

EPA'S MACT RULE FOR HAZARDOUS WASTE COMBUSTORS

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ABSTRACT

In early 1999, U.S. EPA expects to promulgate final regulations controlling emissions of hazardous air pollutants (HAPs) from incinerators, cement kilns, and lightweight aggregate kilns that burn hazardous waste. DOE's mixed waste incinerators (as well as any privately-owned mixed waste incinerators) will also be subject to these regulations. Together, these facilities are responsible for about 80% of the hazardous waste burned each year in the U.S. EPA's final rule will impose a national set of technology-based emission standards. These standards will limit emissions of dioxins/furans, mercury, two semi-volatile metals (i.e., lead and cadmium), three low volatility metals (i.e., arsenic, beryllium, and chromium), particulate matter, total chlorine, carbon monoxide, and hydrocarbons. Emission standards and associated requirements on combustion operations will be regulated and permitted only under the Clean Air Act. Hazardous waste permits will continue to be required for other waste management activities conducted at these facilities (such as storage and corrective action). These hazardous waste permits, issued under authority of the Resource Conservation and Recovery Act (RCRA), can be expanded in unusual circumstances to include special emission standards needed to ensure full protection against potential risks to human health or the environment.

BACKGROUND

The U.S. Environmental Protection Agency (EPA or the Agency) intends in early 1999 to adopt a final rule that imposes national, technology-based emission standards on three categories of facilities that burn hazardous waste. These facilities include incinerators (both commercial and on-site), cement kilns, and lightweight aggregate kilns.

EPA is doing so for several reasons. First, these standards will satisfy EPA's legal obligations under the Clean Air Act to control emissions of hazardous air pollutants (or HAPs) from hazardous-waste burning incinerators and portland cement kilns. In 1992, EPA published a list of categories of major and minor (or area) sources of HAPs, including hazardous waste incinerators and portland cement plants.(1) The Agency shortly thereafter committed to developing MACT standards for these two source categories within 10 years.(2) The expected final rule for hazardous waste combustors would fulfill most of this obligation, but some cement kilns do not burn hazardous waste. Therefore, to complete its task, the Agency has also proposed MACT standards for portland cement plants that do not combust hazardous waste.(3) [This proposal is not discussed in this paper.]

Second, this final rule will meet the Agency's public commitment under its 1994 Hazardous Waste Minimization and Combustion Strategy.(4) As a centerpiece to its Strategy, the Agency undertook to "develop and promulgate rules that impose more rigorous controls on combustion facilities based on an assessment of available technologies and most current science." Other goals of EPA's Strategy being implemented through a variety of other Agency actions include: (1) enhanced public outreach and EPA-State coordination; (2) increased use of waste minimization; (3) aggressive compliance and enforcement efforts; (4) enhanced public involvement opportunities in the permitting process; and (5) advancements in scientific understanding on combustion issues and risk assessment.

Third, EPA will fulfill key terms of a litigation settlement agreement entered into in 1993 with a number of groups that had challenged EPA's current rule addressing emissions from hazardous waste boilers and industrial furnaces.(5) These groups include the Natural Resources Defense Council, Sierra Club, Inc, Environmental Technology Council, National Solid Waste Management Association, and a number of local citizens' groups. Among other commitments in this settlement agreement, EPA agreed to initiate one or more rulemakings to revisit various particulate matter, dioxin/furan, and metal standards, and to include an option for technology-based standards.

