Sorbent Traps

for Continuous Measurement of

Metal Hazardous Air Pollutants (HAP)

Method Summary

Ohio Lumex is currently developing a sorbent trap method for continuous monitoring of metal Hazardous Air Pollutants (HAP) emissions, with support from the U.S. Environmental Protection Agency (EPA) Small Business Innovation and Research (SBIR) program. The information provided here summarizes the method's characteristics and status as of April 15th, 2024.

The sorbent trap method is modeled after EPA Performance Specification 12B (PS 12B) for mercury, extended to cover a range of other metals, including, but not necessarily limited to: Sb, As, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, and Zn. The sorbent traps are specially designed and produced by Ohio Lumex to capture filterable metals (bound to particulate matter) and vapor-phase metals. This is accomplished with the use of a two-stage filter inside the trap, followed by two sections of sorbent material. A third section of sorbent material is added if a spiked section is required for the application. See Figure 1 below.

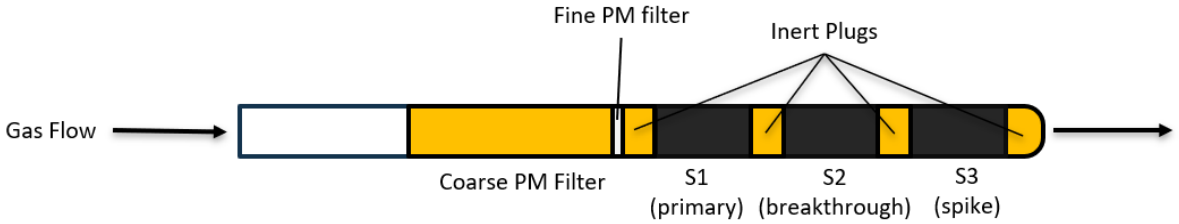

Figure 1 – Ohio Lumex HAP Metals Sorbent Trap

Metal HAP emissions from stationary sources are currently estimated using emissions factors derived from intermittent stack testing measurements, input feed stream data, and plant operating parameters. Emissions factors may have significant uncertainty, particularly for sources where feed stream metal content is highly variable. Continuous measurements are needed to provide superior accuracy, but current technology is limited and cost prohibitive.

The sorbent trap method would meet that need with repetitive in-stack sampling, using paired sorbent traps with periodic analysis of time-integrated samples collected over a period of several days. This innovative and performance-based method will include robust quality controls, including pair agreement, breakthrough measurements, and spike recoveries (optional).

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This method will also provide a superior alternative to EPA Method 29, an impinger-based sampling method which is generally regarded as cumbersome, expensive, and hazardous. Method 29 is also limited to sampling for only a few hours, while the sorbent trap method is designed to be sampled for up to several days at a time, if required.

The sorbent trap method is designed primarily for hazardous waste combustors, metal smelting operations, iron and steel production, secondary smelting facilities, coal-fired power plants, and biogas/renewable natural gas applications.

There are three primary applications for the sorbent trap method, and each application has slightly different sorbent trap configurations and sampling characteristics:

Continuous Emissions Monitoring	Direct Alternative to Method 29	Analysis of Biogas and Renewable Natural Gas
•Sorbent Traps are sampled for a maximum of 7 days, after which they are replaced with additional traps •Includes a third section to measure spike recovery, analogous to PS 12B •Proportional flow sampling	•Sorbent Traps are sampled for a maximum of 4 hours •Isokinetic sampling	•Sorbent Traps are typically sampled for 1 hour •Filter is reduced to a single stage. •Extractive sampling

Method Development Schedule

The project was separated into three phases:

Phase I - Proof of Concept

December 2021 - May 31 2022

- During this phase of the project, Ohio Lumex tested multiple sorbent materials and performed various laboratory experiments to confirm essential method performance characteristics, such as background concentrations and spike recoveries.

Phase II - Method Validation

October 2022 - October 2024

- Ohio Lumex built a dedicated metals analysis laboratory, optimized the analytical method, scaled and improved sorbent material production, and is currently performing field testing to validate the method in a variety of gas matrices.

Phase III - Fine Tuning

October 2024 - October 2025

- This phase of the development plan will focus on making improvements to the method beyond the basic scope of the SBIR project. This includes reducing quantitation limits, adding metals to the method scope, and testing various gas matrices. This time will also be used to gather additional data for EPA to use in the process of drafting and publishing the method.

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Method Performance and Development Status

As of April 15th 2024, the method's performance and development status are as follows:

Background Metals	• Background metals in sorbent traps have been reduced to levels that are very low relative to capture mass for most applications. • Background is very consistent, allowing for blank subtraction
Breakthrough (Percentage of total mass captured by Section 2)	• Emissions source testing has yielded <1% total breakthrough (including filter mass) and <10% for vapor-phase breakthrough
Spike Recovery (Recovery of pre-spiked mass on Section 3)	• Laboratory tests indicate spike recovery from 75-125% • Field tests pending
Pair Agreement (% Relative Deviation between paired traps)	• Emissions source testing has yielded <10% relative deviation between paired sorbent trap concentrations
Relative Accuracy (Difference between Trap Method and Method 29)	• Relative Accuracy tests currently underway • Ohio Lumex seeking several source categories to accumulate comparison data
Analytical Method	• Analysis meets EPA Method 6020B performance criteria

Major Takeaways

Over the last two years, Ohio Lumex has steadily made progress towards the development of a HAP metals sorbent trap. Method Development is nearing completion and recent field tests have demonstrated excellent performance. For some applications, the sorbent traps are ready for use in their current state, while for others additional data is required to validate the method.

Ohio Lumex has several field tests planned for the remainder of 2024, many including the parallel use of Method 29 in order to compare the methods and provide EPA with the data it needs.

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