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# COMPLIANCE WITH THE NEW EMISSIONS GUIDELINES FOR EXISTING MUNICIPAL WASTE COMBUSTION FACILITIES

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**Abstract**

The EPA proposed air emission guidelines for existing Municipal Waste Combustion (MWC) facilities on December 20, 1989. The regulation, 40 CFR Subpart Ca, was eventually issued on February 11, 1991, but Section 129 of the Clean Air Act Amendments of 1990 required the EPA to review and revise the regulations. On October 31, 1995, Subpart Ca was withdrawn and replaced by a more stringent regulation, 40 CFR Subpart Cb. The new guidelines apply to all existing MWC facilities for which construction began before September 20, 1994 and have a capacity to combust over 35 megagrams per day. Most facilities will be required to be in compliance with the new regulations four years from the date Subpart Cb was issued, or by December 19, 1999.

Subpart Cb requires significant capital expenditures and increases in operating costs. The major modifications EPA based the guidelines on are summarized below:

-Spray dryer and baghouse for reduction of sulfur dioxide, hydrochloric acid, dioxin/furans, metals, and particulate on those MWC plants that currently do not have such a system or a spray dryer electrostatic precipitator combination.

-Selective Non-Catalytic Reduction System to reduce nitrogen oxide emissions on nearly all large MWC plants.

-Continuous Emissions Monitoring Systems to monitor sulfur dioxide, nitrogen oxides, carbon monoxide, and opacity for all MWC plants.

-Implementation of good combustion practices to meet carbon monoxide and dioxin/furan emission limitations.

-Activated carbon injection system for most mass-burn MWC units to meet emissions limits of mercury and dioxin/furans.

Estimated capital and annualized costs required to meet these regulations are summarized along with the technologies available to meet these requirements.

## INTRODUCTION

MWC facilities constructed during the 1980s were subjected to varying air emission limitations depending on the state in which the facility was constructed. The federal standards for Municipal Waste Combustors (MWC) that existed before 1990 (40 CFR Subparts E and Db) only limited particulate emissions. Therefore, emission limitations and monitoring requirements for other pollutants were established at the state level on a case-by-case basis as part of the New Source Review process. New Source Review requirements generally became very stringent beginning in the late 1980s. However, with the promulgation of the Emission Guidelines for existing MWC facilities, 40 CFR Part 60, Subpart Cb, on October 31, 1995, all existing MWC facilities in the United States will be required to meet similarly stringent emission standards and monitoring requirements. For many MWC facilities, particularly those constructed prior to 1990, compliance with the Emission Guidelines will require significant air pollution control system and emissions monitoring equipment improvements.

## REGULATORY HISTORY

In the early 1980s, the Environmental Protection Agency (EPA) conducted several studies to determine whether Municipal Waste Combustion (MWC) emissions should be regulated, and if so, under what section of the Clean Air Act. On December 20, 1989, the EPA proposed Emission Guidelines for existing MWCs under section 111 of the Act based on "best demonstrated technology". The Emission Guidelines for existing Municipal Waste Combustion facilities were published on February 11, 1991 as 40 CFR Part 60 Subpart Ca. The Federal EPA regulations required the state agencies to incorporate and implement these "guidelines" as part of their state implementation plans. The term "guidelines" is misleading as the states must implement regulations which are at least as stringent or "protective to the environment and community" as the "guidelines".

Before the Emission Guidelines for MWCs were finalized in 1991, they became obsolete with the passage of the Clean Air Act Amendments (CAAA) of 1990. The CAAA required regulation of existing MWC facilities in accordance with the more stringent requirements of Section 129 of the Act. Section 129 requires emission limitations to be no less stringent than the average emissions limitations achieved by the best performing 12 percent of existing MWC facilities and also requires regulation of pollutants that were not addressed in Subpart Ca.

