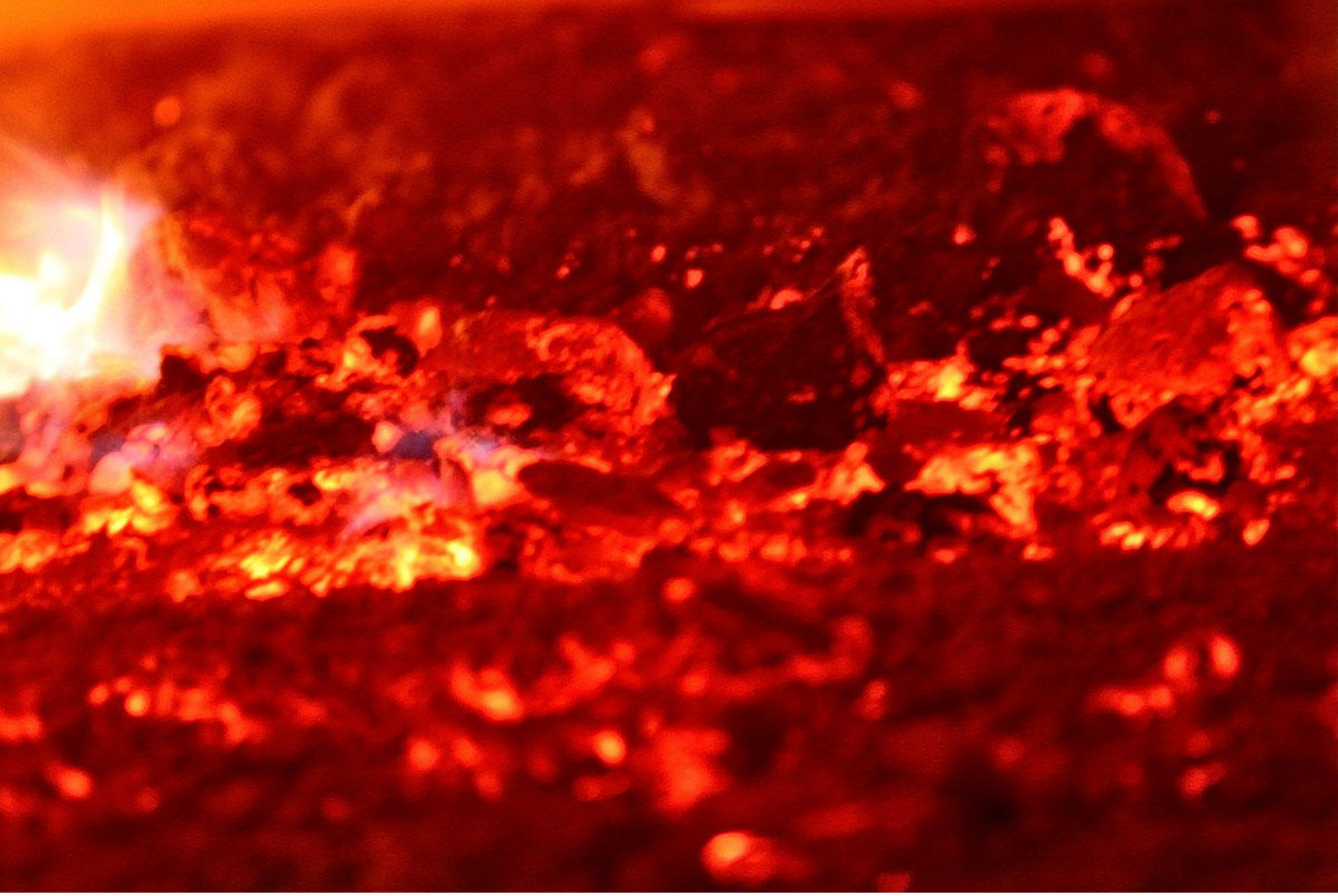


Application Note AN-PAN-1066

Online analysis of cadmium in incineration plant wet gas scrubbers

Municipal solid waste incineration (MSWI) produces flue gas filled with heavy metals, requiring stringent emission control measures. Treatment involves particle separation, scrubbing, and desulfurization. Treated gas is released, while residues (waste stream) undergo disposal. Water used in the wet gas scrubber plays an important role in the treatment process. Thus, wastewater treatment is essential for meeting regulatory standards.

