

EVALUATION OF EMISSIONS MONITORING TECHNIQUES FOR METALS AND PARTICULATE MATTER AT THE DOE OAK RIDGE TSCA INCINERATOR

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ABSTRACT

One of the focal points of the U.S. Department of Energy (DOE) Toxic Substances Control Act (TSCA) Incinerator Facility operations is the monitoring of emissions from the air pollution control system (APC) effluent stack. Greater attention and resources have been devoted to stack monitoring in recent years due to technological advances in the area of emission monitoring, stakeholder concerns with air emissions, and proposed new environmental regulations that would require the use of continuous emission monitoring systems (CEMS) for demonstrating compliance with new emission standards. The TSCA Incinerator staff has embarked upon a course to address stakeholder and facility needs by employing continuous monitoring technologies for measuring specific pollutants of concern. Additionally, the incinerator has demonstrated the capability of supporting DOE complex-wide and national CEMS initiatives as a test venue for evaluating the performance of prototypical and commercially available CEMS to determine deployment feasibility, evaluate state of technology development, and establish the degree of technology maturity when considering regulatory compliance monitoring.

This paper will describe two metals emission monitoring projects at the TSCA Incinerator. The first involves the demonstration and ultimate deployment of a batch-wise continuous sampling system for measuring metals emissions. The batch-wise sampling system was commissioned for the purpose of addressing both stakeholder and facility needs for characterizing metals emissions. The second project was conducted in support of a DOE milestone to demonstrate a commercially available total mercury monitor by comparing the CEMS performance with Environmental Protection Agency (EPA) Performance Specification 12.

A third project described herein will evaluate the performance of particulate matter CEMS. The EPA is proposing to require the use of PM CEMS in conjunction with promulgation of the Hazardous Waste Combustor (HWC) rule. To address both stakeholder needs and to position the facility for meeting the proposed HWC rule, two commercially available PM CEMS will be tested at the TSCA Incinerator in 1999 by evaluating their performance using EPA Performance Specification 11.

INTRODUCTION

Since the Environmental Protection Agency (EPA) released the draft Hazardous Waste Combustor (HWC) Rule in 1996 (1) and subsequent revisions to the draft rule in 1997 (2), there has been an increased level of activity in the development community with regard to developing and improving techniques for measuring metals emissions in combustion gases. In parallel with development activities, heightened interest by

potential industrial users of metals monitoring systems has also been seen. In the HWC Rule, the EPA proposed a set of technology based emission standards derived from the performance of Maximum Achievable Control Technology (MACT) on operating hazardous waste combustor units. The MACT standards establish limits for three classes of metals based on their relative volatility: volatile metals (mercury), semi-volatile metals (cadmium and lead), and non-volatile metals (arsenic, beryllium, chromium). Although not required by the draft HWC Rule, the use of a metals continuous emission monitoring system (CEMS) for compliance assurance with the MACT standards is allowed and encouraged by the agency. The technology, however, is still considered to be under development and has yet to be proven for compliance monitoring.

Interest in metals monitoring technology is evident by work performed and resources expended by both governmental agencies and industry in the past two years. In 1997 the EPA and U.S. Department of Energy (DOE) jointly sponsored a demonstration of multi-metals CEMS at the EPA National Risk Management Research Laboratory, Air Pollution Prevention and Control Division's combustion laboratory in Research Triangle Park, North Carolina, to determine the current state-of-the-art in metals CEMS. Of the seven multi-metals CEMS tested, none of them were able to measure all six of the MACT metals with a relative accuracy of 20% required by Performance Specification 10 (PS 10) in the HWC rule. The study concluded that no multi-metals CEMS were ready for long-term testing for demonstrating acceptance as a regulatory compliance instrument (3).

Active investigation by industrial operators of hazardous waste combustors into the use of metals CEMS has in some ways progressed despite conclusions reached by the regulatory agency. These companies have recognized the potential benefits of continuously monitoring stack emissions of metals and are leading the industry in applying this technology to benefit their operation. Eli Lilly and Company reported on a continuous metals sampling system used as a process tool for identifying specific waste feeds high in metals content. This sampling technique uses a Hazardous Element Sampling Train (HEST) developed by Cooper Environmental Services to capture particulate and vapor-phase metals on rotating filter disks. The filters are removed from the mechanical sampling device and analyzed off-line by non-destructive x-ray fluorescence (XRF) analysis. Although the technique is not a CEMS in the true sense of providing an on-line measurement in real-time, it was capable of time resolved measurements at 5-min intervals. Lilly hopes to avoid costly upgrades to their incinerator air pollution control (APC) devices in order to meet the MACT standards by utilizing the metals monitoring system to identify the source of troublesome waste and impose waste minimization efforts at the generator site (4). In another venture, VonRoll America, Inc. has teamed up with Thermo Jarrell Ash Corporation (TJA) to deploy a *TraceAIR* monitor, an argon/air inductively coupled plasma (ICP) based multi-metals CEMS, on the Waste Technologies Industries (WTI) incinerator in East Liverpool, Ohio. This project is likely the most aggressive attempt in the country to deploy a multi-metals CEMS on a hazardous waste incinerator unit. Over the past year, TJA and WTI have focused on optimizing the CEMS hardware, concentrating primarily on the sampling system – an extremely important but often overlooked aspect of a stack monitor. TJA contends that if a representative sample of the gas can be delivered to the analyzer, then the ICP instrument is well suited to handle and analyze the gaseous sample (5). These are just two examples of industries that through a cost/benefit analysis have concluded that metals monitoring technology is quickly approaching a demonstrable state and the benefits of monitoring metals emissions go beyond simply meeting a regulatory compliance requirement.