EPA expects these emission standards to create a national baseline of regulation that will help to assure the American public that combustion of hazardous waste is being properly controlled. The standards themselves are grounded upon section 112 of the Clean Air Act and apply to the three major categories of hazardous waste burners – incinerators, cement kilns, and lightweight aggregate kilns. Collectively, these three categories are referred to as hazardous waste combustors (or HWCs). Together, HWCs are responsible for about 80% of the hazardous waste that is burned each year within the United States. EPA has estimated that the final rule, when implemented, will result in significant reductions in the amount of key hazardous air pollutants being emitted each year from these HWCs. For example, depending on the baseline year chosen, up to 98% of the annual dioxin and furan emissions and up to 80% of the annual mercury emissions from HWCs would be eliminated.(6)

HAZARDOUS WASTE COMBUSTORS COVERED BY THE MACT RULE

Hazardous Waste Incinerators

Hazardous waste incinerators (HWIs) are enclosed, controlled flame combustion devices under EPA's regulatory definition in 40 CFR 260.10. These devices may be fixed (in situ) or mobile and transportable. Major incinerator designs used in the United States are rotary kilns, fluidized beds, liquid injection and fixed hearth, while newer designs like those using infrared, plasma arc technologies are coming into operation. As of 1997, 149 HWI facilities operated 187 incinerator units in the U.S.(7) Of these, 20 facilities (26 units) are commercial HWIs. The remaining 129 facilities (161 units) are non-commercial, on-site HWIs.

Hazardous Waste-Burning Cement Kilns

Cement kilns are refractory-lined, horizontally-inclined rotating cylinders designed to calcine (i.e., drive off CO₂) a blend of raw materials (e.g., limestone, shale, clay, sand) to produce portland cement. Raw material is fed into the kiln at the higher end, while fuel firing takes place at the lower end. A number of cement kilns burn hazardous waste-derived fuels to

replace some or all of the fossil fuel, primarily coal, used to provide heat energy to the kiln. Most of these kilns burn liquid waste but several also burn bulk solids and small containers containing viscous or solid hazardous waste fuels. Containers are introduced either at the upper, raw material end of the kiln or at the midpoint of the kiln.

Generally, two different processes are used to produce Portland cement -- a wet process and a dry process. In the wet process, raw materials are ground up, wetted and fed into the kiln as a slurry. In the dry process, raw materials are ground dry and fed into the kiln dry. Wet process kilns are typically longer than dry process kilns to facilitate water evaporation from the slurried raw material. Dry kilns are more thermally efficient and frequently use preheaters or precalciners to begin the calcining process before the raw materials are fed into the kiln. The Agency considered the appropriateness of distinguishing among the different types of cement kilns burning hazardous waste, but at proposal determined that subcategorization was not needed.

In 1997, 18 Portland cement plants operated 38 hazardous waste-fired kilns (7). Of these, 27 kilns use the wet process to manufacture cement and 11 kilns use the dry process. Of the dry process kilns, one kiln employs a preheater and another kiln uses a preheater and precalciner.

Hazardous Waste-Burning Lightweight Aggregate Kilns

A lightweight aggregate kiln (LWAK) consists of a long steel cylinder, lined internally with refractory bricks, which rotates about its axis and is inclined horizontally. Prepared raw material is fed into the kiln at the higher end, while firing takes place at the lower end. As with cement kilns, these LWAKs use hazardous waste in conjunction with or in lieu of fossil fuel to produce the necessary kiln heat.

Dry raw material fed into the kiln is initially preheated by hot combustion gases, then melted to a semi-plastic state. Specific compounds decompose and form gases such as SO₂, CO₂, SO₃, and O₂. The viscous, semi-plastic raw material entraps the expanding gases and produces small, unconnected gas cells, which is the desired "bloating action." These gas cells remain in the product material after it exits the kiln, is cooled with cold air, and then conveyed to a discharge. Kiln operating parameters such as flame temperature, excess air, feed size, material flow, and speed of rotation vary from plant to plant and are determined by the characteristics of the raw material.

In 1997, there were 5 lightweight aggregate kiln facilities in the United States operating 12 hazardous waste-fired kilns.(8)

OVERVIEW OF KEY PROVISIONS OF THE MACT RULE

Universal Coverage

EPA proposed and is expected to establish MACT standards for all types and sizes of incinerators, cement kilns, and lightweight aggregate kilns burning hazardous waste. By statute, MACT standards apply only to major sources--sources that emit (or have the potential to emit) 10 tons or greater per year of any single HAP or 25 tons per year or greater of HAPs in the aggregate. Other sources with less emissions are known as area sources. However, area sources may be regulated under MACT standards if EPA finds that an area source category "presents a

threat of adverse effects to human health or the environment... warranting regulation [under the MACT standards].” EPA has proposed to make this finding for all types and sizes of HWCs, the result being that all would be regulated under the upcoming MACT standards.