Some states, such as Minnesota, issued regulations in accordance with the Emission Guidelines of 1991 (Subpart Ca) with the understanding that the Minnesota regulations would have to be revised in a few years. Other states, such as Florida, got an endorsement from EPA to wait until the revised Emission Guidelines were issued. The revised Emission Guidelines were proposed on September 20, 1994, and signed on October 31, 1995, as 40 CFR Part 60 Subpart Cb; Subpart Ca, the "outdated standard " was simultaneously withdrawn. The regulation was published in the December 19, 1995, Federal Register and compliance dates were triggered.

## COMPLIANCE SCHEDULE

The date that existing MWC facilities will have to be in compliance cannot be stated simply. State agencies have up to one year from December 19, 1995, to submit to the federal EPA a plan to implement and enforce these guidelines. Affected MWC facilities will have anywhere from one to three years from the date the state regulations are approved by EPA to comply. MWC facilities will thus have to be in compliance by approximately 1997-2000 depending upon the time required by the EPA to approve the State plan and the time required by the state to implement the approved plan. Although some facilities currently meet the emission limitations, many existing MWC facilities will require significant modifications and air pollution control improvements before the end of the decade. (EPA, 1995A)

Because of concerns about dioxin/furan and mercury emissions, the states must incorporate an accelerated schedule for large MWC plants for which construction commenced after June 26, 1987. These MWC plants, which generally already have spray driers and fabric filters or high efficiency electrostatic precipitators, are required to be in compliance with dioxin/furan and mercury emissions within one year following the EPA approval of the State plan for regulating MWC emissions since EPA believes that only activated carbon and fine-tuning of the systems is required to meet the limits.

## SOURCES AFFECTED

Municipal Solid Waste (MSW) is defined as either a mixture or a single-item stream of household, commercial, and/or institutional discards. Discards include paper, wood, leather, yard wastes, tree trimmings, plastics, leather, rubber, glass, metals, and other combustible and non-combustible materials. MSW also includes Refuse Derived Fuel (RDF), which is MSW that is shredded or pelletized prior to combustion. The MSW definition does not include used motor oil; sewage sludge; wood pallets; construction, renovation, and demolition wastes (including railroad ties and telephone poles); clean wood; industrial process or manufacturing wastes; regulated medical waste; or motor vehicles. (EPA, 1995A)

40 CFR Part 60 Subpart Cb affects any existing MWC facility with a capacity to combust greater than 35 megagrams per day (38.57 tons per day) of MSW. MWC facilities with capacities to combust between 25 and 35 Megagrams per day

are required to submit a notification report but are otherwise unaffected. An exemption is provided for waste combustion units capable of combusting more than 35 megagrams per day of municipal solid waste but are subject to a federally enforceable permit condition limiting combustion of MSW to 10 megagrams per day or less. (This exemption was intended for facilities that combust large quantities of non-MSW waste in conjunction with small quantities of MSW waste.)

Affected MWC facilities are divided into those with capacities over (large) and under (small) 225 Megagrams per day (247.95 tons per day) even though the Clean Air Act required EPA to promulgate regulations for units larger than 250 tons per day and units smaller than 250 tons per day. The emission limitations are more stringent for the large MWC facilities. Existing facilities are defined as those for which construction, modification, or reconstruction began on or before September 20, 1994. Facilities constructed after September 20, 1994, are regulated according 40 CFR Part 60, Subpart Eb, Standards of Performance for New Municipal Waste Combustors. MWC facilities constructed between December 20, 1989, and September 20, 1994, must meet requirements of both the Emissions Guidelines (Subpart Cb) and the "old" New Source Performance Standards (Subpart Ea).

Co-fired combustors are units that burn MSW along with non-MSW fuel such as coal, wood chips, tires, regulated medical waste, or sewage sludge. Co-fired combustors are affected by this regulation only if the MSW comprises over 30 percent by weight of the total waste stream.

Units combusting waste other than MSW, such as regulated medical waste and industrial waste, along with MWC units with capacities less than 35 megagrams per day will be regulated by EPA under different Emission Guidelines. The Emission Guidelines for other waste combustors are scheduled to be issued before November 15, 2000.

Approximately 16% of the MSW generated in the U.S. is combusted. The EPA estimates that in the United States, there were 370 operating MWC units in 179 plants as of 1994. (EPA, 1995A) All of these facilities were constructed before 1994 and will be affected by the new Emission Guidelines. However, the cost of compliance will vary significantly depending primarily on the existing permitted emission limits for the MWC unit.

