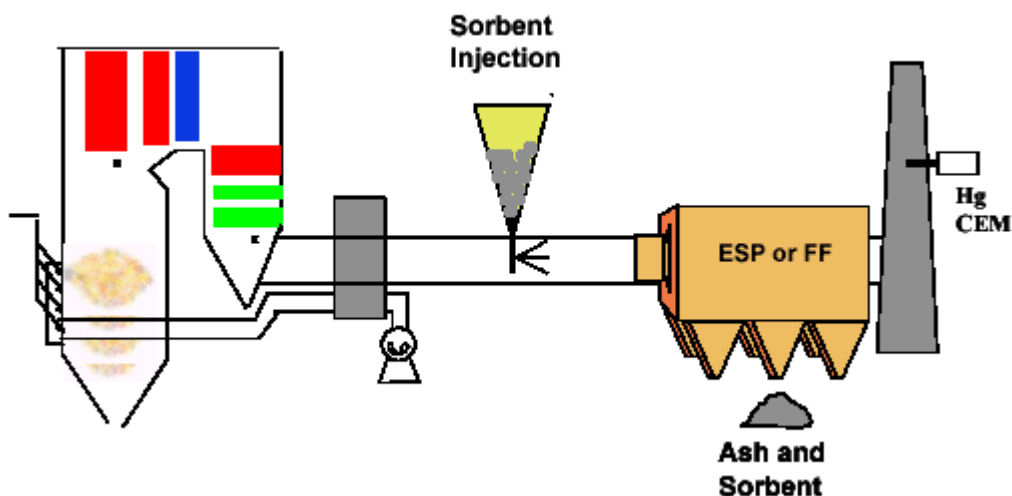


Figure 1. Schematic Diagram of Sorbent Injection Process

The type of particulate control equipment installed at the plant is a key parameter defining both the amount of sorbent that is required and the ultimate limitation of the amount of mercury that can be removed. The two primary particulate control devices are ESPs and fabric filters. When the sorbent is injected into the flue gas it mixes with the gas and flows downstream. This provides an opportunity for the mercury in the gas to contact the sorbent and be removed. This is called “in flight” capture. The sorbent is then collected in the particulate control device where there is a second opportunity for sorbent to contact the mercury in the gas. Because a fabric filter provides better contact than an ESP between the sorbent and the vapor-phase mercury, higher levels of mercury removal can be achieved at lower sorbent rates on units with a fabric filter. Currently only 10% of the power plants have fabric filters and the other 90% have ESPs.

Four full-scale demonstrations were conducted during 2001 and 2002 under a cooperative agreement from the Department of Energy National Energy Technology Laboratory (DOE/NETL), ADA-ES, PG&E National Energy Group (NEG), We

Energies, Alabama Power Company, Ontario Power, TVA, FirstEnergy, and EPRI. Follow-on funding was received for additional tests being conducted in 2003.

The first program was completed in the spring of 2001 at the Alabama Power E.C. Gaston Station (Bustard et al., 2002). This unit burns a low-sulfur bituminous coal and uses a hot-side ESP followed by a COHPAC™ fabric filter as a secondary collector for remaining fly ash. Activated carbon was injected into the fabric filter. The second program was conducted during the fall of 2001 at the WEC Pleasant Prairie Power Plant (PPPP) (Starns et al., 2002). This unit burns a subbituminous Powder River Basin (PRB) coal and uses an ESP to collect the carbon and fly ash. The third program was completed in the summer of 2002 at PG&E National Energy Group's Brayton Point Station (Durham et al., 2002). This unit burns low-sulfur bituminous coals and uses ESPs for particulate control. The fourth program was completed in the fall of 2002 at PG&E National Energy Group's Salem Harbor Station. Salem Harbor fires bituminous coals with an ESP for particulate control and an SNCR system for NO_x control.

Figure 2 presents full-scale data from two sites with ESPs; one bituminous coal and the other a Powder River Basin (PRB) coal. For both cases, mercury removal increases with increased rates of carbon injection. For the PRB coal, mercury removal was limited to 70% across the ESP. This limitation is most likely due to the trace amounts (< 1 ppm) of HCl available in the gas stream. For the bituminous coal, mercury removal exceeded 90% at the highest carbon injection rate. This coal has a high chloride content that resulted in approximately 150 ppm of HCl.

Manual mercury measurements were made at all sites following the draft Ontario Hydro method. Table 1 presents measurement results from the PRB test site with carbon injected upstream of an ESP. These tests show that the overall removal was 73% even though the majority of the mercury was in the elemental form, which is thought to be the more difficult form to capture. In fact, the collection efficiency was nearly identical for both elemental and oxidized mercury. This test is typical of all of the results that validate the capability of powdered activated carbon to capture all forms of mercury from both bituminous and subbituminous coals.

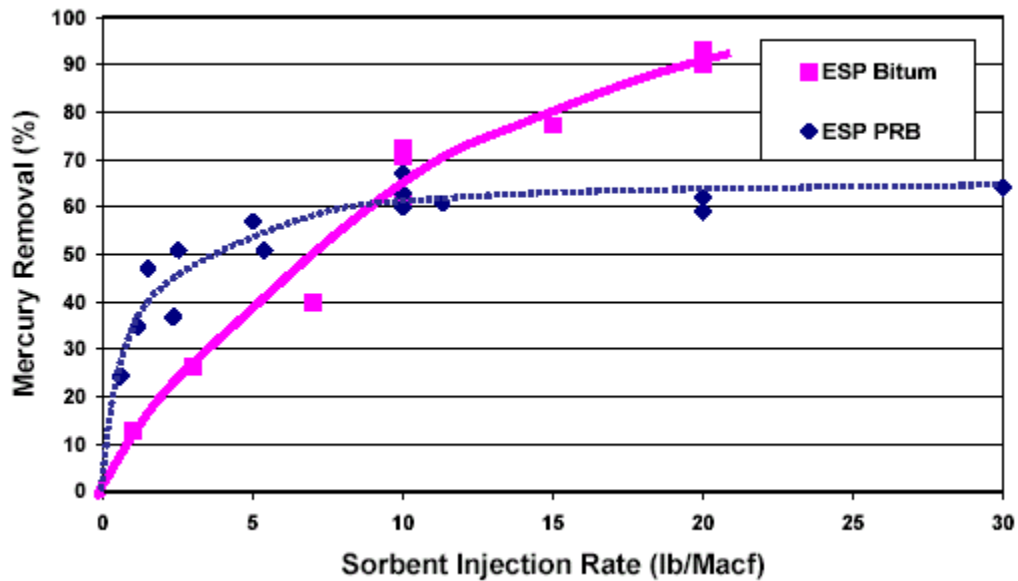


Figure 2. Mercury Removal with Activated Carbon Injection Upstream of an ESP

Table 1. Speciated Mercury Measured by the Ontario Hydro method, long-term tests with activated carbon injection concentration = 11 lbs/MMacf. Tests conducted at Pleasant Prairie Power Plant in fall 2001 (note: The configuration used at this facility made the ash unsuitable for sale).

