Emission Criteria for Biomedical Waste Incinerators

Municipal Solid and Biomedical Waste Branch
Environmental Protection Division
B.C. Environment
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Foreword

The Emission Criteria for Biomedical Waste Incinerators have been developed in consultation with British Columbia stakeholders.

The Executive Committee of the Ministry of Environment approved the release of these criteria on June 17, 1991.

The Municipal Solid and Biomedical Waste Branch is responsible for the development of these criteria. The Branch intends to continue development work with British Columbia stakeholders in order that the emission criteria continue to be current and valid. All stakeholders are invited to submit their comments and recommendation for improvements to the Manager, Reduction, Recycling and Treatment, Municipal Solid and Biomedical Waste Branch.

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1. Definitions

"Acid Gases" mean those gaseous contaminants, as listed in Appendix A, which contribute towards the formation of acidic substances in the atmosphere.

"Biomedical Waste" means a substance that is defined as biomedical waste in the current edition of the *Waste Management Act.*

"Chlorobenzenes (CBs)" mean those chlorinated benzene compounds listed in Appendix A.

"Chlorophenols (CPs)" mean those chlorinated phenolic compounds listed in Appendix A.

"Incinerator" means any device designed specifically for controlled combustion of wastes, alone or in conjunction with any auxiliary fossil fuel, for the primary purpose of reduction of the volume of the waste charged by destroying the combustible portion therein and/or to recover the available energy from the waste.

NOTE: Only those incinerators which are designed to burn wastes in a controlled manner, whether in a single chamber or a multiple-chamber unit, and are capable of meeting the requirements of these Emission Criteria, with or without any emission control devices are to be considered.

"Polycyclicaromatic Hydrocarbons (PAHs)" mean those polycyclicaromatic hydrocarbon compounds listed in Appendix A.

"Polychlorinated dibenzo-para-dioxins (PCDDS) and polychlorinated dibenzofurans (PCDFs)" mean those PCDD and PCDF compounds listed in Appendix A.

"Regional Manager" means the "manager" as well as the "district director" as interpreted in the current edition of the *Waste Management Act.*

"Standard cubic metre (m3) of gas" means the volume of dry gas in cubic metres measured at a pressure of 101.3 kPa and a temperature of 20°C (293.15 K) .

"Toxicity Equivalency Factors (TEFs)" means those factors for Congeners of Concern in a Homologous Group for PCDDs and PCDFS.

2. Applicability

2.1 New or Modified Incinerators

These Emission Criteria are effective from the date of issuance and apply to all new incinerators designed and installed for burning biomedical waste or a mixture of biomedical waste and any general refuse originating from any hospital or any other sources of biomedical waste, with the exception of any human and animal remains burned in crematoria and any other Special Waste besides biomedical waste.

2.2 Existing Incinerators

Within five years or less after issuance of these Emission Criteria, the Municipal Solid Waste and Biomedical Waste Management Branch will identify and implement measures for:

(i) phasing out of all older, uncontrolled single chamber incinerators used to burn biomedical waste; and

(ii) modifications of all multiple-chamber, modular and mass burn incinerators used to burn biomedical waste which are not able to comply with these Emission Criteria.

2.3 Ambient Air Quality Impact Analysis and Site Specific Emission Limits

Notwithstanding the provisions of these Emission Criteria, no person shall operate a facility to cause emission of contaminants from an incinerator in quantities which may result in adverse impacts on the air quality in the vicinity of the site.

2.3.1 Ambient Air Quality Impact Analysis

An ambient air quality impact analysis shall be one of the major criteria for the selection of a site for an incineration facility. In general, the impacts of emissions from a proposed facility on the ambient air quality shall be determined for the contaminants listed in Table 1. However, depending on the location of the proposed facility, the Regional Manager may require an air quality impact analysis only for certain contaminants selected from Table 1.

The ground level concentrations of the above contaminants shall be estimated for the worst case scenario by a dispersion model approved by the Regional Manager. The impact analysis must show that predicted ground level concentrations do not exceed the ambient air quality criteria of the contaminants as stipulated by the Regional Manager.

2.3.2 Site Specific Emission Limits

Depending on the ambient air quality impact analysis results, the Regional Manager may require additional emission control measures for any facility to meet more stringent emission limits than those prescribed herein.

3. Emission Limits

The emission of various contaminants into the atmosphere from an incinerator shall not exceed the corresponding limits listed in Table 1.

4. Incinerator and Emission Control System Design and Operation Requirements

To minimize emission of contaminants from an incinerator, the required design and operation parameters for the equipment as outlined below and summarized in Table 2, shall be followed.

These requirements are based on currently available information and may be revised at a future date, if deemed necessary. Any alternative system of different design, which is operated outside the required parameters, will be acceptable as long as it can be demonstrated that such a system can meet all other requirements of the Emission Criteria. These requirements do not preclude development of any new technology.