Unlike multi-metals CEMS, the EPA mandated the use of particulate matter (PM) CEMS in the proposed HWC Rule. However, the technology base for monitoring PM resides primarily in Europe where PM CEMS are commercially available and have been in use routinely for many years (6). Over the past five years the EPA has investigated the state of PM CEMS technology through several demonstrations, first gaining confidence in the capability of the monitors to measure PM emissions (7) and later testing the monitoring systems against a draft set of performance standards outlined in Performance Specification 11 (PS 11) (8,9,10). The regulated community voiced criticism of the EPA PM CEMS demonstration taking issue with several aspects of the test and the draft performance specifications. The main issues raised by

industry dealt with concerns on inability by facility operators to meet the test conditions of PS 11, lack of detailed information on how to perform instrument calibrations, use of the PM CEMS for compliance and enforcement, and the contention that the test site did not represent the most challenging stack conditions for testing PM CEMS. Some of these concerns were examined and verified through independent testing of PM CEMS funded by industry (11). The EPA has since presented additional guidance, which partially resolves some of these concerns, and is considering additional testing at a hazardous waste burning cement kiln, a hazardous waste burning light-weight aggregate kiln, and a hazardous waste burning incinerator to demonstrate that PM CEMS can be correlated to manual methods while meeting PS 11.

The potential benefits derived from the use of continuous stack monitoring devices have been recognized locally by the Toxic Substances Control Act (TSCA) Incinerator staff and by the DOE. Rewards gained by the facility from investigation and active participation in CEMS testing have included a working knowledge of the state-of-the-art of CEMS technology, ability to address stakeholder concerns with stack emissions data in a timely manner, a better understanding of the incinerator process and APC behavior and performance, and greater insight in knowing how to deal with and come in compliance with proposed and future monitoring regulations. Since 1993 the incinerator staff has proactively sought to attract and encourage developers of monitoring technologies to utilize the TSCA Incinerator as a test site for conducting field demonstrations of their prototype systems. In 1996 the DOE funded the construction of a mobile technology laboratory to house researchers and monitoring system hardware during field demonstrations at the incinerator (12). By investigating monitoring system methods and hosting technology demonstrations, the TSCA Incinerator staff was able to contribute to CEMS technology development and demonstration programs and to stay abreast of the latest innovations in the field. In the spring of 1997 when concerns were expressed by East Tennessee Technology Park (ETTP, formerly K-25 Site) workers and local citizens regarding the levels of metals emissions from the incinerator, the incinerator staff was able to quickly compose a plan for addressing these concerns by testing and implementing the most appropriate technology for monitoring TSCA Incinerator emissions. Previous investigation and involvement with CEMS demonstrations proved to be valuable in meeting this challenge. Test activities currently in progress and planned field tests of metals and PM monitoring systems at the TSCA Incinerator are described below.

TSCA INCINERATOR

The DOE TSCA Incinerator is permitted by the State of Tennessee and the EPA for storing and thermally treating polychlorinated biphenyl (PCB) contaminated radioactive and hazardous (mixed) waste. The incinerator, which is operated by Bechtel Jacobs Company LLC, is located at the ETTP in Oak Ridge, Tennessee. By virtue of the unique combination of nine permits and approvals held by the facility, the TSCA Incinerator is the only incinerator in the country that has regulatory approval for treating PCB contaminated mixed wastes. Over 23,000,000 lbs. of waste in the form of solids and organic and aqueous liquids have been treated since routine operations commenced in April 1991.