## REQUIREMENTS OF THE EMISSION GUIDELINES

**MWC Organics (Dioxins & Furans) Emission Limitation** Large MWC facilities are required to meet total mass dioxin/furan emission limits, corrected to 7% Oxygen, as defined below:

-60 ng/dscm if an ESP particulate control system is used.

-30 ng/dscm if a fabric filter particulate control system is used.

Small MWC facilities are required to meet a dioxin/furan total mass emission limit of 125 ng/dscm.

**Meeting the Emission Limits** Perhaps no single air pollutant causes greater public concern and outcry than "dioxin". While the guidelines specify stringent dioxin/furan emission limits, continuous emissions monitoring for dioxin/furans is not technically feasible at this time. Annual stack tests and good combustion practice are required to verify that operating practices conducive to low dioxin/furan emissions are continuously complied with. Because of the difficulty in continuously monitoring dioxin/furan emissions, carbon monoxide emissions are used as a surrogate parameter even though the correlation between dioxin/furans and carbon monoxide is not universally accepted.

The average dioxin/furan emissions from an uncontrolled MWC with poor combustion can be as high as 1000 ng/dscm total mass but are typically lower for facilities with good combustion practices (EPA, 1994). Good combustion practices can reduce dioxin/furan emissions to less than 100 ng/dscm.

At low temperatures, dioxins/furans are sorbed onto particulate matter. Removal of dioxin/furans is thus generally closely correlated to the particulate removal efficiency of the particulate control system. The combination of good combustion practices in conjunction with a dry scrubber and fabric filter pollution control system can achieve the required dioxin/furan emission limits of 30 ng/dscm. Additional reductions of over 50% can be achieved by injection of activated carbon. (Litaca, 1994)

Meeting the emission limits for dioxins will require at a minimum good combustion practice and a high efficiency fabric filter or electrostatic precipitator. Injection of activated carbon and/or use of a spray dryer may also be required for large MWC units.

Recent test data supports the fact that the emission guidelines can be met with existing technology. 12 new MWC units at 5 MWC plants (Falls/Bucks County, Pennsylvania; Onondaga, New York; Lee County, Florida; Union County, New Jersey; and Hennepin, Minnesota) have recently initiated operation of air pollution control systems that include dry scrubbers, fabric filters, and carbon injection. All units were able to demonstrate initial compliance with the New Source Performance Standards (NSP) emission limits for dioxins/furans (13 ng/dscm), which are significantly more stringent than the Emission Guideline limits required for existing MWC units. Emission levels reported at these plants range from 1 ng/dscm to 11.6 ng/dscm with eleven of the units achieving emission levels less than 7 ng/dscm for the initial compliance tests. (EPA, 1995B) The referenced EPA background document does not provide any long-term test data to verify whether these emission levels can be maintained.

**Estimated Cost of Compliance** Air pollution control systems that reduce dioxin/furan reduction (spray dryer, fabric filter, and carbon injection) are also required to meet the particulate, metals, and acid gas requirements and therefore no major capital costs should be required. Operating costs will be higher than required to meet metals and acid gases because of increased carbon injection and increased exhaust gas cooling requirements.

**MWC Metals & Particulate Matter Emission Limitation** MWC facilities are required to meet the following emission limits, corrected to 7% Oxygen, for metals and particulate matter.

EMISSION LIMITATION (MG/DSCM)

| Pollutant | Small MWC Facilities | Large MWC Facilities |
|---|---|---|
| Particulate Matter (PM) | 70 | 27 |
| Cadmium (Cd) | 0.10 | 0.040 |
| Lead (Pb) | 1.6 | 0.49 |
| Mercury (Hg) (note 1) | 0.080 | 0.080 |
| Opacity (note 2) | 10% | 10% |

Notes:

(1) 85 % removal efficiency is an alternative to meeting the 0.080 mg/dscm emission limit. The MWC unit must meet the emission limit or removal efficiency requirement.

(2) Using a 6-minute average.