	Particulate ($\mu\text{g}/\text{dncm}$)	Elemental ($\mu\text{g}/\text{dncm}$)	Oxidized ($\mu\text{g}/\text{dncm}$)	Total ($\mu\text{g}/\text{dncm}$)
ESP Inlet	1.0	14.7	1.7	17.4
ESP Outlet	0	4.3	0.4	4.7
Removal Efficiency (%)	100	70.7	74.5	72.9

Figure 3 shows performance of activated carbon injection (ACI) upstream of a fabric filter. This plot includes full-scale data from Plant Gaston on a bituminous, and reduced-scale tests conducted by EPRI on a PRB coal (Sjostrom, 2002a). The data from both fabric filter test programs show that ACI can produce 90% removal of mercury for both bituminous and subbituminous coals. Comparing the data from the fabric filter results in Figure 3 with the ESP results in Figure 2, it can be seen that the increased contact between the flue gas and the sorbent in the dust cake reduces the carbon feed requirements by nearly a factor of ten.

Ontario Hydro measurements of mercury removal during ACI tests with a fabric filter at Plant Gaston are presented in Table 2. As can be seen, the activated carbon is effective for both species of vapor-phase mercury.

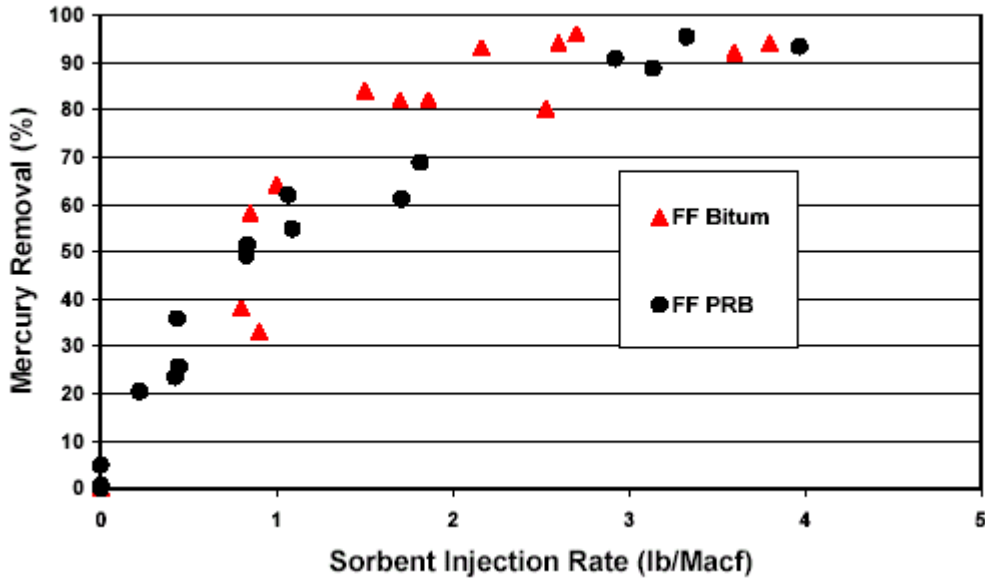


Figure 3. Mercury Removal with Activated Carbon Injection Upstream of a Fabric Filter.

Table 2. Average Mercury Removal Efficiencies Across COHPAC™ as Measured with the Ontario Hydro method.

Sampling Location	Particulate (µg/dncm ₁)	Oxidized (µg/dncm ₁)	Elemental (µg/dncm ₁)	Total (µg/dncm ₁)
COHPAC Inlet	0.2	6.4	4.6	11.2
COHPAC Outlet	0.1	0.9	0.0	1.1
Removal Efficiency (%)	50	86	99	90

Long-Term TOXECON Field Test at E. C. Gaston Station

The results of the first field test program at Gaston provided a good indication of the capabilities and limitations of the TOXECON technology for controlling mercury. However, the tests were performed for a limited amount of time, less than 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 was selected by the DOE to continue to mature the technology and conduct a long-term test program at the Gaston Station.

This program provides the first opportunity to evaluate activated carbon in the TOXECON configuration for a year of operation. Although new TOXECON units may be designed more conservatively than COHPAC units, important long-term operating data will be obtained through this test. Technical and financial support on this program will be provided by Southern Company and Alabama Power, the EPRI, Allegheny Energy, Arch Coal, Inc., FirstEnergy, Hamon Research-Cottrell, Ontario Power Generation, Duke Power and TVA (Durham, et al., 2003).

Figure 4 shows a plot of inlet and outlet mercury concentrations and overall mercury removal during four months of continuous operation. As can be seen, in spite of significant variability in the inlet mercury, the system has been able to maintain consistent levels of mercury removal with an overall average above 85%. These results further demonstrate the effectiveness of activated carbon injection for reducing mercury emissions. This technology is ideally suited for use on existing coal-fired boilers as it provides the following advantages: minimal capital cost of equipment (<\$3/kW); can be retrofit with little or no downtime of the operating unit; effective for both bituminous and subbituminous coals; and can achieve 90% removal when used with a fabric filter that has been designed properly for carbon injection.

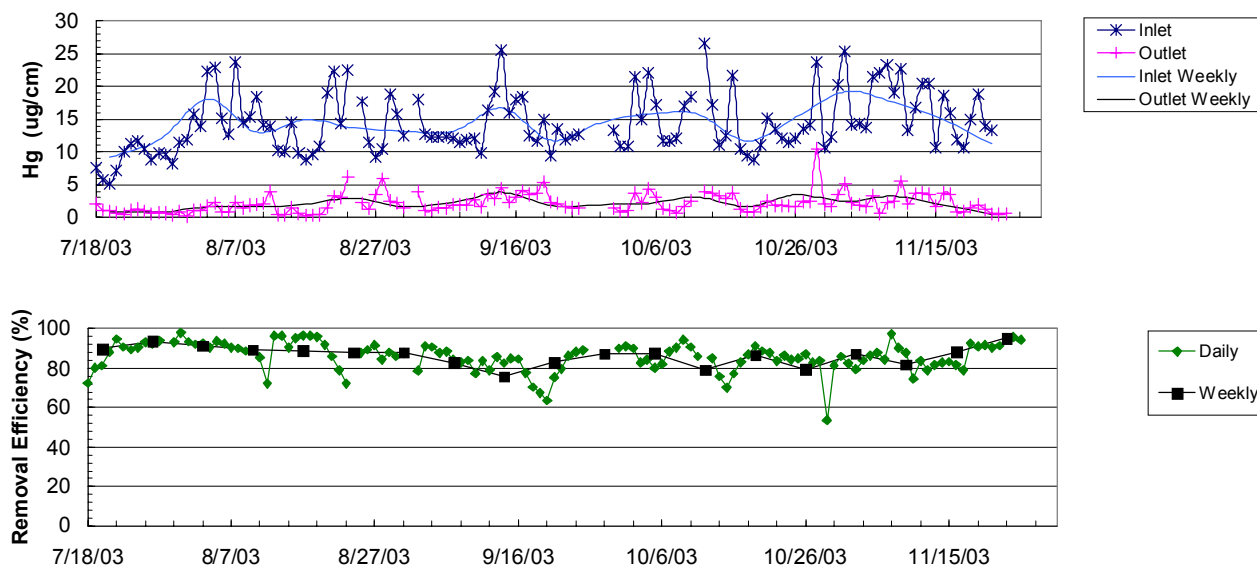


Figure 4. Inlet and Outlet Mercury Concentrations and Removal Efficiency for Toxecon Technology During Four Months of Operation at E. C. Gaston Station

Multipollutant Control Approaches

In anticipation of markets fostered by regulation or legislation, a number of multi-pollutant control technologies that also reduce mercury are currently being demonstrated. The long-term viability of these technologies for the coal-fired power

market largely depends on meaningful regulation to enable a commercial market in which these technologies would compete. That competition among a range of technologies, and enabled with flexibility within regulation, leads to the availability of increasingly cost-effective control options. Information has been included on electro-catalytic oxidation and a pre-combustion control technologies, technologies with vastly different approaches on how to address the same multi-pollutant problem on coal-fired power units.