The incinerator consists of a rotary kiln and a secondary combustion chamber (SCC) followed by a wet off-gas cleaning system. Organic liquids, aqueous, and solid wastes can be fed into the rotary kiln. Permits only allow high heat value organic liquid wastes to be fed to the SCC. The rotary kiln and SCC each have an auxiliary burner that utilizes natural gas to control incineration temperatures. Auxiliary systems servicing the incinerator include a tank farm containing fifteen storage and feed tanks with a combined storage capacity of 90,000 gal, a kiln ash removal system, and sumps for managing scrubber water blowdown.

The off-gas cleaning system consists of a quench chamber, venturi scrubber, packed bed scrubber, two ionizing wet scrubbers (IWS) in series, induced draft fan, and exhaust stack. The APC devices cool and saturate the combustion gases, neutralize the acidic gas components such as hydrochloric acid (HCl), and remove particulate matter from the off-gas.

BATCH METALS SAMPLING SYSTEM

System Selection

In response to health concerns expressed by workers and nearby residents at the ETTP in early 1997, a project was organized to assess the best available monitoring technologies for measuring metals emissions from the TSCA Incinerator stack (13). The ultimate goal of this project was to determine the most reliable and cost effective manner of monitoring metals emissions and to propose recommendations for future testing, evaluation, and deployment of a metals monitor. Without a metals monitoring device on the stack, metals emissions from the TSCA Incinerator could only be estimated by multiplying the removal efficiency for a particular metal determined during regulatory air testing times the amount of that metal fed into the incinerator over a given time period. A system was needed to give a more direct measure of metals being emitted from the stack.

The three candidate systems selected for testing were the *TraceAIR* inductively coupled plasma atomic emission spectroscopy monitor manufactured by Thermo Jarrell Ash Corporation, a laser-induced breakdown spectroscopy (LIBS) monitor developed at the Sandia National Laboratories, and a Hazardous Element Sampling Train (HEST) employing off-line X-ray fluorescence of the filters. Although all three systems were designed to measure metals contained in a combustion off-gas, each system approaches the problem in a very different manner. The *TraceAIR* monitor uses an extractive sampling system to deliver the gas sample to the analyzer at some distance away. The LIBS monitor, on the other hand, provides an in-situ measurement of the metals concentration in the stack gas. Both are considered CEMS in that they provide near real-time, on-line analysis within 2-4 minutes of sampling the off-gas stream. The HEST system continuously samples the stack gas, concentrating the metals on filters which are analyzed after the fact in the laboratory.

Of the three monitors evaluated, the HEST system reported data for more metals than the other two systems (nine metals from the analyte list as compared to eight for the *TraceAIR* and six for the LIBS). It also demonstrated deployment potential for a greater number of stack metals concentrations than the other systems (twelve metals concentrations as compared to four for the *TraceAIR* and six for the LIBS). Operational problems with the *TraceAIR* monitor and lack of data accuracy and precision with both the *TraceAIR* and LIBS systems dropped them out of consideration for near-term deployment. The study concluded that a batch sampling system like the HEST could be used to measure metals emissions from the TSCA Incinerator as an interim solution until multi- metals CEMS can be shown to be more reliable. A recommendation was made to install and evaluate a batch metals sampling system on the TSCA Incinerator to measure metals emissions from the stack. In lieu of the EPA's intent to require PM CEMS for MACT compliance, a recommendation was also made to select and evaluate a commercially available PM CEMS at the TSCA Incinerator.

System Design

As shown in Fig. 1., the batch metals sampling system continuously extracts a slipstream of gas from the stack through a fixed, single-point nozzle and heated probe and into a heated glass filter holder assembly where metals are removed from the stack gas. The nozzle is made of glass while the probe is a Teflon tube protected by an external stainless steel sheath. The filter holder assembly is housed inside a stainless steel canister where the temperature is held at approximately 129°C to prevent condensation from occurring. Particle phase metals are collected on a quartz fiber filter, while vapor phase metals (primarily mercury at temperatures in the stack) pass through the quartz fiber filter but are adsorbed onto two carbon impregnated filters. The front carbon filter provides enough surface area for removing all of the vapor phase mercury at anticipated concentration levels; the second filter is a backup in case of breakthrough. The extractive sampling system design was adopted from the HEST system concept tested at the incinerator in 1997 and is similar to a device used by 3M Company on a hazardous waste incinerator in Cottage Grove, Minnesota (14).

Due to severe space limitations on the stack sampling platform, the metals sampler was designed so that the probe and filter holder assembly could be easily removed as a single unit from the canister. When recovering samples, the heavy canister remains rigidly attached to the stack, eliminating the need to manually lift or move the canister. The probe and filter holder assembly, on the other hand, are removed and inserted as a single unit by use of guide rods for positioning the unit inside of the canister. In practice, the used probe/filter holder assembly is removed from the stack and taken intact to a laboratory where it is disassembled under controlled conditions. In its place a newly cleaned probe/filter holder assembly is inserted into the canister.