Development of Standards

Clean Air Act Section 112 requires National Emission Standards for Hazardous Air Pollutants (or NESHAPs) to reflect the maximum degree of reduction in hazardous air pollutant emissions that is achievable taking into consideration the cost of achieving the emission reduction, any non-air quality health and environmental impacts, and energy requirements. These NESHAPs are often referred to as maximum achievable control technology (or MACT) standards.

Emission reductions may be accomplished through application of measures, processes, methods, systems, or techniques, including, but not limited to: (1) reducing the volume of, or eliminating emissions of, such pollutants through process changes, substitution of materials, or other modifications; (2) enclosing systems or processes to eliminate emissions; (3) collecting, capturing, or treating such pollutants when released from a process, stack, storage, or fugitive emissions point; (4) design, equipment, work practice, or operational standards (including requirements for operator training or certification); or (5) any combination of the above.

To establish a MACT standard, EPA typically first identifies an emission level representing reductions that are routinely achievable. This is the “MACT floor.” EPA then evaluates whether to develop standards that are more stringent than the floor and which would be achievable by using more advanced emission control technologies or practices. These are referred to as “beyond-the-floor” standards. In evaluating potential beyond-the-floor standards, EPA considers primarily the cost-effectiveness of achieving the additional emission reductions. However, its judgment can also be informed by a wide variety of factors, including risks to human health and the environment, energy implications, and other policy objectives (such as source reduction and recycling).

To make these findings and judgments, EPA compiles available information and, in some cases, collects additional information about facilities comprising the source category. This includes information on types, quantities, and characteristics of HAPs being emitted; pollution control technologies; results of emissions tests (e.g., compliance tests, trial burn tests) at controlled and uncontrolled facilities; and costs, energy, and environmental impacts of various emission control techniques. EPA uses this information in analyzing and developing possible regulatory approaches. EPA, of course, is not always able to assemble the same amount of information per industry and typically bases the standard on information practically available.

NESHAPs are normally structured in terms of numerical emission limits. However, alternative approaches can be adopted if necessary and appropriate. Section 112(h) authorizes EPA to promulgate a design, equipment, work practice, or operational standard, or a combination thereof, in those cases.

HWC Emission Standards

The final rule is expected to include eight emission standards -- chlorinated dioxins and furans; particulate matter; mercury; semivolatile metals (lead and cadmium); low volatility metals (arsenic, beryllium, and chromium); hydrogen chloride and chlorine gas (combined); and carbon monoxide or hydrocarbons. A MACT standard for destruction and removal efficiency to control non-dioxin/furan organic HAPs is also being considered. Each source category -- incinerators, cement kilns, and LWAKs -- will have its own set of emission standards for these HAPs and HAP surrogates. Also, EPA will establish separate emission standards for existing versus new sources in each source category. Because EPA's final MACT rule has not completed final Agency review and approval, no specific emission standards can be identified at this time.

Toxic Metals and Particulate Matter. The Clean Air Act list of HAPs includes 11 metals: antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, and selenium. To establish an implementable approach for controlling this suite of metal HAPs, the Agency has grouped the metals by their relative volatility given that emission control strategies are governed primarily by volatility. For example, while semivolatile metals (SVMs) and low volatility metals (LVMs) are in particulate form in the emission control train and can be removed as particulate matter (PM), mercury species are generally emitted from HWCs in the vapor phase and cannot be limited by controlling PM unless a sorbent (e.g., activated carbon) is injected into the combustion gas. In addition, LVMs are easier to control than SVMs. LVMs do not volatilize significantly in the combustion chamber and are larger, easier-to-remove particles entrained in the combustion gas. Conversely, SVMs do volatilize substantially in the combustion chamber and condense on fine PM, which is relatively more difficult to remove from the combustion gas stream.