Electro-Catalytic Oxidation (ECO) is an integrated multi-pollutant control technology that achieves major reductions in emissions of NO_x , SO_2 , fine particulate matter, and mercury from the flue gas of coal-fired power plants. The process also produces a valuable fertilizer co-product that reduces operating costs and avoids landfill disposal of waste.

ECO treats flue gas in three steps to achieve multi-pollutant removal as shown in Figure 5. In the first step of the process, a barrier discharge reactor oxidizes gaseous pollutants to higher oxides. For example, nitric oxide is oxidized to nitrogen dioxide and nitric acid, a small portion of the sulfur dioxide is converted to sulfuric acid, and mercury is oxidized to mercuric oxide. Following the barrier discharge reactor is an ammonia scrubber that removes the sulfur dioxide and the oxides of nitrogen. A wet electrostatic precipitator (WESP) follows the scrubber that in combination captures acid aerosols produced by the discharge reactor, fine particulate matter and oxidized mercury.

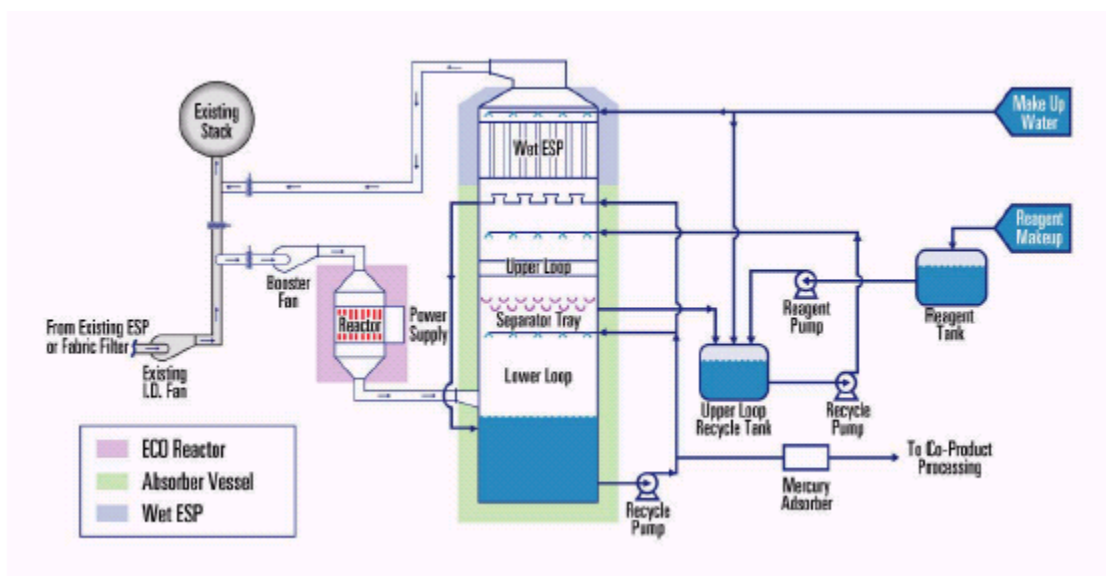


Figure 5. Schematic Diagram of Electro-Catalytic Oxidation (ECO) Process

The ECO process has undergone pilot scale testing on a 1-2 MW flue gas slipstream at FirstEnergy's R.E. Burger Plant for 2 years. In addition, a 50 MW commercial demonstration has been constructed at the same plant. The R.E.

Burger Plant burns a blend of eastern bituminous and western sub-bituminous coals with oxidized mercury being the predominant mercury species measured. The pilot testing has been successful and has shown that the ECO process consistently achieves 80 to 90% capture of the mercury contained in the plant's exhaust gas. Due to the multi-pollutant nature of this technology, the ECO pilot was also able to achieve greater than 90% NO_x removal, 98% SO₂ removal, and 96% removal of particles under 3 microns in size. A mercury semi-continuous emission monitoring system was recently installed on the 50 MW commercial demonstration unit. Although data is not yet available, total mercury removal is projected to be 80 to 90%; consistent with results obtained during pilot testing.

Pre-combustion coal scrubbing process was developed at Stanford Research Institute and currently holds the U.S. patent as *K-Fuel*. Pre-combustion cleaning of pollutants and their precursors is another mechanism to address multi-pollutant control issues on coal-fired power facilities, particularly the low rank coals such as lignite and western sub-bituminous coals. The established pre-combustion technology uses heat and pressure to physically and chemically transform low Btu, high moisture content low-rank coals, such as western sub-bituminous coal and lignite, into a high Btu, low moisture fuel. This coal processing technology increases energy efficiency of sub-bituminous coal and lignite by 30-55%. An added benefit of this technology is that 65-70% of mercury is removed, with as high as 90% reduction in some cases, and up to 30% of SO₂ and NO_x removed from the initial feedstock. During the process of removing the water, mercury is volatilized and released in the gas and water off-streams. The mercury and other pollutants are captured with carbon filters and disposed of at permitted disposal sites. The result is a pollutant scrubbed high energy coal. The number and geographic scope of patents around the world that are applicable to this technology have increased dramatically in anticipation to requirements for a wide range of coal types.

As demonstrated in Table 3, the resultant coal product improves the quality of low-grade western and lignite coals, increasing efficiency of steam generating units, and offering another approach for facilities to comply with air emissions standards. Since western sub-bituminous coal is typically already low in mercury and sulfur before refining, facilities can substitute the scrubbed coal for bituminous coal feedstocks for significant emission reduction benefits.

Table 3. Product Comparison Between Sub-bituminous and Lignite, K-Fuel, and Eastern Coal

	Sub-bituminous and Lignite Coal ¹	K-Fuel™ Product	Eastern Compliance Bituminous Coal ²
Heating Value (Btu/lb)	6,850-8,804	10,637-11,683	13,210
Moisture Content (%)	26.29-45	5.74-8.0	7
Mercury (ppm)	0.0289-0.342	0.008-0.163	0.15

Source: K-Fuel test data

¹ Includes four sub-bituminous and one lignite coal feedstock used in K-Fuel tests

² Average of Eastern Compliance Coal, USGS

The pre-combustion process employs both mechanical and thermal means to increase the quality of sub-bituminous coal and lignite by removing moisture, sulfur, nitrogen, mercury, and other heavy metals. Because these constituents are removed before burning the coal at the plant, this form of control can virtually replace the need for post-combustion controls.