Particulate matter shall be tested in accordance with EPA Reference Method 5. Opacity shall be tested in accordance with EPA Reference Method 9. Cadmium, mercury, and lead shall be tested in accordance with EPA Reference Method 29.

## Meeting the Emission Limits

**Cadmium, Lead, and Particulate** Most cadmium and lead compounds have very low vapor pressures and are readily condensible at the typical inlet temperatures (approximately 300-400°F) for particulate removal devices (electrostatic precipitators and fabric filters). For instance, the vapor pressures of lead chloride and lead sulfide do not equal 1 mm Hg until temperatures over 1000°F are reached. (Perry, 1973) Cadmium and lead compounds also have a strong affinity to adsorb onto particulate matter. As a result, cadmium and lead emissions are closely related to the particulate matter control device efficiency. (EPA, 1995A) The emission limits required for existing MWC units represent a 99% reduction for large facilities and 97% reduction for small facilities from uncontrolled, baseline level emissions of particulate matter. These emission limits can typically be met with modern fabric filters and electrostatic precipitators. (EPA, 1995B)

Emission test results at 5 newly constructed plants equipped with dry scrubbers, fabric filters, and carbon injection have demonstrated the ability to reduce emissions to NSP limits of 24 mg/dscm for particulate matter, 0.020 mg/dscm for cadmium, and 0.20 mg/dscm for lead.

**Mercury** Unlike cadmium and lead compounds, which have negligible vapor pressures at 300°F (<<1mm mercury), elemental mercury and most mercury compounds, including mercuric chloride and mercuric bromide, have vapor pressures of approximately 4 mm mercury at 300°F (Perry, 1973). Therefore, without cooling the flue gas, significant quantities of mercury will pass through the particulate control device as a vapor and condense at ambient temperature. Uncontrolled mercury emissions are estimated at 0.20 to 1.4 mg/dscm. The emission guidelines therefore represent a reduction efficiency of 60 to 94% for both small and large MWC facilities. (EPA, 1994)

Reduction in mercury emissions can be achieved by use of a particulate control device in conjunction with cooling of the flue gas entering the particulate control device. Cooling the flue gas can be achieved by use of a spray dryer upstream of the particulate control device. At lower temperatures mercury will be sorbed onto particulate matter and collected as flyash. Injection of activated carbon into the flue gas upstream of the spray dryer and particulate control device has also been shown to reduce mercury emissions. (EPA, 1994)

Test results with carbon injection at the Stanislaus County and Camden County MWC units demonstrated that the emission guidelines of 80 mg/dscm or 85% reduction in mercury emissions can be achieved with a spray dryer, fabric filter, and carbon injection. The referenced EPA background document does not provide any long-term test data to verify whether these emission levels can be maintained. (EPA, 1995B)

**Estimated Cost of Compliance** The estimated capital cost for a new spray dryer and fabric filter baghouse is $13.3 Million with annualized costs (operating costs plus capital cost amortized) of $4.0 Million for a 730 MG/day MWC and $6.0 Million with an annualized cost of $1.0 Million for a 90 Mg/day plant. (EPA, 1994) Reasonable estimates for MWC facilities with different capacities can be obtained by scaling these capital or annualized costs to the capacity of the MWC facility in question.

The EPA's estimated capital cost of an activated carbon injection system to reduce mercury emissions (as well as dioxin/furan emissions) is $310,000 for a 980 MG/day plant and $61,000 for a 135 MG/day plant. Annualized costs are $553,000 and $46,000 respectively. (EPA, 1994)

## ACID GASES(HYDROGEN CHLORIDE AND SULFUR DIOXIDE)

**Emission Limitations** MWC facilities are required to meet the following emission limits for hydrogen chloride (HCl) and sulfur dioxide ($SO_2$). All removal efficiencies are corrected to 7% Oxygen. All limits are based on a 24-hour average. Emission limits are defined below for small and large plants.

| | EMISSION LIMIT (PPMV) | | REMOVAL EFFICIENCY | |
|---|---|---|---|---|
| | Small | Large | Small | Large |
| Sulfur Dioxide | 80 | 31 | 50 | 75 |
| Hydrogen Chloride | 250 | 31 | 50 | 95 |

The facility must meet requirements for both $SO_2$ and HCl; however requirements for each pollutant can be achieved by meeting the removal efficiency or emission limit requirements.