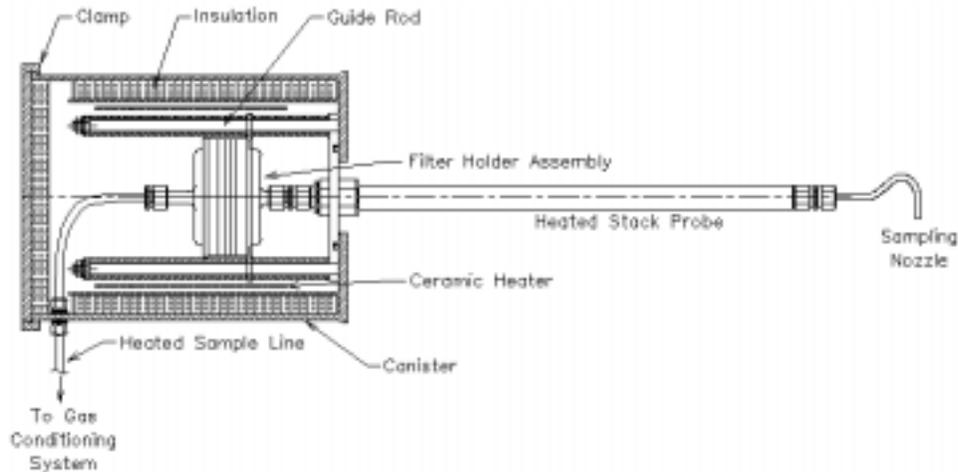


Fig. 1. Batch metals sampler schematic

The gas sampling rate is manually adjustable. During normal sampling operations the system is set to sample at a fixed subsokinetic rate. A heated sample line transports the filtered gas to the conditioning system located on the ground and outside of the radiation area surrounding the incinerator. The gas conditioning system resides in a temperature cooled CEMS shed and consists of a radiator, condensate collection tank, drying tubes to remove residual moisture, flow control valve, pump, and dry gas meter.

The system is designed to sample the stack gas continuously for a one-week period while the incinerator is in operation. When the incinerator is on standby at temperature for routine weekly calibrations, the nozzle, probe, and filter holder are removed from the stack and canister and exchanged with clean hardware. The spent sampling system components are taken to a laboratory where the samples are recovered in preparation for laboratory analysis. Recovery includes rinsing the nozzle and probe with nitric acid to recover metals deposited on the surface and removing the quartz and carbon impregnated filters. The sampling system operational protocol is very similar in concept to an existing system at the TSCA Incinerator used for continuously sampling radionuclide emissions on a weekly sample recovery frequency.

The filters and nitric acid solution recovered from the sampler are analyzed in the laboratory for mercury using cold vapor atomic absorption spectroscopy (CVAAS) and for all other metals of interest using inductively coupled plasma-mass spectrometry (ICP-MS). The ICP-MS analyte list includes antimony, arsenic, barium, beryllium, cadmium, total chromium, cobalt, lead, manganese, mercury, nickel, selenium, silver, thallium, and uranium. Since the HEST system tested in the multi-metals monitoring system evaluation utilized XRF analysis, a comparison of XRF and ICP-MS was made to determine which method of analysis would be the most appropriate for the TSCA Incinerator application. X-ray fluorescence offers the advantages of non-destructive analysis allowing archival for future reference, low cost, and rapid turn-around of the analytical results. One disadvantage is the instrument's inability to detect beryllium, which

exists in many of the waste streams treated at the TSCA Incinerator. Another drawback was the need to develop an analytical protocol for handling a filter that has sampled the stack for one-week. Unlike the earlier multi-metals monitoring system demonstration where a sampling run with the HEST lasted only two hours, the batch metals sampling system will be operated for one week, thus introducing significantly greater variability in deposit uniformity and thickness. ICP-MS, on the other hand, is routinely used for analyzing EPA Method 29 samples for metals and is universally accepted as an analytical method for compliance purposes. The turn-around time may take longer, but since the analysis is off-line and after-the-fact there is no need to report the results rapidly. The filters are completely consumed in the ICP-MS preparation step and cannot be archived in their original form. In another sense, however, complete digestion insures that all of the sample material is accounted for in the analysis and removes complications with filter deposit thickness and uniformity. In the final analysis, ICP-MS was selected because of its ability to detect all metals of interest and similarity to the EPA reference method protocol.