The K-Fuel process diagram is given in Figure 6 below. To start the process, raw coal is delivered directly from a mine to the coal processing facility. The coal enters the first stage separator, developed using conventional coal cleaning technology, where it is crushed and screened to remove the large rock and rock material. The processed coal is then transferred to an intermediate storage facility prior to being sent via a distribution system to the specialized thermal process. This process essentially operates like a giant pressure cooker, utilizing Lurgi Mark IV vessels under high pressure and temperature to place thermal stress on the coal. The coal passes through pressure locks into the processors, and then steam is injected into the processors at 460° F and 485 psi. The coal is maintained at these conditions, and the mineral inclusions are fractured under the thermal stress, removing both the included rock (containing some mercury) and sulfur-forming pyrites. The inherent moisture of the coal also released.

After being treated for a sufficient time in the main processor, the coal is discharged into a second pressurized lock, which is sealed off from the primary reactor. After sealing, the processor pressure is vented into a water condenser to return the processor to atmospheric pressure, and to flash cool the coal to approximately 200°F. The coal is then discharged onto a belt and further cooled by convection and indirect cooling. Following cooling, the coal is sent to a second stage separator for additional screening to remove sulfur- and mercury-containing material liberated by the thermal process. Water liberated from the coal is removed at various points in the process. This water, along with some condensed process steam, is either sent directly to treatment or is reused within the process. The water treatment system removes coal fines and hydrocarbon compounds liberated from the coal in the processor, and uses carbon filtering to remove mercury and other heavy metals that were released from the coal and rock. The waste products (carbon, mercury, and heavy metals) from the filtering process are sent to a qualified, permitted disposal site for final disposition.

Third party and company tests have demonstrated the clean-burning qualities of the patented pre-combustion product. Results reported in 2002 indicated the ability to achieve 70% mercury removal when using Wyoming Wyodak sub-bituminous coal, and up to 65% mercury removal when using Louisiana Dolet Hills lignite coal.

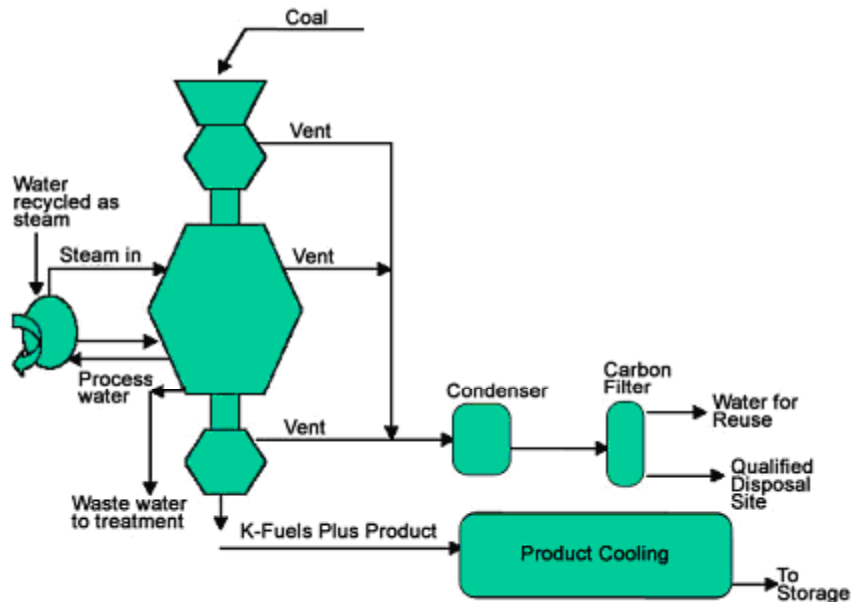


Figure 6. K-Fuel Thermal Processing Plant

The first commercial 750,000 ton per year K-Fuel plant will be in operation by the end of the first quarter of 2005 near Gillette, Wyoming. In early May 2004, the company announced an agreement-in-principle to locate the first commercial K-Fuel plant at the Buckskin Mine, north of Gillette. The Buckskin mine has the potential to be expanded to 8 million tons per year of capacity. In addition, the company announced a signed agreement to purchase the Fort Union Mine site and related facilities.

The commercial plant currently under development is fully funded and approximately two-thirds of the production from the initial 750,000 tons per year plant has been committed, with the balance to be used for test burns to facilitate future contract commitments, for plant expansions, and future coal processing facilities. There are plans to own and operate coal processing production facilities, as well as license the technology to third parties. These coal processing facilities plants are built using proven, off-the-shelf, modular equipment designed by Lurgi SA, that allows for adding capacity to each plant as demand grows.

Enhancing Control Through Existing Control Technologies

Mercury may be removed from the flue gas of coal-fired boilers to a greater or lesser extent by devices such as electrostatic precipitators, baghouses, SCRs, and SO₂ scrubbers used to control other emissions. The efficiency of such co-beneficial collection depends on the specific equipment and operating parameters, as well as

on the chemical form of mercury in the flue gas, which in turn is influenced by fuel composition and combustion parameters.

Sorbent addition in wet scrubbers has been shown to be highly effective in capturing the oxidized portion of mercury in the vapor phase in boiler flue gas. This is because vaporous mercury that is in an oxidized rather than elemental form is soluble. Scrubbers have been shown to be highly effective in capturing the oxidized mercury in the vapor phase in boiler flue gas, on the order of 60-80% depending on site specifics and fuel factors. Addition of sulfides is being used to retain the mercury in solution and prevent a small fraction of the captured mercury that can potentially be re-emitted as elemental mercury.

Wet FGD systems are currently installed on about 25 percent of the coal-fired utility generating capacity in the U.S., representing about 15 percent of the total number of coal-fired units. Depending on the effects of the operating parameters, FGD systems can provide a cost-effective, near-term mercury emissions control option with a proven history of commercial operation. For boilers already equipped with FGD systems, the incremental cost of any vapor-phase mercury removal achieved is minimal. To be widely accepted and implemented, technical approaches that improve mercury removal performance for wet FGD systems should also have low incremental costs and have little or no impact on operation and SO₂ removal performance.

Mercury Oxidation in Selective Catalytic Reduction System: The speciation of mercury is known to have a significant impact on the ability of air pollution control devices to capture mercury. The oxidized form of mercury is highly water soluble, therefore, it is easier to capture in wet FGD systems than the elemental form of mercury which is not water-soluble. The oxidized form of mercury is also more easily adsorbed than elemental mercury on unburned carbon in the flyash and on injected sorbents. SCR catalysts act to oxidize a significant portion of the elemental mercury, making it easier to remove it in downstream wet FGD systems or PM collection devices.