**Meeting the Emission Limits** Hydrogen chloride and sulfur dioxide emissions result from the oxidation of sulfur and conversion of chlorine found in MSW. The chlorine content of typical MSW ranges from 0.20-0.50%. The sulfur content of typical MSW ranges from 0.15-0.35%.(M.L. Smith, 1993). Typical uncontrolled emissions for MWC units are 210 ppmv Sulfur Dioxide and 530 ppmv Hydrogen Chloride (Litaca, 1994).

Meeting the limits of the emission guidelines for Sulfur Dioxide and Hydrogen Chloride will typically require a spray dryer. For MWC units currently equipped with spray dryers that do not meet emission limits, adding more lime may be sufficient to meet emission limits. For some existing spray dryers, major equipment modifications, such as increased atomizer capacity, slurry delivery system modifications, or additional modules, will be required to meet the emission limits.

Hydrogen Chloride is more readily converted to Calcium Chloride than Sulfur Dioxide is converted to Calcium Sulfate because of the relative reactivity. The lime, Calcium Oxide, will thus preferentially neutralize Hydrogen Chloride before Sulfur Dioxide. Therefore, compliance with the Sulfur Dioxide limit will usually be more difficult than compliance with the Hydrogen Chloride emissions limit.

**Estimated Costs of Compliance** A spray dryer plus a baghouse or electrostatic precipitator will typically meet emission limits for both particulate and metals. The estimated capital cost for a new spray dryer and fabric filter baghouse is $13.3 Million with annualized costs (operating costs plus capital cost amortized) of $4.0 Million for a 730 MG/day MWC and $6.0 Million with an annualized cost of $1.0 Million for a 90 Mg/day plant. (EPA, 1994) Reasonable estimates for MWC facilities with different capacities can be obtained by scaling these capital or annualized costs to the capacity of the MWC facility in question.

## NITROGEN OXIDES

**Emission Limitation** Nitrogen Oxides ($NO_x$) emission limits are provided below for large MWC units. Small MWC units have no emission limit for $NO_x$ emissions. The plant average is the daily weighted average. MWC facilities will also be allowed to trade $NO_x$ reduction credits.

| Large MWC Unit Type | $NO_x$ Emission Limit Each MWC unit | Plant Average |
|---|---|---|
| Mass Burn Waterwall | 200ppmv | 180 |
| Mass Burn Rotary Waterwall | 250ppmv | 220 |
| Refuse-derived fuel combustor | 250ppmv | 230 |
| Fluidized bed combustor | 240ppmv | 220 |
| Mass burn refractory | No limit | No limit |
| Other | 200ppmv | 180 |

The plant average emission limits are approximately 10% more stringent than the emission limits for individual units. Rather than applying controls to all units, a facility can implement a control system on one unit that exceeds regulatory limits and apply no controls on another unit provided the plant average meets the regulatory limits.

**Meeting the Emission Limits** In contrast to HCl and $SO_2$ which are formed solely from the elemental composition of the MSW, Nitrogen Oxides are formed by two mechanisms: oxidation of elemental Nitrogen in the MSW (Fuel-bound Nitrogen) and oxidation of Nitrogen supplied with the combustion air. Average uncontrolled emissions for $NO_x$ from MWC unit are typically 225 ppmv (EPA,1994). Good combustion practices, which promote oxidation of both carbon compounds and nitrogen, can produce higher $NO_x$ emissions. Continuous compliance with the emission limit will therefore require modification for most large MWC plants.

Selective Non-Catalytic Reduction (SNCR) appears to be the most practical method of reducing $NO_x$ emissions for most MWC units. SNCR involves the use of ammonia to reduce $NO_x$ to Nitrogen and water. SNCR reaction occurs at a temperature of 1600 to 2100°F. At lower temperatures, a catalyst is required to promote the reaction.