Work in Progress and Planned Demonstration

The sampling system was assembled, installed, and underwent three weeks of trial operation in the fall of 1998. Two operational problems were identified during the shakedown. The first involved the use of a standard off-the-shelf electrical condenser to remove water from the gas prior to flow rate determination. The condenser was located on the stack near the extractive sampling system hardware. Because of the high water content in the stack gas, however, the condenser was not able to completely condense all of the water vapor. To continue testing, a second condenser was added in series. This was determined adequate for short-term testing but not acceptable for long-term deployment. The water removal step is being relocated to the CEMS shed which is kept below 20°C; water condensation will be achieved using a radiator and drying tubes for polishing, which is identical to the method used by the continuous sampling system for radionuclides.

The filter holder assembly used during the three-week test period was constructed of Teflon and experienced thermal degradation and permanent expansion after being heated at 129°C for one week. The problem was not detected until three sampling runs had been completed. Expansion of the filter holder allowed the stack gas to leak around the filter plates and filters and thus bias the samples. The filter holder assembly is currently being modified by replacing the Teflon filter holder with a glass filter holder.

After the planned modifications are complete, the system will be operated for four weeks to test the sampling system hardware and finalize the operational protocol. Samples will be recovered and submitted to the laboratory for analysis. Following the trial operational period, a validation test will be conducted to compare measurements made with the batch metals sampling system with EPA Method 29 measurements to assess the performance of the sampling system. Beyond the validation test, the system will be operated on a long-term basis. It is hoped that the batch metals sampling system will provide a direct measurement of stack metals emissions. This data will be used to confirm the validity of previously calculated theoretical emission rates and verify that emissions are well below the currently permitted limit.

TOTAL MERCURY CEMS FIELD DEMONSTRATION

A field test of three total mercury CEMS was conducted in 1996-1997 at a commercial hazardous waste burning cement kiln at Holly Hill, South Carolina. The CEMS failed to perform up to expectations due to the combination of high particulate matter, moisture, and acid gases in the kiln emissions. Suspecting that a DOE mixed waste incinerator would present less adverse conditions and thus allow a total mercury CEMS to operate successfully, the DOE Office of Science and Technology Characterization, Monitoring and Sensor Technology Crosscutting Program and the Mixed Waste Focus Area elected to conduct a follow-up total mercury CEMS investigation at the TSCA Incinerator. The system selected for further evaluation was a MERCCEM unit, manufactured by Perkin Elmer in Germany and represented by Aldora Technologies in the United States.

The project objectives were to (1) evaluate the performance of the MERCEM emission monitoring system against EPA draft Performance Specification 12 (PS 12) for mercury CEMS, (2) evaluate methods for calibration with reference mercury concentrations, and (3) assess qualitatively the long-term endurance of the MERCEM under wet stack conditions of a mixed waste incinerator. A summary of the test program and preliminary results are presented below. A formal report giving details of the project and testing results is currently in preparation (15)

MERCER Description

The MERCER monitor is designed to measure total mercury emissions from hazardous waste combustors. Fig. 2 shows a flow diagram of the MERCER system. A gas sample is extracted in a non-isokinetic fashion from the stack at 1000 L/h and transported to the analyzer through a probe, filter, and sample line. All components in contact with the stack gas are heated to 185°C to avoid condensation and corrosion. The sample gas is reduced to 35 L/h at the analyzer before entering a reactor where mercuric chloride is reduced to elemental mercury by a stannous chloride (SnCl₂) solution. The sample gas containing vapor phase elemental mercury passes through a cooler and enters a gold trap where mercury forms an amalgam with the gold. The trap is purged with nitrogen at the end of the collection period and the analyzer baseline is established. Mercury is then driven from the unit by heating the trap and swept to the photometer where it is measured using atomic absorption spectrometry. An advantage of the amalgamation step is that optical interferences from other stack gas components are eliminated. Additionally, the system sensitivity can be varied by using different sample collection periods. The entire cycle time is on the order of 3 minutes.

Experimental

The test program participants consisted of five organizations, which directly contributed to the project. Bechtel Jacobs Company LLC provided overall coordination of the test program and managed the operation of the TSCA Incinerator. Lockheed Martin Energy Systems, Inc. was responsible for test planning and reporting, and Method 101A testing. Aldora Technologies and Perkin Elmer provided the MERCER system hardware and operated the CEMS during the performance test. Spectra Gases provided bottled mercury standards for calibration purposes.

Since available data on mercury emissions from the TSCA Incinerator indicated that most of the mercury has previously been vapor phase as elemental mercury, a performance evaluation addressing speciated mercury was determined to be beyond the scope of the project. Accordingly, EPA Method 101A was selected as a cost-effective alternative to Method 101B and the Ontario-Hydro method for speciated mercury or Method 29 for metals including mercury. An initial series of reference method tests to develop a response factor to adjust raw CEMS data before the calculation of relative accuracy from subsequent measurements was recognized to have merit particularly in cases where calibration standards are unavailable or unreliable. However, due to the short-term schedule of the project, no preliminary reference method testing was performed to determine a site specific correction factor for the MERCER data.