(i) Minimum Incineration Temperature and Residence Time

The incinerator shall be designed, equipped and operated in such a manner that a minimum temperature of 1000°C is maintained in the final combustion zone, at the fully mixed height after the final introduction of combustion air.

The incinerator design must provide for a minimum residence time of 1 second for the combustion gases at 1000°C at the said location during normal operation.

The residence time is to be calculated from the point where most of the combustion has been completed and the incineration temperature fully developed.

In multi-chamber incinerators the residence time is calculated from the secondary burner(s) flame front or final secondary air injection point(s).

In an incinerator where the furnace is one continuous space, such as in spreader stoker and single chamber mass burning equipment, the location of the complete combustion and fully developed temperature shall be determined by an overall design review.

It is recommended that new incinerators be designed conservatively to provide the combustion gases a capability, to attain at least 1.2 seconds of residence time at a temperature of 1000°C at the above location.

(ii) Primary Air

The incinerator shall be designed to ensure that an adequate quantity of primary combustion air is distributed properly inside the initial combustion zone to promote good contact between the waste and the air. The design features shall also include the capability to control and adjust both the air flow rate and its distribution to minimize quenching of the combustion reaction and entrainment of particles, as well as to compensate for irregular waste loading on the grate.

(iii) Secondary Air

The incinerator shall be designed for adequate air supply through properly located injection ports to provide sufficient turbulence and mixing of the reactants in the final combustion zone. The location and design of the air injection ports shall ensure good penetration and coverage of furnace cross-section under all flow conditions.

(iv) Auxiliary Burner(s)

The incinerator shall be equipped with auxiliary burner(s) of adequate heat capacity to be used during start-up, shutdown, upset conditions, when burning marginally combustible waste, and at any other time as necessary to maintain the minimum incineration temperature. The auxiliary burner(s) shall be designed such that the minimum combustion zone temperature of 1000°C can be maintained for at least 15 minutes without any waste feeding to the unit. The firing of the auxiliary burner(s) and the supply of combustion air shall be modulated automatically to maintain the required minimum combustion zone temperature.

(v) Oxygen Level in Flue Gas

To maintain adequate availability of combustion air in the incinerator, the combustion air supply system shall be designed to maintain the oxygen content in the flue gas leaving the unit within the prescribed range.

(vi) Turndown Restrictions

The incinerator shall be designed to meet the minimum requirements of temperature, residence time, combustion air supply, and oxygen level in the flue gas over the recommended range of the waste feed load.

(vii) Maximum Carbon Monoxide Level in Flue Gas

The recommended maximum CO concentration of 55 mg/m^3 corrected to 11% 02 (4-h rolling average) in the incinerator flue gas shall be used as the operating target. Any excursion of CO concentration to twice the above specified level shall require adjustment of operating parameters until the normal combustion conditions are restored.

(viii) Combustion Efficiency

A combustion efficiency of at least 99.9% as specified in the current edition of the Special Waste Regulation of the Waste Management Act, must be maintained during normal operation of the incinerator. The combustion efficiency (CE) is to be calculated as follows:

CE = 100 x (CO2) / [(CO2) + (CO)]
where:
(CO2) = concentration of carbon dioxide in the exhaust emissions; and
(CO) = concentration of carbon monoxide in the exhaust emissions.

The above CE must be maintained on a 8-hour rolling average basis.

(ix) Emission Control Systems

The temperature of the flue gas at the outlet of the emission control equipment used for simultaneous removal of acid gases and particulates, or at the inlet of a separate particulates control device, shall not exceed 140°C.

This limit of 140°C temperature requirement does not preclude the use of alternate emission control systems, which may necessitate a higher flue gas discharge temperature, provided it can be demonstrated that the stipulated emission limits in Table 1 can be achieved. To ensure that the particulates control device is operating efficiently, the opacity of the flue gas leaving the stack shall be maintained below 5% during normal operation of incinerators.

4.1 Requirements for Waste Charging System

The incinerator shall be equipped with an automatic waste loading device and an interlock system shall be provided to prevent unnecessary opening or charging of the incinerator. The loading system must be designed to prevent any overcharging of the incinerator.

The systems for waste feed, combustion control, and continuous monitoring of combustion parameters must be modulated in such a manner that proper incinerator operating conditions are maintained automatically. In addition, the following requirements are essential:

4.1.1 No waste shall be charged to the incinerator until the required minimum temperature in the final combustion zone is achieved and maintained for at least 15 minutes by using the auxiliary burner(s).

4.1.2 In the event of any unscheduled or scheduled shutdowns:

(i) the waste feed to the incinerator shall be automatically discontinued; and

(ii) the minimum required temperature in the final combustion zone shall be maintained by using auxiliary burner(s): (a) until the carbon monoxide concentration in the stack gas can be maintained below the required level, and a complete burnout of the remaining waste in the incinerator has taken place and the burndown cycle is complete; and (b) for a minimum of 15 minutes from the beginning of an unscheduled shutdown and when an emergency discharge of the flue gas directly to the atmosphere becomes necessary.

