

# SEWAGE SLUDGE INCINERATION: MEETING AIR EMISSIONS REGULATIONS IN THE NINETIES AND BEYOND

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## Discussion by:

Ron Albrecht  
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The authors are congratulated for presenting a thorough and well documented review of a variety of air quality control technologies for multiple hearth and fluid bed sludge incinerators. The thrust of the paper is to outline approaches to meet CFR, Part 503 regulations on total hydrocarbons and heavy metals and other regulations on particulate matter, carbon monoxide, nitrogen oxides, sulfur oxides, and other pollutants. Inherent differences between the two types of furnaces in meeting these regulations are explained. The authors' presentation of the effects of both furnace's operating parameters on the various types of pollutant emissions and different types of pollution control equipment with anticipated effectiveness on different furnaces is concise and referenced. Case studies of the performance of multiple hearth and fluid bed furnaces are presented. The references should be a useful resource to anyone involved in air quality work on sludge incinerators.

## AUTHORS' REPLY

No comments to respond to. Thank you for your kind comments.

## Discussion by:

Ben C. Wester  
Havens and Emerson  
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The paper was well researched and well written. The following are comments which hopefully can add to this paper.

(a) On p. 372, the first full paragraph states "Heavy metals tend to condense onto fine particulates because of the relatively large surface area available." This is correct when considering that fine particulates have a larger surface to mass ratio than heavier particles or when considering that larger available surface areas of the combined fine particles exist compared to available surface areas of larger particles. The writers may wish to explain this better.

(b) In p. 372, in the last sentence of the third full paragraph, the writers may wish to add "and cooling" to read "Burn-out and cooling of ash..."

(c) On p. 373 under Particulate Emissions it is mentioned that Table 1 gives a summary of measured particle size distributions for the wet scrubber. The reader could not find these numbers and believe them to be missing.

(d) On p. 374, or possibly elsewhere, the writers may wish to mention that recently EPA has allowed CO monitoring as a surrogate to THC monitoring. This policy is most important for fluidized bed incinerators.

## AUTHORS' REPLY

(a) Mr. Wester is correct. The reason why heavy metals tend to coalesce onto fine particulate matter is the relatively larger surface-to-mass ratio compared to heavier particles. More surface area is available on finer particles for metal deposition. This is the challenge in designing air pollution control equipment that can remove such fine particles, containing a large proportion of the metals so adequately.

(b) Mr. Wester is correct.

(c) Particle size distribution measured at the furnace exit and at the scrubber exit are given in Table 1. The two right columns indicate the percentage (by weight) of total particulate less than 10  $\mu\text{m}$  in diameter, and less than 1  $\mu\text{m}$  in diameter.

(d) We did not have a chance to include the new policies concerning Part 503 because of the time the paper was due at the printer. It was discussed in the presentation. In summary, the new policies are as follows:

(1) *CO monitor can be used in lieu of a THC monitor.* In response to a lawsuit by some sludge incinerator operators in New Jersey, who currently operate CO continuous emission monitoring systems (CEMS) under tight limits by the State, the USEPA has recently allowed a CO monitor to be installed and operated in place of a THC monitor, under the limit of 100 ppm<sub>dv</sub> CO. While a CO CEMS is less expensive and more "reliable" (older technology) than a THC unit, CO emissions tend to fluctuate ("spike") more greatly than THC emissions. Therefore, particularly for older multiple hearth units, a CO CEMS may show violations of Part 503, which may not be apparent if a THC CEMS is operated instead.

(2) *Deadline for installing CEMS.* The original deadline for installing and operating the CEMS was February 19, 1994 (February 19, 1995 if construction of the incinerator is necessary). Because the USEPA issued no guidance on the selection, features, installation, certification, and operation of CEMS, many facilities delayed procurement. The USEPA waived the deadlines upon issuance of final CEMS guidelines. The USEPA headquarters issued draft guidance in March 1994. It is our understanding that the guidance is not yet final. We are not aware of how much time facilities will be given once the clock starts again.

(3) *Moisture determination.* Because the THC/CO measurements must be reported as dry, moisture measurements in the stack must be taken. Instrumentation to measure moisture is generally two O<sub>2</sub> CEMS, one dry bulb, one wet bulb. This can be fairly costly. Because the exhaust stream of a sludge incinerator is saturated with moisture (sludge itself is wet; the exhaust generally passes through a scrubber or wet ESP and is cooled), moisture can be estimated easily by temperature and appropriate saturation curves. This is probably more accurate than readings from two CEMS. The USEPA has agreed with this approach. Moisture may be determined by using a thermocouple in the stack and appropriate software to use the temperature to select a moisture content.

#### **Discussion by:**

Walter R. Niessen  
Camp Dresser & McKee, Inc.  
Cambridge, Massachusetts

The authors indicate that there was no difference in the metal emissions between multiple hearth and fluid bed furnaces. I believe it is observed that emissions of the more volatile pollutants (e.g., As and Cd) increase as furnace temperature increases. The character zones of MHF often approach 1750°F, whereas freeboard temperatures in FB usually <1600°F.

#### **AUTHORS' REPLY**

While it stands to reason that, as furnace temperature increases, emissions of more volatile compounds will also increase, a correlation between furnace type and volatile metal emissions is not evident from the data studied. Our database included only one set of data on uncontrolled metal emissions from a fluid bed incinerator, and was thus insufficient to draw conclusions.

As we discussed in our paper, emissions data reviewed from multiple hearth furnaces showed a trend of increasing lead emissions with furnace temperature, but did not show a significant correlation between emissions of other volatile metals (arsenic, cadmium, and mercury) and furnace temperature.

We agree that, in many cases, peak temperatures within a multiple hearth furnace exceed those within a fluid bed furnace. Inherent differences, however, exist between the combustion processes within the two furnaces. For example, sludge residence time and temperatures differ in the various burning hearths of the multiple hearth furnace, and turbulence within the fluid bed furnace affects the combustion process. An association between volatile metal emissions and furnace type would also have to account for these differences.