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Combustion Emissions Technical Resource Document (CETRED)

Executive Summary

EXECUTIVE SUMMARY

The Draft Combustion Emissions Technical Resource Document (CETRED) contains the initial technical analysis by the U.S. Environmental Protection Agency (EPA) concerning emissions of dioxins/furans and particulate matter from certain types of devices that burn hazardous waste: cement kilns, light-weight aggregate kilns, incinerators, and industrial boilers. CETRED represents the first, preliminary step in the development of regulations under the Resource Conservation and Recovery Act (RCRA) and the Clean Air Act (CAA) to impose upgraded standards on hazardous waste combustors (HWCs). CETRED also represents a major effort towards implementing the commitment made by EPA Administrator Carol M. Browner in the Draft Hazardous Waste Minimization and Combustion Strategy, released on May 18, 1993, to upgrade the technical standards governing emissions from HWCs.

EPA's intention in releasing CETRED at this time is to give the regulated community and other interested persons the earliest possible opportunity to understand the nature of the technical analysis that EPA is pursuing. CETRED can appropriately be regarded as a preliminary technical analysis of certain HWCs and their emissions of PM and dioxins/furans. CETRED represents the current state of analysis of EPA's technical staff in the Office of Solid Waste as regards the emission levels of PM and dioxins/furans achievable by the best controlled sources.

At this time, CETRED does not contain a characterization of emissions for toxic metals and other hazardous air pollutants from the HWCs studied. EPA will initiate a technical analysis to characterize these emissions in the near future. EPA expects to make the results of that analysis available to the public for review prior to the time that any regulatory proposal would be developed.

Process Descriptions

Cement Kilns. Many cement facilities burning hazardous wastes use "wet" process kilns where the raw materials are slurried before introduction to the kiln. Hazardous waste is burned in other types of cement kilns, however, including long dry kilns, preheater kilns, and preheater/precalciner kilns.

Liquid hazardous waste fuels are fired into the hot, lower end of the kiln as a supplement to fossil fuels. Solid hazardous waste fuels are also fired using several methods, including: (1) in long wet or dry kilns, containerized waste can be charged through a hatch on the rotating kiln wall in the calcining zone of the kiln; (2) in preheater or precalciner kilns, solid waste fuels can be injected directly into the precalciner vessel or preheater inlet; (3) in long wet or dry kilns, containerized waste can be injected at the hot end of the kiln using an "air cannon" at a high enough velocity to project the containers in the calcining zone; and (4) powdered hazardous waste can be pneumatically fired into the hot end of the kiln.

Cement kilns are normally equipped with either an electrostatic precipitator (ESP) or fabric filter (FF) to control emissions of particulate matter (PM).

Light-weight Aggregate Kilns. Light-weight aggregate kilns slowly heat raw materials such as clay, shale, or slate to expand the particles to form light-weight materials generally for use in concrete products. The light-weight aggregate concrete is produced either for structural or thermal insulation purposes. When burning hazardous waste, these kilns generally burn the liquid waste as their sole fuel.

Most light-weight aggregate kilns burning hazardous waste are equipped with FFs to control PM emissions.

Hazardous Waste Incinerators. Hazardous waste incineration technology has been developed over a number of years as a means of treating various types of waste to destroy toxic organics in the waste and reduce the volume of the waste. There are many types of incinerators in use including rotary kilns, fluidized bed units, liquid injection units, and fixed hearth units.

Incinerators use many types of air pollution control devices to control emissions of particulate matter, metals, and acid gases. In general, the control systems can be grouped into the following three categories: (1) wet systems, where a wet scrubber is used for both particulate and acid gas control; (2) dry systems where a FF or ESP is used for PM control, sometimes in combination with dry scrubbing for acid gas control; and (3) hybrid wet/dry systems where a dry technique (ESP or FF) is used for PM (and possibly acid gas control with use of dry scrubbing) followed by a wet technique (venturi or packed bed scrubber) for acid gas control.

Boilers. The three common boiler design categories that burn hazardous waste are firetube, watertube, and stoker-fired. Although most boilers burn liquid hazardous waste, some burn solid hazardous waste. The hazardous waste firing rate (percentage of heat input contributed by the hazardous waste) ranges from less than 10 percent to 100 percent.