The sampling probe for the MERCER analyzer was installed in a port on the lower sampling platform approximately 9.14 m from the ground. Ports at this stack level are normally used for experimental CEMS testing and compliance testing for gaseous pollutants. A heated sample line transported the gas sample to the analyzer that was placed in the mobile technology laboratory trailer. The probe of the reference method sampling train was co-located with the MERCER probe and remained fixed. Testing was conducted during normal incinerator operating conditions, and no feed streams were spiked. Performance data were obtained while incinerating liquids only as well as both liquids and bulk solids.

The overall scope of the evaluation was carried out over approximately a two-month period from September through October 1998. Perkin Elmer supplied a newly factory reconditioned MERCER emission monitoring system. The MERCER was installed, commissioned, and underwent performance

testing including a calibration error test and a one-week zero and calibration drift test, as well as relative accuracy test with comparison to reference method measurements. The performance test was repeated after four weeks of instrument operation and data collection under normal operating conditions with interference response testing conducted as part of the second performance test. The MERCEM remained installed and collecting data intermittently during the four weeks between each performance test to provide a qualitative assessment of long-term operational issues.

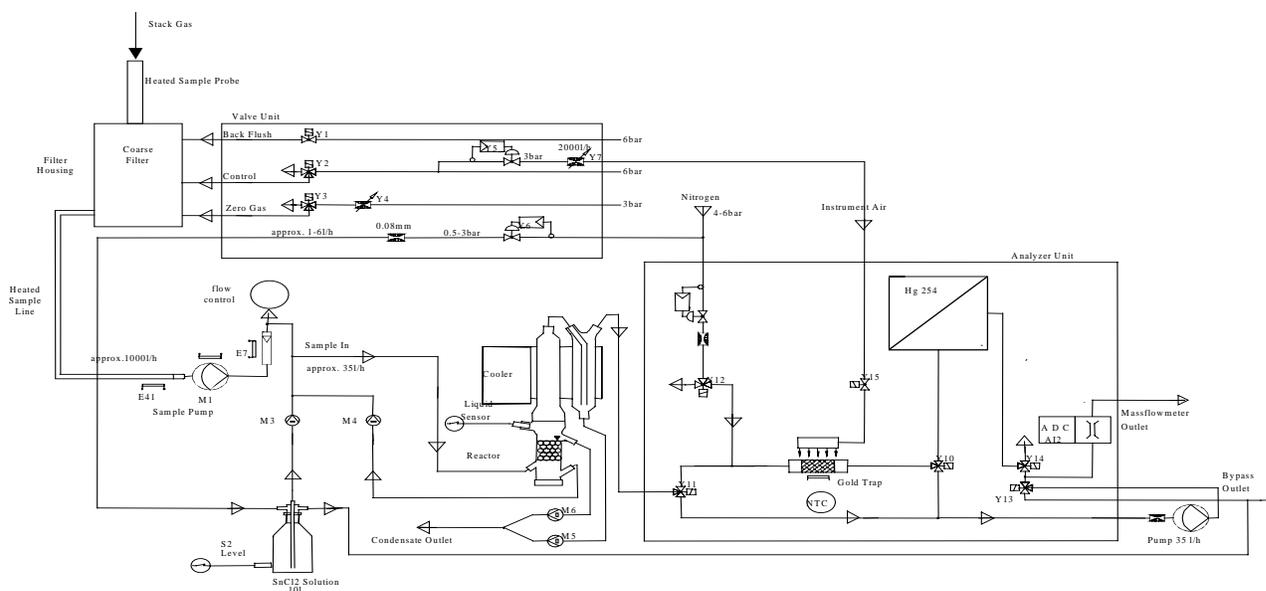


Fig. 2. MERCEM flow chart.

Relative accuracy, a regulatory statistic in PS 12 expressed as the deviation of the CEMS from the reference method relative to the emission levels occurring at the time of the test, was determined by comparing MERCEM and Method 101A measurements. The relative accuracy expression is commonly used as a criterion for accepting or rejecting CEMS systems. Nine one-hour runs were conducted during each performance test period. The runs were scheduled during a consistent set of operating conditions for the incinerator to the extent possible. No additional waste feed characterization was performed beyond that required for operation under applicable regulatory permits and approvals.

Only gas phase elemental mercury was used to assess calibration error and calibration drift. Aldora Technologies investigated both the use of calibration gases of known mercury vapor concentrations supplied in gas cylinders and the generation of a gas phase mercury standard using a permeation tube device.