Reduction with the aid of a catalyst, such as titanium dioxide, vanadium pentoxide, or zeolites, is termed Selective Catalytic Reduction (SCR).

SCR systems have been applied successfully on several coal-fired power plants, however, capital and operating costs are significantly higher than for SNCR. Capital costs for SCR are estimated at five times that of SNCR systems. (Parkinson, 1994)

As of September 20, 1994, SNCR had been applied to 16 existing MWC units. Tests conducted at the Stanislaus, California MWC facility demonstrated that $NO_x$ emission levels of 150 ppmv (45 to 55 % reduction) can be achieved with SNCR. (EPA, 1995B)

Combustion modifications, such as flue gas recirculation can also be used to reduce $NO_x$ emissions. However, such modifications typically involve reducing excess air and are often accompanied by an increase in CO emissions. SNCR is expected to be the most economical technology for nearly all facilities.

**Cost of Compliance** The EPA's capital cost estimates for SNCR systems using aqueous ammonia ranged from $1.8 Million (low) for a 450 MG/day plant to $4.8 Million (high) for 2050 MG/day plant using the Thermal DeNO$_x$®. The annualized costs range from $470,000 to $1.4 Million, respectively. Capital costs for urea injection systems are typically slightly lower. (EPA, 1995B)

Alternatively, capital cost estimates can be estimated at $10-20/kw electrical generating capacity or $400-3000/ton of Nitrogen Oxide ($NO_2$) removed. (Bartok, 1993)

## FUGITIVE ASH EMISSIONS

**Emission Limitation** Visible emissions from ash transfer systems shall be less than 5% opacity except during maintenance and repair activities for both large and small MWC plants.

**Meeting the Emission Limit** Meeting the fugitive ash emission limit will require a wet ash handling system or enclosed system. Most MWC facilities are in compliance or will require only minor modifications to meet the fugitive ash emission limits.

**Estimated Costs of Compliance** No significant capital or operating cost increases are expected.

## GOOD COMBUSTION PRACTICES

**Operating Practice Requirements** The category in the Emission Guidelines for "Good Combustion Practice" includes quantitative emission limits for Carbon Monoxide (CO) as well as operating practice requirements. Operating practice requirements apply to both large and small MWC plants and include the following:

- A site-specific operator training manual is required to be developed and made available to MWC personnel.
- The chief facility operator, shift supervisors, and control room operators are required to complete the EPA or State MWC operator training course.
- The chief facility operator and shift supervisors must obtain the ASME (or State equivalent) full operator certification.
- The MWC load level must be measured and not exceed 110 percent of the maximum load level measured during the most recent dioxin/furan performance test. The maximum demonstrated unit load is the highest 4-hour arithmetic average load achieved during four consecutive hours during the most recent test during which compliance with the dioxin/furan emission limit was achieved.
- The maximum temperature of the flue gas to the particulate control device must be measured and shall not exceed 17°C (30°F) above the maximum temperature measured during the most recent dioxin/furan performance test.

**Emission Limitation** CO limits for both large and small MWC units are summarized below:

| MWC Unit Type | CO Limit | Averaging Time |
|---|---|---|
| Modular starved-air and excess-air | 50 ppmv | 4-hour |
| Mass burn waterwall and refractory | 100 ppmv | 4-hour |
| Mass burn rotary refractory | 100 ppmv | 24-hour |
| Fluidized bed combustion | 100 ppmv | 4-hour |
| Pulverized coal/RDF mixed fuel-fired | 150 ppmv | 4-hour |
| Spreader stoker coal/RDF mixed fuel-fired | 200 ppmv | 24-hour |
| RDF stoker | 200 ppmv | 24-hour |
| Mass burn rotary waterwall | 250 ppmv | 24-hour |

**Meeting the Requirements** The primary verification for good combustion practice is continuous monitoring of CO emissions. The emission limit and averaging time for CO varies significantly for different combustor types because emissions typical of good combustion vary with the combustor type. Mass burn MWCs burn unprocessed waste in deep beds where the residence time is approximately one hour. Low and stable CO emissions can usually be achieved. RDF is burned as processed waste that is pneumatically injected through feeders. CO emissions are highly dependent on fuel characteristics. CO excursions can occur from RDF feed chute blockage and burning char that is quenched in the tube banks. (EPA, 1995B)