SCRs are already used for reducing NO_x emissions on close to 100 GW of the approximately 310 GW of coal-fired capacity in the U.S. Additional SCR installations are projected to occur due to existing ozone-related rules including: NO_x SIP call, State Regulations and the proposed CAIR/IAQR. SCR catalyst is known to oxidize elemental mercury to oxidized mercury forms such as HgCl₂ that are more easily captured and removed by downstream air pollution control equipment (Lee et al., 2003). Mercury oxidation is enhanced by lower temperature, higher coal chlorine content, and increased residence time. Due to the low gas-phase chlorine in flue gases from low-rank coals (e.g. sub-bituminous coals such as PRB), the mercury oxidation level over SCR catalyst has been found not to be as high as it is for flue gases in bituminous-fired units.

A number of simple approaches can achieve more mercury emissions control in a shorter timeframe. Under the NO_x SIP call, a cap-and-trade program to reduce NO_x emissions from power plants in 19 northeastern states and the District of Columbia is being implemented starting in May 2004. The emission limits governing affected sources under the NO_x SIP call only apply during a five-month ozone season from May through September. Year-round operation of the SCRs at those units could achieve greater mercury co-benefits as soon as implemented. Additionally, if SCRs are run October to April without ammonia injection, the absence of ammonia would result in higher mercury oxidation levels and thus downstream capture for all coal types where downstream FGD or PM capture devices will be in place. It is expected that many SCR installations will go to year-round operation under the existing and proposed rules, but early implementation of this approach can provide quicker co-benefits without the addition of new equipment.

If SCRs are run October to April with ammonia injection, the co-benefit of mercury oxidation will likely not be as high as mercury oxidation is inhibited by ammonia. However, it would still contribute significant mercury emissions control co-benefits due to full-year operation versus ozone season where effective downstream capture equipment is in place such as wet FGD.

Another approach would be to add an extra layer of catalyst to the existing SCR installations. The extra layer would be effective for both NO_x and mercury oxidation. Mercury oxidation would be enhanced due to the lower ammonia concentration in the last layer. The additional benefits include both additional NO_x reduction, that would generate valuable NO_x credits to defray the cost of the catalyst or even generate a net benefit, as well as higher co-benefits for mercury emissions control. Most or maybe all SCR installations in the U.S. already have provision for one or more extra layers built into the ductwork so that no additional construction would be needed to implement this approach and would have the highest co-benefit mercury capture where wet FGD or other effective capture equipment is in place downstream of the SCR.

New technologies are being developed for mercury oxidation across an SCR that inject chloride prior to the catalyst. The enhanced mercury oxidation is due to improved thermodynamics at regular SCR operating temperatures due to higher flue gas chloride concentrations which otherwise limits the extent of Hg oxidation possible. At low chloride levels, thermodynamics limit the extent of Hg oxidation that is possible. The higher chloride concentration makes the reaction possible while the catalyst speeds it up. This new patented technology will be especially useful for low-rank coals and will be ready for implementation in a short time horizon. This technology should greatly enhance the mercury co-benefits for sub-bituminous and lignite installations that have or will have SCR installations for NO_x control and where effective downstream capture equipment is or will be in place. It is expected that chloride concentrations downstream of the SCR would be

no higher than typical chloride flue gas levels seen in average bituminous-fired units, and that chloride injection would not be necessary for flue gases already having high chloride levels.

CAPITAL AND OPERATING COSTS

Levelized capital and operating costs are generally low for mercury control approaches compared to new full-scale installation costs for control of criteria pollutants such as NO_x and SO₂. This is true for mercury control through enhancements to existing equipment such as SCR and wet FGD, as well as for installation of new equipment for mercury specific control technologies such as sorbent injection. In addition, the costs for mercury specific controls will likely decrease over time as more is learned about current approaches and new ideas are tested as has been seen in prior experience curves for pollution control equipment.

The costs for activated carbon injection technology consists of capital equipment and operating costs. The capital costs to retrofit an existing facility will depend on site-specific issues. Generally, the uninstalled cost for the sorbent injection equipment for power plants generating 100 to 500 MW is in the range of \$600,000 to \$1,000,000. The primary operating cost and the largest cost element for the technology is the cost of the throwaway sorbent. Figure 6 shows a plot of the sorbent costs in mils/kWh for both bituminous and subbituminous coals. For a unit with an ESP, the cost of the sorbent would be approximately 1.2 – 1.5 mils/kWh to achieve 60 to 70% mercury removal for both types of coals. If a unit has a fabric filter, it is expected that up to 90% mercury removal can be achieved at a sorbent cost of between 0.3 - 0.4 mils/kWh.

One option that a plant might consider is to trade off capital costs for operating costs by installing a fabric filter to reduce sorbent requirements. The cost of a pulse jet fabric filter designed for the collection of the injected activated carbon would be \$40 - \$50/kW and would result in a factor of three reduction in sorbent costs while achieving up to 90% mercury removal. This is an example of the importance of a regulation that gives the utility flexibility in how to achieve mercury reduction at each site.

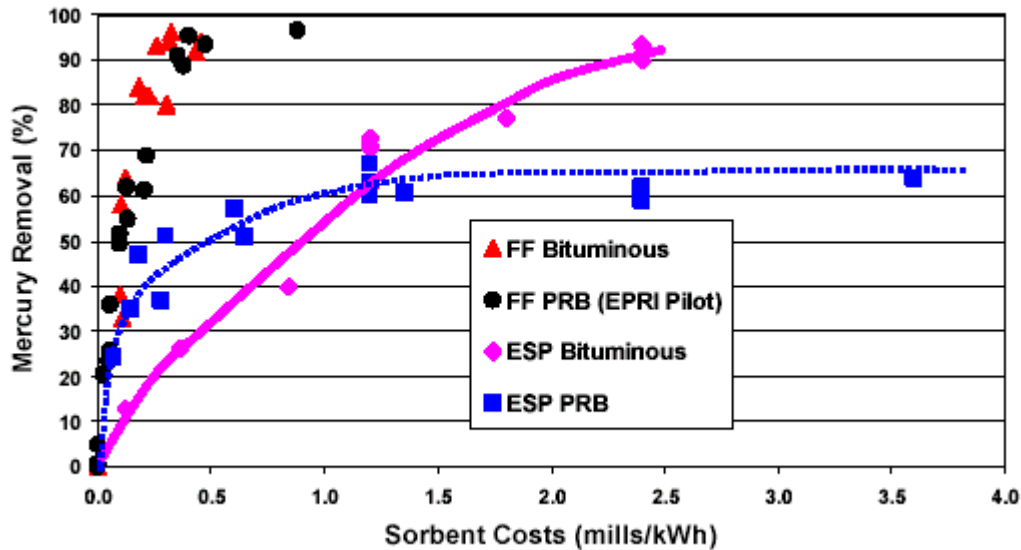


Figure 6. Costs of Sorbents for Mercury Control at Coal-Fired Power Plants.

As the ECO process is a multipollutant technology, the costs incorporate control of SO₂, NO_x, PM and mercury and are considerably higher. For the development of a compliance strategy for a particular unit, one must weigh the cost of control installations for individual pollutants such as scrubbers for SO₂, SCR or SNCR for NO_x, fabric filters for PM, etc. The capital cost associated with an ECO installation is estimated to be \$200/kW, including balance of plant modifications. The operating costs are estimated to be 2.5 mills/kWh.