PM Emission Levels

EPA is evaluating PM emission levels because controlling PM will control emissions of most toxic metals and toxic organic compounds adsorbed onto the PM. PM levels are evaluated for several different source categories (or subsets thereof), as well as various degrees of aggregation of these source categories. For example, commercial incinerators are evaluated separately from on-site incinerators as a crude attempt to determine if the best controlled of the generally smaller on-site incinerators are achieving PM emissions levels substantially different from the best controlled commercial incinerators. Further, PM emissions from the best controlled incinerators, boilers, and industrial furnaces are evaluated as an aggregated group representing the hazardous waste combustor source category. While the Agency is interested in examining the appropriateness and implementability of establishing standards that apply across all types of hazardous waste combustors, EPA recognizes that in doing so there may be technical and policy determinations that have not yet been fully illuminated or explored. The Agency emphasizes that, at this time, it has not decided if and which source categories will be grouped in determining PM emission limits.

For this study, EPA is evaluating PM emission data that facilities had submitted to the EPA Regional Offices and the States as part of Certifications of Compliance under the Agency's Boiler and Industrial Furnace (BIF) Rule, and from incinerator trial burns used to consider issuance of operating permits. To identify the best controlled sources, the sources are ranked in order of ascending PM emission levels considering the average emission level for the source and the variability of the emissions data. The best 12 percent (or best five sources, which ever is greater) of the sources are then selected as (potentially) the best controlled sources. Each of the sources in the selected pool is then evaluated to determine if they achieve low PM emissions because they use advanced control techniques or because they simple burn wastes or other materials with low levels of ash. Sources with low PM levels because of low ash feed rates are screened out of the pool as being unrepresentative of best controlled sources, and the next best controlled sources are brought into the pool as replacements.

Once the pool of the best controlled sources is established, their emissions data are analyzed statistically to predict a PM emission level that could be achieved under two alternative approaches. Under Option 1, a PM emission level is identified that all of the sources in the best controlled source pool could be expected to meet 99 percent of the time, with 95 percent confidence. Under Option 2, a PM emission level is identified that a source with emissions equivalent to the average for the sources in the pool, and displaying emissions variability similar to sources in the pool, could be expected to meet 99 percent of the time, with 95 percent confidence. Under Option 1, all of the sources in the best controlled source pool should be able to achieve the PM level without modifications, while under Option 2, some of the sources in the pool may not be able to achieve the PM level without modifications to the facility design or operation, while

The table below presents the PM emission levels achievable by the best controlled sources for the source categories and groups of source categories, and for the alternative analytical approaches:

PM EMISSION LEVELS ACHIEVABLE BY THE BEST CONTROLLED SOURCES
(gr/dscf @ 7% O2)

Source Category	Option 1*	Option 2+
Cement Kilns	0.033	0.010
Lightweight Agg. Kilns	0.022	0.0077
Commercial Incinerators	0.010	0.0049
On-Site Incinerators	0.015	0.0075
All HW Incinerators	0.0057	0.004
Boilers	0.021	0.011
All Hazardous Waste Combustors	0.0086	0.0052

* Under Option 1, a PM emission level is identified that all of the sources in the best controlled source pool could be expected to meet 99 percent of the time, with 95 percent confidence.

Under Option 2, a PM emission level is identified that a source with emissions equivalent to the average for the sources in the pool, and displaying emissions variability similar to sources in the pool, could be expected to meet 99 percent of the time, with 95 percent confidence.

Dioxin/Furan Emission Levels

Dioxin/furan emission levels are evaluated for hazardous waste burning incinerators, cement kilns, lightweight aggregate kilns, and boilers in the aggregate (i.e., as a hazardous waste combustor (HWC) source category). EPA is not currently aware of any overriding technical reason why all HWCs should not be able to meet the emission level achievable by the best controlled sources.

The dioxin/furan emissions data used for the analysis are obtained from BIF Certifications of Compliance and incinerator Trial Burn results. The Agency is using the same methodology used for PM to identify the best controlled sources, except that the sources in the (potentially) best controlled source pool are screened for three criteria. First, the pool sources are screened to determine if they have low dioxin/furan emissions because their feedstreams contain insignificant levels of chlorine.

