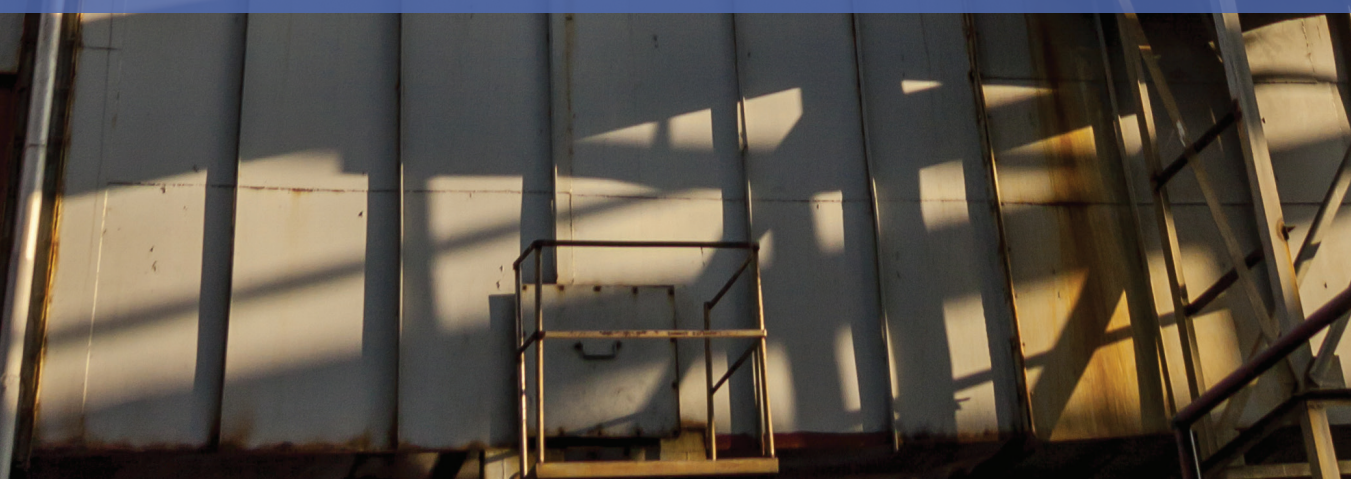
CASE STUDIES FOR U.S. EPA MERCURY COMPLIANCE FOR POWER & CEMENT PLANTS

The Clean Air Mercury Rule (CAMR) was first announced by the U.S. Environmental Protection Agency (EPA) in 2005 for power plants. After much debate, the rule was vacated until the announcement of the Mercury and Air Toxics Standards (MATS) for Coal, Oil, and IGCC power plants as well as the NESHAP (National Emission Standards for Hazardous Air Pollutants). This was for the Portland Cement Association (PCA) cement kilns under the U.S. Clean Air Act (CAA) of 1990. This case study will focus solely on mercury emissions monitoring because these regulations place a burden on power plants and cement kilns with stringent emissions monitoring and reporting requirements.



Background

In 2012, the EPA estimated that there were approximately 1,350 units affected by MATS in the U.S. The EPA also estimated that the PCA NESHAP rule would affect about 100 Portland cement facilities located in the U.S. and Puerto Rico. The MATS rule created a mercury emission limit of 1.2 lb/TBtu or 0.013 lb/GWh for existing coal fired units and 4 lb/TBtu for units that burned lignite coal. Cement plants had to meet an even harsher emission limit of 55 pounds per million tons of clinker averaged over 30 days. These plants typically have mercury emissions from both fuel burned and raw materials used to produce the cement clinker. Several years into compliance, 54% of power plants use sorbent traps for mercury compliance monitoring and a little over 40% of cement plants use sorbent traps for NESHAP mercury compliance.

U.S. Power Plants

U.S. Cement Plants

Ohio Lumex Approach

Plants have two options for compliance monitoring with regards to mercury measurement. The first option is the use of a Continuous Emissions Mercury Monitor (CEMM). These analyzers sample continuously and transport stack gas down through a heated umbilical line to the Cold Vapor Atomic Fluorescence (CVAF) or Atomic Absorption analyzer in the instrument shelter. The analyzers measure the mercury concentration in the stack gas in real time. The second option is mercury sorbent trap sampling utilizing EPA reference Method 30B and EPA Performance Specification 12B (PS 12B) for continuous sorbent trap monitoring. Joseph Siperstein, President and CEO of Ohio Lumex, has spent years developing the industry's most widely used, well respected, and highest quality mercury sorbent traps. These traps are currently used by the majority of power plants, cement plants, and stack testers in the U.S.