Fluctuations in the contaminant load necessitate periodic monitoring. Traditional methods like atomic absorption spectroscopy (AAS) provide only a snapshot view, prompting the need for continuous monitoring.

This Process Application Note details the use of an online analyzer like the 2060 VA Process Analyzer to target this challenge. The 2060 VA Process Analyzer offers hourly measurements, alerting operators when limit values are approached. This ensures timely intervention—such as ion exchanger regeneration, preventing breaches—and maintaining compliance with established regulations.

INTRODUCTION

Municipal solid waste incineration (MSWI) (Figure 1) is a commonly used waste management method because of both its ability to significantly reduce the volume of waste and its potential for energy generation [1]. However, it generates flue gas loaded with heavy metals and other harmful pollutants, requiring strict emission control measures.

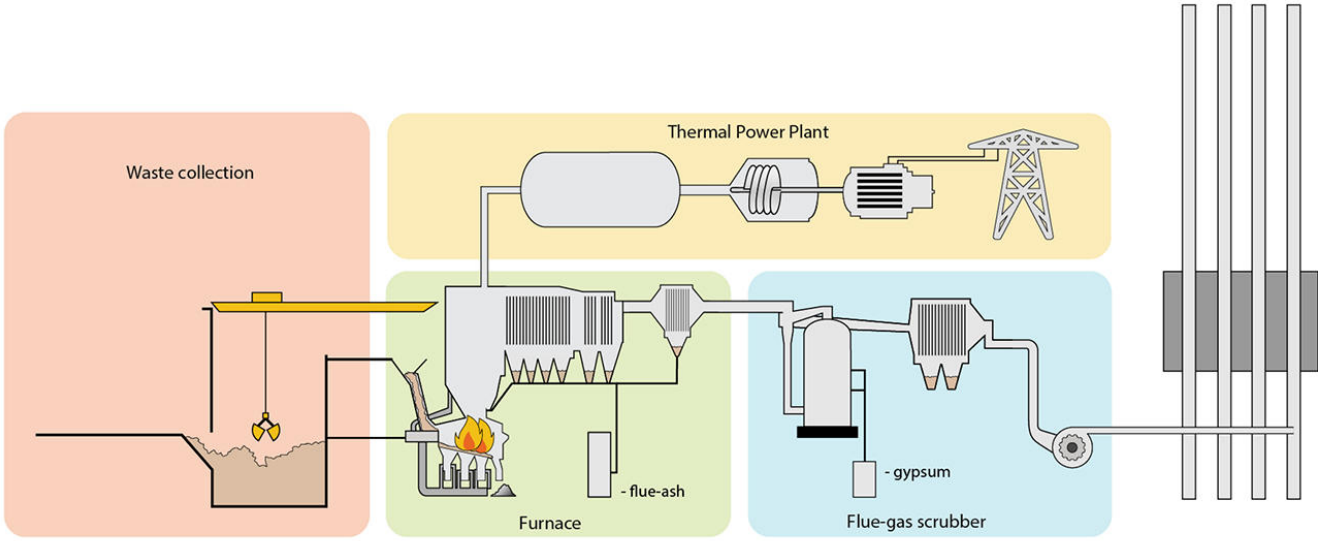


Figure 1. Schematic of a municipal solid waste incineration plant.

An air pollution control (APC) system is used at these plants to reduce such emissions. First, solid particle separation occurs via an electrostatic precipitator. Following this, the flue gas undergoes scrubbing, starting with a cooling process achieved by water spraying which simultaneously removes chlorides and heavy metals (Figure 2). Then, desulfurization occurs (this is also known as the alkaline phase), which is achieved by introducing caustic soda into the scrubbing water.

The cleaned waste gas is released into the environment, while the purified ash and APC residue are discarded appropriately. Since these impurities are dissolved in the scrubbing water, the water must undergo treatment and subsequent examination in the wastewater treatment plant (WWTP).

The plant's wastewater must comply with the local regulatory limit values. Traditionally, monthly in-house inspections use atomic absorption spectroscopy and photometry in the laboratory.