For the precombustion control option, the marketplace would ultimately establish the per ton price for clean, pre-combusted western sub-bituminous and lignite coal. K-Fuel would compete with eastern coal of a similar Btu heat value.

An analysis of the cost for the SCR mercury optimization options outlined above, as well as the new chloride injection technology is in progress and will be submitted to EPA shortly. The analysis looks only at the amount of electric generating capacity that is projected to be equipped with both SCR and wet FGD in the year 2010

SCR catalyst is already used for reducing NO_x emissions on about 100 GW of the approximately 300 GW of coal-fired capacity in the U.S. Currently, there is approximately 25 GW of coal-fired electric generating capacity in the U.S. equipped with both SCR and wet FGD. The amount of capacity equipped with both SCR and wet FGD is projected to rise to about 40 GW by 2005 and to about 93 GW by 2010 as companies install new control equipment to comply with NO_x requirements related to the NO_x SIP call and SO₂ and NO_x requirements related to the proposed Clean Air Interstate Rule. About 94 percent of the projected capacity equipped with both wet

FGD and SCR is expected to burn bituminous coal, with the remaining six percent burning sub-bituminous.

The in-progress analysis examines the mercury removal performance, associated costs of several optimization options, combinations of options for enhanced Hg oxidation, and capture for units that would be equipped with both SCR and wet FGD in the year 2010 with and without chloride injection technology.¹ *The analysis of the options for mercury control through SCR enhancements will be submitted to EPA shortly.*

Option 1—Operating SCRs Year-Round

Option 2—Installing an Additional Layer of SCR Catalyst

Option 3—Combination of Options 1 and 2, With Ammonia Injection

Option 4—Combination of Options 1 and 2, With No Ammonia Injection During the Non-Ozone Season (October 1-April 30)

Option 5--Chloride Injection

CONTROL TECHNOLOGY GUARANTEES

Mercury reduction regulations are currently being implemented in certain states such as Massachusetts, New Jersey, Wisconsin, North Carolina, and Connecticut. In addition, new power plants being planned are required to meet Maximum Achievable Control Technology (MACT) requirements for mercury. Carbon injection is being specified as the MACT technology for most of these new coal-fired power plants. Because of these state regulations and the new power projects, there is a significant amount of commercial activity for mercury control technologies. Bids are being requested from power companies for equipment to meet these emissions regulations and many require guarantees.

Guarantees of mercury control are being offered commercially in the marketplace today for many plant configurations and coal types. For mercury control technologies consisting of carbon injection systems followed by a particulate collector, such as a fabric filter or ESP, performance guarantees have been provided to firm customer specifications on commercial projects in various stages of development. These guarantees have included performance guarantees for mercury emissions and powdered activated carbon consumption that are contingent on coal type, coal mercury content, existing flue gas cleaning equipment, and plant operational data. The frequency of the compliance requirements; such as whether the guarantee would be based on hourly, daily or monthly average; would also influence the level of the guarantee. Generally, the process for developing guarantees for mercury control is the process that is common to development of guarantees for control of other air pollutants.

Vendors will guarantee a given emission rate for a specified range of coals having specified mercury content. They would generally not provide a collection efficiency guarantee since that would be progressively more difficult to meet the less mercury there is in the coal. For example, a coal with a mean mercury content of 0.15 ppm would typically be provided a guaranteed emission value between 1.5 – 7.0 micrograms Hg /Nm³ (corresponding to between 90 to 50 % removal efficiency respectively), all depending on the factors listed above. This issue could be simplified with a regulation that had a dual limit of a lower emission rate and a maximum efficiency. Given a longer compliance period, such as a yearly average, it is expected that guarantees for higher removal efficiencies would be provided for the vast majority of plants compared to shorter averaging periods.

Guarantees can be provided for the oxidation performance of mercury across an SCR. Mercury oxidation activity is adequately sustained with SCR catalyst over its lifetime for NO_x reductions. Based upon studies in the literature and data from vendor studies, the activity decline rate is similar to the De- NO_x decline rate. Coupled with predictive models for mercury oxidation that are being validated with full-scale data, performance guarantees can be provided.

At this point in the commercialization of mercury control equipment, the guarantees will likely be more conservative than in the coming few years. As with other air pollution control technologies such as wet scrubbers for SO₂ control and selective catalytic reduction for NO_x control, the more mercury control equipment that is installed and more experience gained, the tighter and more aggressive guarantees will become. In fact, some customers have not requested performance guarantees for criteria pollutant control technologies as the technologies are well established and able to easily meet the state and federal requirements.

In general, the guarantees provided for mercury controls are provided in the same manner that guarantees are provided for SO₂, NO_x and PM control technologies. The industry source will request a bid for a particular situation based on their regulatory requirements. The vendor will then submit a proposal based on the specific site characteristics defining the emission rate that is achievable and can be guaranteed for that specific application. After the control installation has been completed, testing will be performed to verify that the emissions guarantee has been met. The vendor may provide a ‘make right’ statement in the guarantee that the vendor will have a window of time, typically up to twelve months, to make adjustments to the technology if the guaranteed level was not initially satisfied. This is the general approach that is taken by vendors when guaranteeing a control technology installation whether it is for a SO₂, NO_x, PM or mercury control.

COMMERCIAL AVAILABILITY OF CONTROL TECHNOLOGIES

A number of air pollution control technologies for mercury control from power plants are commercially available or will be available by the end of the 2004. Mercury specific control technologies such as activated carbon injection systems are currently available and have already been used on full-scale systems for the power sector as well as for other industrial sectors. These systems can be applied to any plant configuration and coal type.

A number of mercury control approaches can be applied through the utilization of existing air pollution control equipment. These applications have the potential to provide immediate mercury control benefits and require little if any capital investment. For plants that already have an SCR installation, a promising technology that adds a reagent across an SCR catalyst is expected to be available in 2005. A U.S. patent was granted in October of 2003 that uses a chlorinating agent and ammonia to accomplish the simultaneous reduction of NO_x and oxidation of mercury over SCR catalyst. This technology has been successfully demonstrated in pilot work and will be tested on a much larger scale.

In addition, adding an additional layer of catalyst to existing SCR installations, and/or running existing SCR installations year-round, are viable options that increase the oxidized form of mercury making it easier to capture in existing downstream control equipment. This technology is immediately available to almost one-third of the coal-fired electric power sector due to the almost 100 GW of SCR installations for the NO_x SIP call, and is likely to pay for itself in the best plant configurations depending on the value of additional NO_x credited generated.

Other technologies such as the multipollutant ECO process are in the commercial demonstration stage. Pilot studies on smaller slip streams have been performed for 24 months and a 50 MW demonstration is in the beginning stages of operation. Based on successful commercial demonstration, the ECO technology is expected to be commercially available in late 2004.