The EPA based its cost impact analysis estimates for the emission guidelines on the premise that no significant capital expenditures or major equipment modifications will be required to meet good combustion practice requirements. For most facilities, CO emission guideline levels can be met by sophisticated control of combustion air distribution, MSW feed rate, boiler draft, and induced draft fan settings. However, a few facilities that have a feed system that does not provide steady, uninterrupted RDF flow and does not prevent uncontrolled combustion air from entering the boiler will have difficulties meeting the CO emission limits. Such facilities will probably require major modifications of the feed systems. Other facilities that do not have throat overfire air will also require more than simple "fine-tuning".

**Estimated Costs of Compliance** The EPA estimated costs for meeting requirements for a 980 MG/day plant will be $95,000 capital and $164,000 annualized cost. Most of this cost is associated with operator and supervisor training and certification. The EPA assumed that large MWC plants are already in compliance with good combustion practices including the carbon monoxide emissions limits. Compliance costs for small MWC plants (135 Mg/day) are actually estimated higher than for the large plant. Most small plants will require some capital improvements, such as implementation of a new control system or distribution of combustion air, to meet requirements. (EPA, 1994) Compliance costs for facilities that require feed system modifications, new control systems, or combustion air distribution modifications will be significantly higher than the EPA estimate.

## MONITORING AND TESTING REQUIREMENTS

**Regulatory Requirements** A continuous emissions monitoring (CEM) system is required for the following pollutants:

| Pollutant | Basis |
|---|---|
| CO | 24-hour or 4-hour average depending on combustor type |
| $SO_2$ | 24-hour daily geometric mean |
| $NO_x$ | 24-hour daily arithmetic average (large plants only) |
| Stack Opacity | 6-minute average |

In addition to the continuous monitoring of pollutants, load and flue gas temperature at the particulate control device inlet must be continuously monitored and reported on a 4-hour block average basis. 4-hour block average means the average of all hourly emission concentrations when the affected facility is operating and combusting municipal solid waste measured over 4-hour periods of time (midnight to 4 a.m., 4 a.m. to 8 a.m., etc.).

Annual stack testing must be conducted for the following pollutants: dioxins/furans, particulate matter, cadmium, lead, hydrogen chloride, and mercury. The frequency of testing at small MWC plants can be reduced to every three years if the MWC passes the test for a given pollutant three consecutive years and at large plants by displaying dioxin emissions below 7 ng/dscm @ 7 % Oxygen.

**Meeting Regulatory Requirements**

Although many existing MWC facilities have CEM systems in operation, most systems will not meet the new requirements. New reporting and record keeping requirements for most facilities will include collecting more data, maintaining the data longer, and performing new calculations. Software technology has changed dramatically over the last few years and trying to modify old software programs will be difficult. Replacement with new state-of-the-art CEM systems will be more economical than trying to modify or reprogram existing systems.

**Estimated Costs of Compliance** The estimated cost of a new CEM system to meet regulatory requirements including equipment, installation, engineering, and all certification tests is $500,000-1,000,000.The estimated cost of the annual CEM system certification testing including quarterly accuracy determinations and annual relative accuracy testing audit (RATA) is approximately $50,000. Additional monitoring costs are also associated with load and flue gas temperature.

## CONCLUSION

Existing Municipal Waste Combustors (MWC) are currently subjected to varying air emission regulations depending on the location (state) and year that the MWC was constructed. Implementation of 40 CFR Part 60, Subpart Cb, Emission Guidelines for existing MWC units, will require facilities to meet emissions limits and monitoring requirements at least as stringent as the "guidelines". Implementation of these regulations will result in relatively uniform emission standards for all MWCs. For some facilities that are currently subjected to stringent requirements in a construction or operating permit, modifications required will be minimal. However, some facilities will require extensive new or modifications of existing air pollution control and monitoring systems to meet the Emission Guidelines.

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