The high-volatility group is comprised of mercury, the semivolatile group is comprised of lead and cadmium, and the low volatility group is comprised of arsenic, beryllium, and chromium. The remaining five metals (Sb, Co, Mn, Ni, and Se) are proposed to be controlled by using the PM standard as a surrogate to limit emissions.

Toxic Organic Compounds. Dioxin/furan (D/F) emissions are likely to be controlled directly with a D/F emission standard based on toxicity equivalents (TEQs), which takes into account the differing toxicities among D/F congeners. EPA has proposed to control other non-D/F organic HAPs by compliance with continuously-monitored emission standards for carbon monoxide (CO) or hydrocarbons (HC). CO and HC are widely accepted indicators of combustion conditions that, if proper, will destroy organic compounds. For example, current RCRA regulations for HWCs use emissions limits on CO and HC to control emissions of non-D/F toxic organic emissions.(5) In addition, the Agency's emission standards for municipal waste combustors and medical waste incinerators also contain a limit on emissions of CO to control non-D/F organic HAPs.

The Agency is also considering the extent to which the RCRA destruction and removal efficiency (DRE) standard is also needed as a MACT standard to ensure adequate control of non-D/F organic HAPs. The potential DRE MACT standard would involve compliance with operating parameters, including but not limited to minimum combustion zone temperature and maximum flue gas flowrate. Adopting a DRE standard as part of the MACT rule would also

necessitate additional implementation-related decisions, such as how to transfer DRE standard from the current RCRA permit regime into the MACT regulations and Title V permitting structure.

Hydrochloric Acid and Chlorine Gas. HWCs often feed waste containing high levels of chlorinated compounds. After combustion, the chlorine is emitted as hydrochloric acid (HCl) or chlorine gas (Cl₂). Both of these pollutants are designated HAPs. The Agency has indicated that it may control HCl and Cl₂ by a combined total chlorine MACT standard for two reasons. First, the test method used to determine HCl and Cl₂ emissions may not be able to fully distinguish between the compounds in all situations. Second, both of these HAPs can be controlled by limiting the feedrate of chlorine in hazardous waste and also by installing wet scrubbers in the post-combustion gas stream.

Compliance Procedures

EPA's position is generally centered around the notion that the MACT standards should apply at all times, except during startup, shutdown, or malfunction provided that hazardous waste is not being burned and does not remain in the combustion chamber. Sources may have an option when not burning hazardous waste (and when hazardous waste does not remain in the combustion chamber) of complying with any other Clean Air Act standards that may exist for the same types of sources that do not burn hazardous waste (e.g., non-hazardous waste cement kilns).

Compliance with MACT emission standards is to be documented by stack performance testing. Continued compliance assurance for those standards that are not monitored with a CEM is generally to be based on specified operating parameter limits, which are identified for each HAP standard. Most of the operating parameter limits are calculated based on initial stack performance testing; a few will be based on manufacturer specifications (for example, minimum pressure drop for low energy wet scrubbers). All operating parameters may be modified after subsequent stack testing. These operating parameter limits are typically adopted and enforced as permit conditions to ensure that emissions do not exceed performance testing levels for time durations equivalent to the amount of time it typically takes a source to manually sample its emissions during three test runs.

Operating parameter limits are typically continuously monitored with appropriate continuous monitoring systems (CMS). For carbon monoxide and hydrocarbon standards, continued compliance is assured by continuous *emissions* monitoring systems (CEMS). An automatic waste feed cutoff system is also to be used. This system will immediately stop the flow of hazardous waste feed to the combustor if a CEMS reading exceeds a standard or if an operating parameter limit is exceeded (considering the averaging period for the standard and operating parameter).

Compliance Period and Initial Performance Testing

The compliance date for EPA's MACT rule is three years after the date of publication of the final rule. A source will be able to request an extension of the compliance date -- up to one year -- if it cannot complete system retrofits and demonstrate compliance within three years despite a good faith effort to do so.