Then, two additional screening criteria are used because of concern about the potential conflict between minimizing dioxin/furan and PM emissions at the same time. Given that dioxins/furans may be formed in HWCs operating under good combustion practices by surface-catalyzed reactions, dioxin/furan emissions can be affected by PM emissions. Thus, these screening criteria ensure that the dioxin/furan emissions from the pool sources are representative of emissions from sources that use best operating practices to control both PM and dioxin/furans. The first of these criteria screened out of the pool sources that had low PM emissions because they are feeding materials with low ash content. These sources may have low dioxin emissions simply because there was little PM to promote surface-catalyzed formation. The second criterion screened out sources that have high PM emissions. These sources may have low dioxin emissions simply because they are not removing PM and thereby providing an attenuated residence time (e.g., in an ESP or FF) for surface-catalyzed reactions to take place.

After the pool of best controlled and representative sources is identified, the same statistical approaches used to analyze PM emissions are used to analyze dioxin/furan emissions. The table below presents the dioxin/furan emission levels achievable by the best controlled HWC sources under the alternative analytical approaches:

DIOXIN/FURAN EMISSION LEVELS ACHIEVABLE
BY THE BEST CONTROLLED SOURCES
(ng/dscm @ 7% O_2)

Basis	Option 1*	Option 2+
TEQ	0.17	0.12
Total Tetra-Octa Congeners	9.4	5.4

* Under Option 1, a PM emission level is identified that all of the sources in the best controlled source pool could be expected to meet 99 percent of the time, with 95 percent confidence.

Under Option 2, a PM emission level is identified that a source with emissions equivalent to the average for the sources in the pool, and displaying emissions variability similar to sources in the pool, could be expected to meet 99 percent of the time, with 95 percent confidence.

Note that EPA believes that it is appropriate to control dioxin/furan emissions for HWCs based on toxicity equivalents (TEQs). Under this approach, weighting functions knows as toxicity equivalence factors are assigned to the various dioxin and furan congeners to account for their toxicity relative to 2,3,7,8 TCDD. EPA is considering whether it is also appropriate to control emissions based on total tetra-octa congeners. If so, emission limits would be established on the basis of total congeners as well as TEQ.

European Emission Regulations

On March 23, 1992, the EEC issued a proposal for a Council Directive on the Incineration of Hazardous Waste. The Directive requires all its Member States to establish laws, regulations, and administrative procedures to comply with the directive by June 30, 1994. The directive stipulates that any new incinerator must comply immediately and existing facilities by June 30, 1997.

The regulatory approach adopted in the 1992 EEC Directive establishes a wide array of continuous emission monitoring requirements, including continuous monitors for carbon monoxide and total dust emission levels, and monthly measurements for metals, dioxins, and furans. A summary of European guidelines and limits for PM and dioxins/furans is presented below:

EMISSION GUIDELINES/LIMITS FOR WASTE INCINERATION IN EUROPE

Pollutant (Daily Averages)	EEC Guideline	Netherlands Limit	Germany Limit
Total Dust (mg/m3)	5	5	5
Dioxin/furan (ngTEQ/m3)[1]	0.1	0.1	0.1

Waste incineration has been in use in Europe longer than in North America. The air pollution control device (APCD) systems are similar. However, because the majority of the European facilities have undergone retrofits and have faced more stringent emission standards, design differences exist. Incinerators in Europe currently incorporate some sort of dust control device, such as wet and dry electrostatic precipitators (ESP) or fabric filters (FF). Most facilities have added multi-stage wet and dry scrubbers or spray drying and dry absorption processes for controlling acid gas and heavy metal emissions. The future trend is expected to be toward wet scrubbers, even though all APCD

[1] It is important to note that the European guideline or limit of 0.1 TEQ is corrected to 11% oxygen, and compliance is based on daily averaging. EPA requires that dioxin/furan emissions be corrected to a stack gas oxygen level of 7%. A 0.1 limit at a 11% oxygen correction factor is equivalent to a 0.14 limit at a 7% correction factor. Further, EPA requires hazardous waste burning devices operating under RCRA regulations to comply with emissions standards generally on a hourly rolling averaging period. The European guidelines/limits are based on daily averaging, a less stringent approach in terms of operational variability. Finally, RCRA regulations require a facility to comply with the emissions standard for each of three triplicate runs during a Trial Burn or compliance test. Compliance with the European guidelines/limits is based on the average of test runs.

systems must be a zero liquid discharge systems. Some new technologies that are emerging include adding Selective Catalytic Reduction DeNOx reactors, activated carbon filters, and gas suspension absorbers. As new options arise, it appears to be the general practice in Europe to continue to retrofit facilities with new APCDs in series with existing equipment.