Sorbent trap sampling differs from CEMMs in that mercury is absorbed onto a three-section compliance sorbent trap eliminating the transport issues associated with CEMMs. Most in the U.S. have come to realize that the sorbent trap approach yields the most accurate data because it utilizes the EPA reference method. Mercury is collected right in the stack near the end of the probe with no stack gas transport issues.

Case Study 1 Data

The first data set is from an 850 MW coal-fired power plant burning bituminous coal. This plant uses sorbent traps for mercury compliance monitoring as well as the Ohio Lumex 915J mercury

process monitor. The process monitor is used to provide real time feedback to control the carbon injection rate. A special note for clarity regarding the Ohio Lumex 915J; although the 915J mercury process monitor is a continuous mercury monitor, Ohio Lumex does not market this instrument for compliance in the U.S. because it is specifically designed for process control. The data below shows 915J process monitor results represented in blue versus the sorbent trap data represented in red for an almost 3-month period of time. The 915J is very accurate and tracks very well with the sorbent trap data. This plant has two coal-fired units, both 850 MW, that have a combined 97% rate of data availability using sorbent traps for mercury compliance reporting. The use of the 915J process monitor to control carbon injection rate has saved the plant a considerable amount in carbon costs thus keeping the plant very profitable. This source also has higher than normal SO_2 levels, typically between 210 ppm to 230 ppm, which can add to sampling issues with traditional CEMMs. However, the sorbent trap configuration for this source has an acid gas scrubber section added to prevent analysis breakthrough issues.

Case Study 2 Data

The second data set is from a cement plant burning bituminous coal and tires that uses sorbent traps for mercury compliance monitoring. This plant has had to do carbon injection to reduce mercury emissions as well as dust shuttling to get below the NESHAP Hg emission limit of 55 pounds per million ton of clinker, averaged over 30 days. They have also installed a Compliance CEMM to act as a process monitor giving real-time feedback to control the injection rate of activated carbon for mercury control. Some of the challenges at a cement plant include large changes in temperature and mercury levels. Kilns with an in-line raw mill can vary in temperature from 330°F to 450°F and mercury levels can go from 5-7 ug/scm up to 50-100 ug/scm for short periods of time. This is where sorbent traps can have a distinct advantage over mercury CEMS because sorbent traps can handle large increases in mercury. The surges will only increase the average mercury concentration for a given period, several days for example. Unlike with mercury CEMS where in these instances, one would have to deal with mercury calibration gases covering the span of the mercury concentrations observed during raw mill off events. Looking at the sorbent trap data shown in blue and the mercury CEMS data shown in green below, you can see that in the beginning (shortly after this mercury CEMS was serviced) both the sorbent traps and CEMM tracked close to one another. But as time went on, the deviation grew larger with the mercury CEMS showing about a 28% lower mercury concentration. On occasion, we are asked which data is most accurate and the answer is very simple when comparing sorbent traps to mercury CEMS. If the sorbent traps have passed all the QA/QC requirements for both sampling and analysis and they are utilizing the EPA reference method (Method 30B), the answer is that sorbent traps are the most accurate data represented. Also of note, most cement plants in the U.S. using sorbent traps for compliance have an average data availability rate of 95%.

Summary

Over the last 13 years of working with 200+ power plants, incinerators, and over 40 cement plants we have learned that each source is unique and faces its own challenges. This knowledge has led us to develop many different configurations of sorbent traps to address those obstacles. The other key issue to understand is the importance of the sampling parameters, also referred to as the "sampling profile", which includes selecting sampling flow rate, trap and probe temperature settings, alarm settings, and in some cases with cement plants, whether an air-cooled probe is required or not. The U.S. EPA MATS and Cement MACT rules state when using sorbent traps for compliance you must sample and analyze in accordance with EPA Performance Specification 12B (PS 12B).