WASTE STREAM DISPOSAL

Since the purpose of controlling emissions from coal-fired boilers is to reduce potential buildup of mercury compounds in lakes and streams and ultimately to protect public health, the stability of the captured mercury in the ash and other coal combustion byproducts (CCBs) is a critical component of the overall control scheme. The ICR program showed that currently approximately 30 tons per year of mercury is contained in CCBs. Pending mercury control regulations could result in an additional 20 to 40 tons per year of mercury in CCBs.

In the U.S., approximately 67% of all fly ash produced from utility coal combustion is disposed of in landfills or surface impoundments. The remaining 33% is used for a variety of commercial applications. There are approximately 600 waste disposal sites for CCBs in the U.S.; half are landfills and half are surface

impoundments. Note here that CCBs include other waste streams such as bottom ash and scrubber sludge. A 1999 EPA study estimated that about half of the CCB landfills and a little less than a third of the surface impoundments have some type of liner, the most common type being compacted clay (Senior et al., 2002).

Volatilization of mercury from landfills was estimated by EPA to be small. To date, there has been no evidence based on laboratory leaching studies for leaching of large amounts of mercury from fly ash under landfill conditions. Leaching appears to be the most likely pathway for liberation of mercury from fly ash. Volatilization may be important for certain applications of fly ash as filler in concrete applications. Volatilization is, of course, the primary pathway for mercury release to the atmosphere if fly ash is used as a raw material in cement kilns. However, volatilization will be complete in this case.

PAC-injection applied to coal-fired boilers will result in the fly ash being mixed with a certain amount of mercury-containing sorbent. This material will be sent to land disposal or used in specific applications (assuming that the presence of the sorbent is compatible with the application). Since the mercury on the spent sorbent may be present in a different form than on fly ash, it is necessary to consider what might be the most likely routes for release of mercury in sorbent-fly ash mixtures and how sorbent-containing coal utilization byproducts (CUBs) should be tested.

Senior et al., (2002) evaluated samples of ash with activated carbon from two ADA-ES field demonstration programs. The Gaston sample (the product of a bituminous coal) had a high LOI and mercury content, in spite of the low sorbent injection rate, because most of the ash was removed upstream of the COHPAC baghouse by a hot-side ESP. Thus the sample had a relatively high proportion of sorbent. The Pleasant Prairie sample (the product of a subbituminous coal) had a low LOI and mercury content. Sorbent was injected upstream of an ESP and was combined with the full ash stream. The LOI and mercury content were much lower than the Gaston sample. Little or no mercury was detected with leaching tests including TCLP, SGLP (including 30- and 60-day leaching), and sulfuric acid leach (bituminous ash). Samples were also analyzed by CONSOL as part of a DOE program. They also found no leaching of mercury from activated carbon (Withum et al., 2002).

Although the ash with activated carbon appears to be highly stable, initial testing with a PRB ash determined that the presence of even trace amounts of activated carbon in the ash rendered the material unacceptable for use in concrete. Even though the Pleasant Prairie (PRB) ash conformed to the ASTM C-618 standard for Class C fly ash, it did not pass the Foam Index test that is also required for sale of this ash for use in concrete formulation. These are field tests used to determine the amount of Air Entrainment Additives needed to meet freeze-thaw requirements. This means that with activated carbon injection, the plant

would not only lose revenues from ash sales, it would incur additional expenses to landfill the material.

For the multipollutant ECO technology, it is important to note that the mercury is removed from the co-product stream and is isolated for disposal. The stream is pumped through an activated carbon adsorption bed, which strongly adsorbs mercury compounds to the bed. The mercury is disposed of as a hazardous waste, and the spent activated carbon is replaced in the ECO process. It is estimated that the variable cost of mercury removal with activated carbon in the ECO process is \$800 per pound of mercury, including the sorbent media and its disposal.

During the K-Fuel process, mercury is volatilized and released from the coal in both the gaseous and liquid phases. The mercury and other heavy metals and pollutants are captured with carbon filters and disposed of at permitted disposal sites. The pre-combustion process captures these pollutants in a highly concentrated form compared to post-combustion technologies, thereby creating less waste. The process can achieve significant savings in waste disposal compared to post-combustion technology as tests have shown 5-10 times less solid waste disposal for pre-combustion technology versus post-combustion technology. The quality of the ash produced by the power plant is maintained as a usable, salable product.

RESOURCES FOR ENHANCEMENT OF EXISTING EQUIPMENT AND INSTALLATION OF NEW EQUIPMENT

SCR Catalyst: The SCR catalyst industry for coal-fired systems is a recent example of how quickly companies are able to build new production capacity in response to a significant jump in demand over a short period of time. The air pollution control industry installed close to 100 GW of SCRs over the last several years, with approximately 40 GW being installed in one year, in response to regulations requiring reductions in summer time NO_x emissions. This caused the catalyst manufacturers to more than double their SCR catalyst production to meet the market demand. SCR catalyst for enhanced SCR mercury oxidation is readily available due to overcapacity in this manufacturing sector. We estimate that extra SCR catalyst for SCR enhanced mercury oxidation approaches (extra layer and/or year-round operation) can be manufactured in one year. This would include all existing and projected SCR systems in 2010 under EPA's scenarios for existing rules plus the CAIR/IAQR. Installation manpower is not a limiting factor for catalyst addition.

Activated Carbon Injection: In general, the resources needed for the construction and operation of activated carbon injection technologies is significantly smaller than those required for the installation of SO₂ scrubbers and selective catalytic reduction units. The areas investigated for mercury control options includes the availability of sorbent (specifically activated carbon) and the

availability of skilled labor assuming fabric filter installations along with carbon injection systems.

Activated carbon injection systems consists of a bulk-storage silo and twin blower/feeder systems to convey the activated carbon from the silo to the flue gas duct. The feeder system is typically designed to deliver 750 lb/hr of activated carbon. PAC is delivered in bulk pneumatic trucks and loaded into the silo. The silo is equipped with a bin vent bag filter to prevent activated carbon from escaping during the transfer process. 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 to suspend the activated carbon so that it can be transferred to the flue gas duct. A programmable logic controller (PLC) system is used to control the system operation and adjust injection rates. Figure 7 is a photograph of the sorbent silo and feeder train designed and installed to treat a 150 MW boiler. Hard piping carries the reagent from the feeders to distribution manifolds located on the ESP inlet duct, feeding the injection probes.

An activated carbon injection system can be installed in less than 6 months including the design, installation, and equipment testing which is significantly less than EPA estimated in their Engineering and Economic Factors Analysis (U.S. EPA, 2002). These are the installation times that have been typical for the current set of DOE demonstration projects. The injection systems; including the silo, feeders, controllers, etc., are commonly used in numerous industries, therefore, the production capacity far exceeds the incremental demand from any mercury rule for power plants. One silo company that was surveyed by ICAC indicated that they alone could produce 1500 silos in a single year. By comparison, EPA estimates that only 2 GW of ACI systems, approximately 4 coal-fired units, would be installed by 2010 assuming the simultaneous implementation of the Clean Air Interstate Rule (CAIR). Assuming that the CAIR rule were not implemented, EPA estimated that 63 GW of ACI systems, approximately 126 coal-fired units, would need to be installed. In either case, the supply of hardware for activated carbon injection systems can easily be accommodated by existing production capacity.