Results

During the first performance test, the incinerator was operated with only liquid wastes being fed to the secondary and aqueous waste feed systems. Results from the first relative accuracy test are summarized in Fig. 3. Both sets of measurements were corrected to 7% O₂. The average mercury concentration measured by Method 101A was 56 µg/dscm while the MERCEM data averaged 65 µg/dscm. The calculated relative

accuracy for the first performance test was 20%, which is considered acceptable by PS 12. As seen from the graph, the MERCEM data was biased high but trended the Method 101A results very well.

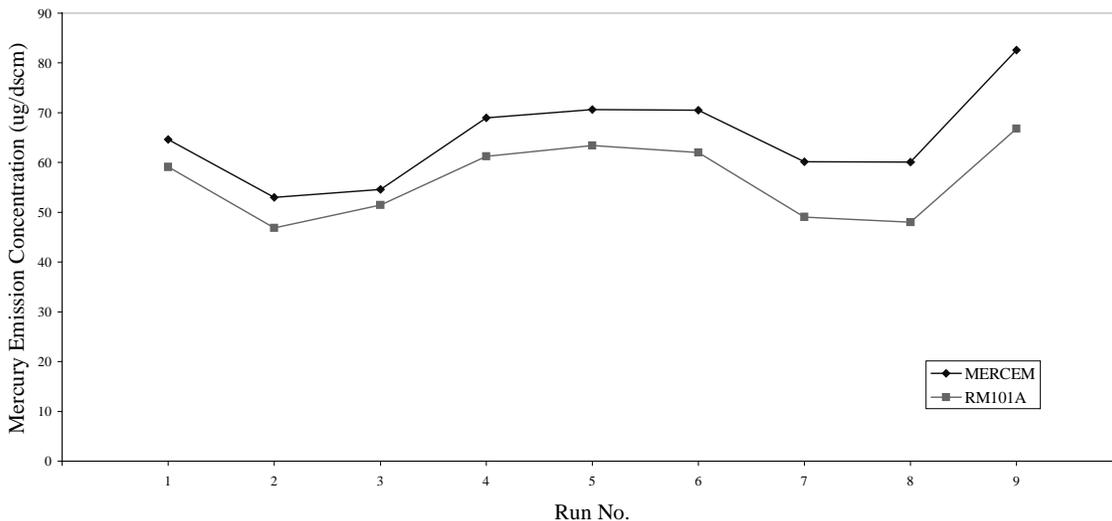


Fig. 3. Trend of MERCEM and Method 101A measurements during first performance test while feeding liquid wastes only.

During the second performance test, the incinerator was operated with organic liquid waste and containerized solids being fed to the rotary kiln. Results from the second test are summarized in Fig. 4. A lower level of mercury emissions in the second performance test proved to be a more challenging set of conditions than experienced in the first test. The average emission level measured by Method 101A was 5 $\mu\text{g}/\text{dscm}$ while the MERCEM reported an average of 21 $\mu\text{g}/\text{dscm}$. As in the first test, the MERCEM data was biased high compared to the reference method values. The relative accuracy for the MERCEM was determined to be 339% compared to the reference method. The cause of the bias between the reference method results and the MERCEM data is still under investigation. Performance of the MERCEM against other elements of PS 12 was satisfactory. The mercury calibration gases used in the test are undergoing a final laboratory analysis to examine the stability of the gases over a several month period.

PM CEMS EVALUATION

A test to evaluate the performance of PM CEMS at the TSCA Incinerator is planned for 1999. The purpose of this test is to evaluate the effectiveness of the tested CEMS in measuring PM emissions in a saturated stack while feeding PCB contaminated mixed-waste, determine compliance of the CEMS with EPA draft PS 11, and select a system for deployment and integration into routine operations at the TSCA Incinerator. The CEMS selection process will consider technology appropriate for PM measurements in a saturated stack and recent CEMS test experience in two separate tests at an Eli Lilly incinerator. The major tasks required to support this mission are briefly described below.

Monitoring system hardware will be leased from the equipment vendors with an option to purchase at the conclusion of the test. In addition to providing the CEMS hardware, the vendors will also be required to provide assistance during setup and initial operation of the CEMS as well as training for operating and maintaining the CEMS. In order to evaluate the practical aspects of operating and maintaining the CEMS systems, TSCA Incinerator maintenance personnel will be responsible for the daily upkeep of the systems during the test.