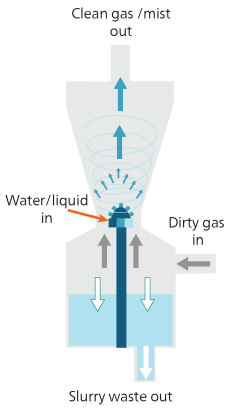


Figure 2. Incineration wet gas scrubber.

However, the contaminant levels in the purified wastewater vary due to its original composition and the charge status of the ion exchanger which requires periodic regeneration. As a result, samples collected during inspections only provide a brief overview. This makes it challenging for operators and authorities to ensure that set limits are consistently met.

Hence, online process analyzers become important for compliance. The 2060 VA Process Analyzer, for instance, provides hourly measurements of the concentration of zinc, cadmium, lead, or other metals in the process wastewater.

Employing voltammetric determination, the 2060 VA Process Analyzer (Figure 3) operates fully automatically. It also features an alarm system that notifies plant personnel when any of the monitored heavy metals approach the limit values. This timely alert enables the introduction of ion exchanger regeneration or other strategies for mitigation, effectively preventing limit value breaches.



Figure 3. 2060 VA Process Analyzer from Metrohm Process Analytics.

APPLICATION

The 2060 VA Process Analyzer employs anodic stripping voltammetry (ASV) with a glassy carbon electrode that is modified with a mercury film (Hg-GC). Both analysis and maintenance of the Hg-GC electrode are fully automated, ensuring efficiency and accuracy. This method proves its resiliency across diverse sample matrices, including highly saline water.

Table 1. Parameters to monitor during wastewater treatment after the incineration plant wet gas scrubber process.

Parameters	Concentration	Technique
Cd	1–30 µg/L	Voltammetry
Zn	1–80 µg/L	Voltammetry
Pb	1–30 µg/L	Voltammetry

REMARKS

While this Application Note primarily focuses on the online analysis of cadmium in wet gas scrubbers at MSWI facilities, it is applicable outside of this specific context. The process analyzer described here is suitable for use with a wide range of incinerators, including coal-burning power plants. This versatility highlights the broader utility of the 2060 VA Process Analyzer, which provides valuable insights for environmental monitoring and regulatory compliance across a wide range of industrial combustion processes.

CONCLUSION

MSWI effectively reduces waste volume and generates energy, but emits pollutants requiring strict control. The 2060 VA Process Analyzer offers continuous monitoring of the process water used in the wet gas scrubber, ensuring regulatory compliance by providing hourly heavy metal concentration values.

REFERENCES

1. Phua, Z.; Giannis, A.; Dong, Z.-L.; et al. Characteristics of Incineration Ash for Sustainable Treatment and Reutilization. *Environ Sci Pollut Res* 2019, *26* (17), 16974–16997. https://doi.org/10.1007/s11356-019-05217-8.

RELATED APPLICATION NOTES

AN-PAN-1009 Online analysis of ammonia, nitrate, and nitrite in wastewater

AN-PAN-1039 Determination of ortho- and total phosphate phosphorus in water

BENEFITS FOR ONLINE PROCESS ANALYSIS

- Guarantee compliance with governmental regulations (wastewater effluent).
- Save money by reducing downtime: analyzer sends alarms for out-of-specification values which inform the operator sooner.
- Process data available at your fingertips 24/7 means no waiting for slow, manual laboratory methods.
- Efficient chemical treatment by constantly monitoring the influent streams.
- Prolonged lifespan of the equipment (ion exchangers) – optimizing the regeneration schedule and hence reducing costs.



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CONFIGURATION



2060 VA/CVS Process Analyzer

The 2060 VA Process Analyzer is an online process analyzer that implements voltammetric analyses to deliver accurate process monitoring. Thanks to its customizable wet part modules, dosing units, pumps, and level sensors can be integrated to target any challenge.

The 2060 CVS Process Analyzer is an online process analyzer designed for online analysis of organic additives in electroplating baths within PCB and semiconductor industries. By using an electrode reaction that mimics the production process, it makes it possible to quantify additives in authentic conditions. Additionally, the modularity of the analyzer supports titration, photometry, sample preconditioning, and interfacing with multiple sample streams.