The most commonly used sorbent for mercury control has been activated carbon. For the past two decades, powdered activated carbon injection upstream of a baghouse has been successfully used for removing mercury from flue gases from municipal and hazardous waste combustors. Activated carbon is carbon that has been “treated” to produce certain properties such as surface area, pore volume, and pore size. Activated carbon can be manufactured from a variety of sources (e.g., lignite, peat, coal, wood). More commonly, steam is used for activation, which requires carbonization at high temperatures in an oxygen-lean environment. As some carbon atoms are vaporized, the desired highly porous activated carbon is produced. Commercially, activated carbons are available in a range of particle sizes, as well as other characteristics that are needed for a specific application.



Figure 7. Carbon Injection Storage Silo and Feeder Trains for 150 MW.

A survey of the major suppliers of activated carbon in the U.S. and abroad demonstrates the amount of material that could be made available for this market with current production capacity (Durham, 2003). The results are presented in Table 4. The excess production capacity in the U.S. is approximately 62,000 tons per year. There is an additional 190,000 tons of AC that is available from China and Germany for this market. Chinese activated carbons are currently flooding the U.S. market and competing for the water treatment business.

The total excess capacity of activated carbon from foreign and domestic sources is approximately 250,000 tons per year. Table 5 presents an estimation of how many plants could be treated by this material in response to a mercury control regulation. The market share depends upon whether the activated carbon is used in conjunction with ESPs or fabric filters. The full-scale data indicate that mercury removal in the 50 to 70% range can be achieved with an ESP at a feed rate of 10 lb/MMacf, whereas 70 to 90% removal could be achieved with a fabric filter at one-third the feed rate. Therefore, if the 250,000 tons per year were applied to ESPs, then 120 of the 1,100 plants could be treated. However, if new fabric filters were installed on many plants, it would be possible to treat 400 units with this same amount of material without increasing the current production capacity.

Table 4. Estimates of Excess Production Capacity of Activated Carbon that could be Available for the U.S. Utility Market.

AC Source	Current excess capacity of AC production in Tons/year
NORIT Americas	22,500
Other U.S. Suppliers	40,000
Total U.S. Excess Capacity	62,500
Rheinbraun (Germany)	130,000
CarboChem (China)	60,000
Total Import Excess Capacity	190,000
Total U.S. and Import Excess Capacity	252,500

Table 5. Estimate of the Number of 250 MW Power Plants that could be Treated with Activated Carbon from Current Excess Capacity.

	Excess Capacity Tons/yr	ESPs (50-70%)	FFs (70-90%)
U.S. AC	62,000	30	99
Total U.S. plus Imports	252,000	120	400

A new mercury regulation would create a significant new market for activated carbon. All of the activated carbon manufacturers that were surveyed expressed a strong interest in investing significant capital in building new production facilities to provide sorbents for the utility market. In order to build new production capacity, between a two- to four-year period would be needed to expand production. However, all of the activated carbon suppliers said that they would be hesitant to invest capital resources to increase capacity based only on the promise of a new regulation. A decade or so ago, the AC industry increased capacity when EPA announced that they were going to tighten up drinking water standards. After the new capacity was added, EPA did not follow up with new regulations, which produced a glut of activated carbon. Some companies went out of business because of this, and the industry as a whole is just now recovering. As a result, it is unlikely that new AC production will move beyond the planning stages until there is the certainty of a regulation.

EPA's Economic and Energy Impact Analysis for the Proposed Utility MACT Rulemaking did not specify the number of fabric filters that would be installed along with the ACI systems to control mercury. The fabric filters, such as those used in the COHPAC and TOXECON systems would be added downstream of

the existing particulate control device and would be installed following the sorbent injection system to collect the waste sorbent. The fabric filters that would be installed for these types of control applications would typically be smaller than the fabric filter that would be built as a dedicated particulate control device. EPA estimates that only 2 GW of ACI would be installed by 2010 assuming the simultaneous implementation of the CAIR rule. This would mean that approximately four units would need a fabric filter for mercury control. If for some reason the CAIR rule were not simultaneously implemented, EPA estimates that approximately 63 GW of ACI controls would be needed. Conservatively assuming that all 63 GW would need the smaller sized fabric filter would not provide a difficult installation challenge especially under the assumption that an additional 63 GW of SO₂ (49 GW of scrubbers) and NO_x (24 GW of SCR) controls would not be installed if CAIR were not implemented during the same timeframe.

ECO Technology: The *ECO technology* is expected to be installed and commissioned within 24 to 30 months after order placement. The components of this system, including the WESP, are commonly used for air pollution control. A picture of the 50 MW ECO commercial demonstration is provided in Figure 8. The predominant reagent used in ECO is ammonia. The ammonia can be supplied to the system in any form—anhydrous, aqueous of any concentration, or even from systems that generate ammonia from urea. All the ammonia that goes into the ECO system becomes part of the ammonia sulfate co-product (Boyle, 2003). Ammonia sulfate is a valued fertilizer both for its sulfur content and for its nitrogen content. The largest use of ammonia in the US is as a nitrogen fertilizer. Some of the ammonia is applied to fields directly, but most of it is converted to a more convenient form of nitrogen, either a liquid such as urea ammonium nitrate or a solid, such as granulated urea. The processing of ammonia into other forms of nitrogen is becoming more common as the difficulties of handling pure ammonia in an agricultural environment increase.



Figure 8. 50-MW ECO Commercial Demonstration Unit at FirstEnergy's R.E. Burger Plant

CONCLUSIONS

ICAC would recommend that a reduction of 50-70% of current emission levels in the 2008 to 2010 timeframe be targeted and that it is achievable via enhancements in existing SCR and wet FGD pollution control technologies as well as installation of mercury specific sorbent injection systems. ICAC would also recommend including flexible mechanisms in the regulation that encourage innovation while providing clear goals and meaningful reductions. This type of approach would provide cost effective solutions and minimize impacts on generation mix.

Flexible mechanisms are important for mercury control technology for a variety of reasons. Some examples of these types of concepts include but are not limited to the following: early reduction incentives, market based approaches, capital recovery programs, plant wide averaging, safety valves or other approaches. The cost of the control technology is related to the size of the plant treated so that two plants of identical size but with a factor of ten differences in emissions would have almost the same capital and operating costs. Therefore, the cost per pound of mercury removed would be ten times higher for the low-emission plant. Flexible mechanisms would provide a means to level the playing field and actually create incentives for the power companies to treat the higher emitting plants, thus, making the largest amount of reductions in total mercury emissions while minimizing costs.

These incentives would also alleviate some of the issues related to differences and uncertainties in performances due to plant-by-plant variations in coal characteristics and equipment design. This will significantly reduce risk for both the air pollution control technology vendor and the power company purchasing mercury control technology. Certain incentives would mitigate risk and reward early compliance for plants that install equipment. This would increase the experience base which will decrease uncertainty and make it possible to provide more aggressive performance guarantees.

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