By the compliance date, a source must self-certify compliance with the MACT standards, and CEMS and continuous monitoring systems for the specified operating parameters must be fully operational. This certification is a preliminary indication of compliance, and is termed a Documentation of Compliance (DOC). It also documents the limits on the specified operating parameters necessary to maintain compliance with the emission standards. The DOC operating parameter limits and CEMS results for carbon monoxide and hydrocarbons are enforceable until after the source conducts a comprehensive performance test and submits a Notification of Compliance (NOC).

Sources must conduct this comprehensive performance test no later than 6 months after the compliance date (i.e., absent any extension, three and one-half years from promulgation of the rule). Within 90 days of completion of the performance test, a source must submit a NOC documenting: (1) compliance with the emission standards during the performance test; (2) the operating parameter limits calculated from the performance test; and (3) that the CO or HC CEMS meets performance specifications. Upon submission of the NOC, the source begins documenting compliance with the revised operating parameter limits.

Subsequent Performance Testing

A comprehensive performance test duplicating the initial performance test is to be conducted periodically, presumably every five years. Operating parameter limits would be revised as necessary based on the levels achieved during the subsequent performance test. Confirmatory testing only for dioxins/furans is conducted midway between comprehensive performance tests. This confirmatory testing is comprised of dioxin/furan stack testing under normal operating conditions. Operating parameter limits are not revised following confirmatory testing unless the D/F emission standard is exceeded.

Coordination with the RCRA Regulatory Regime

EPA proposed several options for coordinating regulatory and permitting provisions under RCRA and the Clean Air Act that apply to HWCs. At this point, the EPA staff has informally signaled its intention to recommend that HWCs should be subject only to Clean Air Act Title V permits insofar as emission standards and associated operations are concerned. Most likely, non-permitted HWCs will continue to be subject to RCRA permitting and performance requirements until they demonstrate compliance with the MACT standards by conducting a comprehensive performance test and submitting a notification of compliance. HWCs that already have RCRA permits would remain subject to permit conditions governing air emissions until the RCRA permit is modified to delete any conditions less stringent than the MACT standards. An individual source can request this type of permit modification at the same time it submits the NOC. During any period of time when both RCRA standards and associated requirements and the MACT standards are effective, the source would have to comply with both sets of requirements.

RCRA Omnibus Authority

The RCRA omnibus authority, statutory in origin and codified at 40 CFR 270.32(b)(2), requires the permitting agency to consider, on a case-by-case basis during permit issuance or renewal, whether emissions may pose an unacceptable risk to human health or the environment.

This consideration is often centered around the results of a site-specific risk assessment. If unacceptable risks are found, then RCRA permit officials must include additional conditions in the permit as necessary to address these risks. The technology-based MACT regulations would not extinguish this risk-related legal obligation. Thus, any risk-based permit provisions that are more stringent than the MACT standards or that address other emission hazards will be placed in or remain in a facility's RCRA permit even after the transition to Title V permitting might occur.

Estimated Regulatory Impacts

Under the terms of Executive Order 12866, EPA has indicated that this rule would be an economically significant regulatory action and therefore has examined social cost impacts.⁽⁶⁾ Total social costs include the value of resources used to comply with the standards by the private sector, the value of resources used to administer the regulation by the government, and the value of output lost due to shifts of resources to less productive uses. Preliminary staff findings suggest that, overall, the difference in aggregate compliance costs for all sectors of the existing regulated community to meet any of the examined emission standard scenarios would not be substantial. Total annualized market adjusted costs for all sectors are thought to be significantly under \$100 million, but no final estimates are publicly available. At proposal, EPA indicated that cement kilns and private on-site incinerators would make up the majority of aggregate national costs under any of the examined scenarios.⁽⁶⁾ In addition, cement kilns are thought to be likely to experience the highest per system compliance costs, while the commercial and on-site incinerators would generally experience the lowest per system costs. Of course, various market adjustments are expected in response to the increased costs of hazardous waste combustion associated with the final MACT standards.

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