Power and cement plants must also look at some additional factors to determine whether to install a mercury CEMS or a permanent sorbent trap system. Cost is one of the biggest factors and not just the initial cost of the sorbent trap system, which typically equates to about 1/3 the cost of a mercury CEMS, but the additional engineering costs mostly related to installation and running heated umbilical lines down the stack. Another factor to consider is that calibration gases are required for the mercury CEMS while the sorbent trap system has no requirement for calibration gases. These are only some of the issues to consider when choosing your mercury monitoring strategy. However, it is important to note that since the implementation of the new mercury regulations, almost every plant in the U.S. that initially chose to use sorbent traps continues to use sorbent trap monitoring for compliance and many of the plants that chose to use mercury CEMS initially now use sorbent traps for compliance because of reliability issues related to the mercury CEMS. The best takeaway from the U.S. plants' experiences is to start conducting sorbent trap testing early before the regulations go into effect and discover the particular characteristics of your source so you can decide which method of mercury monitoring is best for your plant.

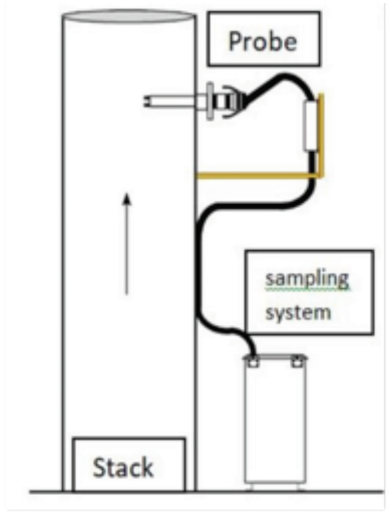


Diagram of Sorbent Trap Sampling

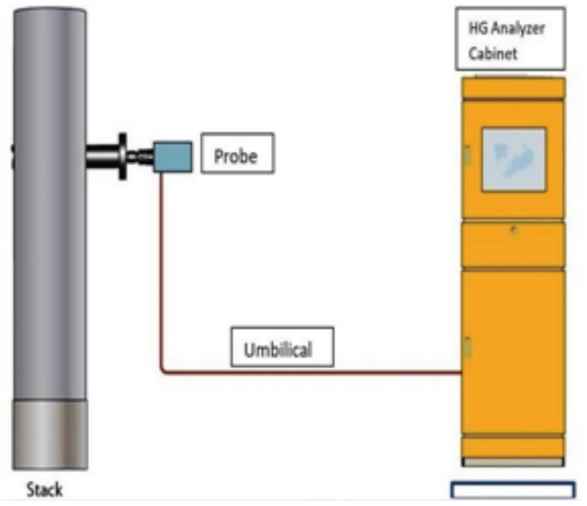
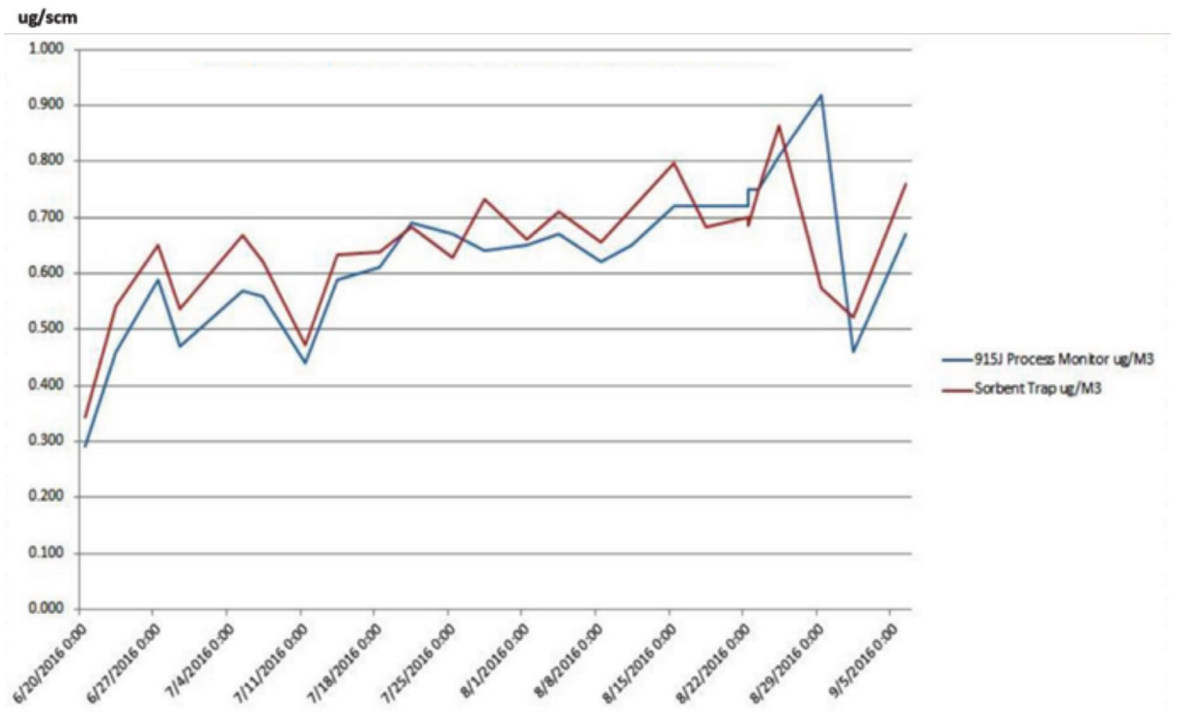
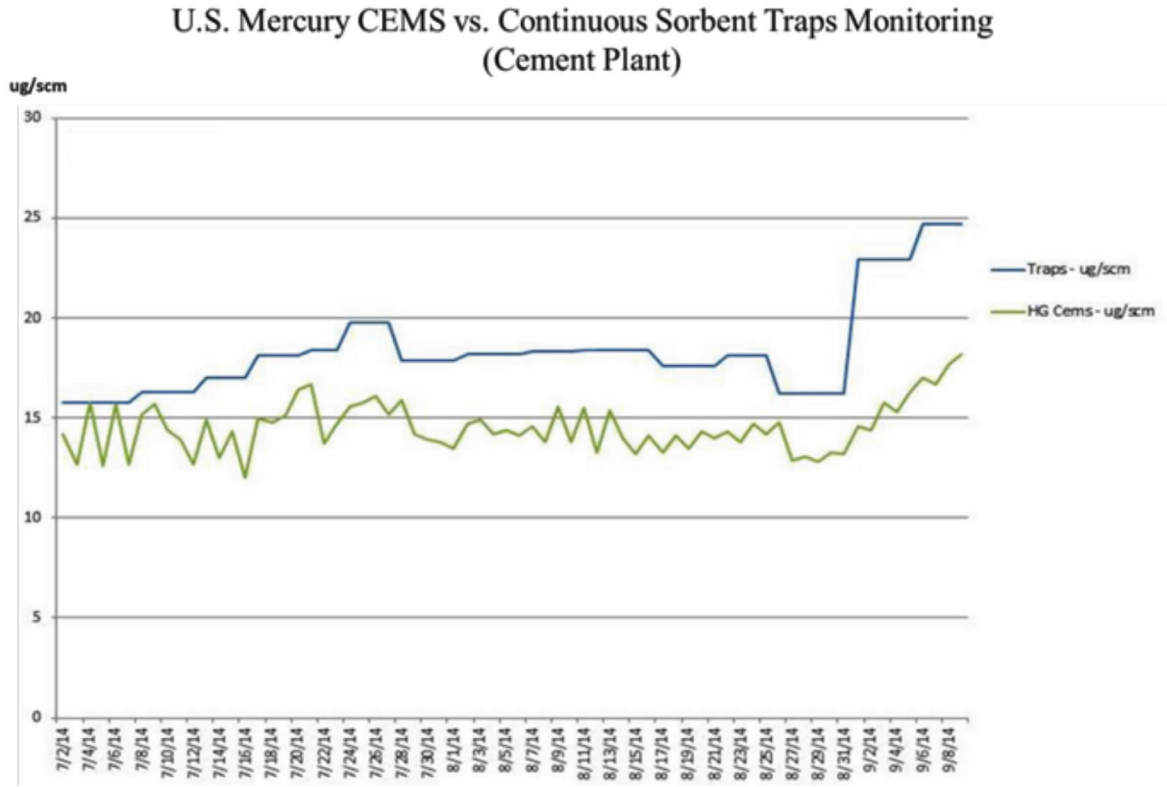


Diagram of Hg CEMS at Stack





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