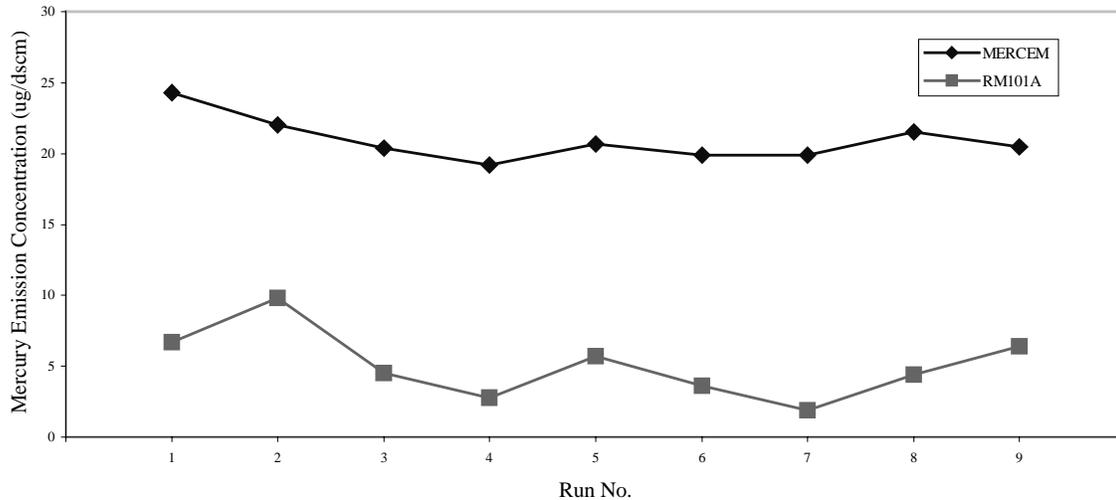


Fig. 4. Trend of MERCEM and Method 101A measurements during second performance test while feeding liquid and containerized solid wastes.

A key factor in successfully establishing a correlation between the CEMS data and the reference method measurements is the ability to vary PM emissions at three distinct levels in the stack as required by PS 11. The range of PM emissions that can be achieved by varying waste feed rates and making adjustments to the APC will be determined through baseline reference method measurements. Test conditions for concurrent CEMS and reference method testing will be decided as a result of the baseline measurements.

TSCA Incinerator maintenance personnel will install the PM CEMS with guidance from the CEMS vendors. Following installation, troubleshooting, and at least one month of trouble-free operation, a correlation test will be conducted. This will consist of 18 paired runs of EPA Reference Method 5i trains conducted at three different operating conditions performed coincidentally with PM CEMS operation. A minimum of 15 runs is required by PS 11, thus 18 runs allow for up to three runs to be discarded if necessary. The Correlation Test will establish the calibration curve for the PM CEMS. A Correlation Audit will be conducted approximately two months after the Correlation Test and will consist of 15 paired Reference Method 5i runs conducted at the same three operating conditions established in the Correlation Test. Data from the PM CEMS will again be compared to the reference method data to verify that the instrument calibration does not drift over a period of time.

In addition to maintaining the CEMS, TSCA Incinerator Facility personnel will be responsible for data logging and incinerator operations. Reference method testing and data reduction will be subcontracted to a source testing service provider having previous experience with Reference Method 5i testing.

The duration of the test is expected to be on the order of five to six months, allowing sufficient time to evaluate the availability of the CEMS over an extended time duration. Data from the Correlation Test and Correlation Audit will be analyzed according to the requirements in PS 11 to establish the calibration curve for the facility, determine instrument performance, and assess viability of PM CEMS application at the TSCA Incinerator.

CONCLUSIONS

Evaluation and implementation of emission monitoring technologies at the TSCA Incinerator plays a vital role in meeting the needs of facility operations, local stakeholders, and the DOE as well as the CEMS development and user communities. Monitoring of metals and PM emissions are of current interest and are excellent examples of how monitoring technologies are being used at the Incinerator to address public concerns, investigate and resolve CEMS deployment issues, and position the facility for compliance with proposed regulations. The batch metals sampling system will provide a means of directly measuring multi-metals emissions from the incinerator stack and confirm that emissions are well below permitted levels. Unfortunately, this system can only provide an integrated average of metals emissions and falls short of a device that provides real-time measurements. For this reason, the batch metals sampling system is seen as an interim solution for characterizing metals emissions from the stack until metals CEMS are ready for long-term evaluation and deployment. The evaluation of the MERCEM total mercury monitor from Perkin Elmer provided a useful venue in determining the feasibility of using a CEMS to measure total mercury in a saturated flue gas. Although the technique appears to be promising, additional testing is recommended for better understanding the monitoring system performance under varying waste feed conditions and the high bias in the CEMS data. Experience gained by the proposed testing of PM CEMS at the TSCA Incinerator will answer both site-specific and general questions regarding the operation and maintenance of PM CEMS and their use in compliance monitoring of PM emissions from hazardous waste incinerators. Deployment and integration of a successfully demonstrated PM CEMS at the TSCA Incinerator will allow in-depth evaluation of CEMS compliance issues, such as time averaging, as well as the usefulness of the monitor as an indicator of process performance.

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