5. Monitoring Requirements

To ensure that the emissions of contaminants from an incinerator are within the stipulated limits, the following monitoring requirements are considered to be essential. Any additional monitoring may be required by the Regional Manager on a site specific basis.

5.1 Continuous Monitoring

5.1.1 Monitoring Instruments Specifications, Locations and Maintenance

The performance specifications of the above continuous monitors for both operating and emission parameters shall be subject to approval by the Regional Manager. The locations of the monitors and the procedures for calibration, operation and maintenance of these instruments must be approved by the Regional Manager. A monthly availability factor of at least 95% for each continuous monitor, with the exception of the hydrogen chloride monitor, is considered essential for data evaluation. For the hydrogen chloride monitor, a monthly availability factor of at least 90% is considered essential.

The Regional Manager must be notified of any continuous monitor failure for a period which may result in non-attainment of the recommended availability factor.

5.1.2 Continuous Monitoring Parameters

The following operating and emission parameters shall be monitored continuously:

(i) Combustion Temperature;
(ii) Oxygen;
(iii) Carbon Monoxide;
(iv) Carbon Dioxide;
(v) Emission Control Device Inlet or Outlet Temperature;
(vi) Opacity; and
(vii) Hydrogen Chloride.

5.1.2.1 Combustion Temperature

The temperature at the fully mixed height in the final combustion zone of the incinerator shall be measured and recorded continuously. Temperature sensors shall be located such that flames from the auxiliary burners do not impinge on the sensors.

With respect to the continuous measurement and recording of the combustion temperature, a suitable and approved alternate location downstream of the final combustion zone may be acceptable, provided:

(i) it is demonstrated that the temperature in the final combustion zone cannot be measured continuously without damaging the temperature sensors; and
a correlation between the final combustion zone temperature and that at the approved location downstream is established to the satisfaction of the Regional Manager.

(ii) a correlation between the final combustion zone temperature and that at the approved location downstream is established to the satisfaction of the Regional Manager.

5.1.2.2 Oxygen, Carbon Monoxide and Carbon Dioxide

Oxygen, carbon monoxide and carbon dioxide concentrations in the incinerator flue gas shall be measured at the same location downstream of the incinerator, but upstream of the emission control devices and where no dilution of the flue gas will occur.

It is recommended that the incinerator be equipped with automatic control and suitable alarm systems, preferably both visual and audible, in conjunction with the monitors for temperature, oxygen and carbon monoxide. The alarms should be set to ensure that whenever the minimum incineration temperature and/or oxygen level drops below, or the carbon monoxide level exceeds, that recommended in Table 2, auxiliary burner(s) should be turned on and/or the waste feed be discontinued automatically, until the normal operating conditions are re-established.

5.1.2.3 Emission Control Device Inlet or Outlet Temperature

The location of the sensor for continuous measurement of temperature at the outlet or inlet of the emission control device, depending on the particular emission control system in use, should be approved by the Regional Manager.

5.1.2.4 Opacity

The opacity monitor should be equipped with suitable alarms set at an opacity level approved by the Regional Manager.

An alarm for excessive opacity level should be investigated for poor combustion of waste and/or malfunction of the particulate control device, and appropriate measures should be taken to rectify the situation.

5.1.2.5 Hydrogen Chloride

The continuous monitor for hydrogen chloride emission should be equipped with suitable alarms set at a predetermined hydrogen chloride concentration level approved by the Regional Manager. This monitor should be linked with the emission control system for acid gases, and the system should be adjusted automatically to reduce the emission, when the preset hydrogen chloride level is exceeded.

If the incinerator emission is to comply with the 90% removal of hydrogen chloride emission requirement, the concentration of hydrogen chloride in the flue gas shall be measured at the inlet and outlet of the emission control device for acid gases. The sampling locations for the continuous monitor(s) must be approved by the Regional Manager. If the two sampling locations are to be monitored with a single analyzer, the sampling must be performed alternately at each location at a regular interval acceptable to the Regional Manager.

5.2 Source Testing

Within 90 days of the start of full normal operation of the incinerator, source testing shall be conducted for: oxygen, carbon dioxide and the contaminants listed in Table 1. The Regional Manager may require source testing of additional contaminants on a site specific basis.

The Regional Manager must be notified in writing well in advance of the actual testing. All source testing procedures shall be approved by the Regional Manager. Any subsequent source testing requirements will be determined by the Regional Manager based on his review of the initial source test results, continuous monitoring data and/or any other information related to the incinerator operation.

5.3 Other Monitoring

The following additional monitoring requirements are listed in general terms, irrespective of the type of incinerator facility. The Regional Manager shall determine the applicable items on a case by case basis.

5.3.1 General

The incineration facility shall be inspected daily by trained personnel to investigate the status of various components, so that malfunctioning of any components is identified and corrective actions are taken immediately. Such inspection should include, but not be limited to: waste and other materials delivery and storage area for spills, equipment leaks, corrosion, hot spots, gauges, monitors and recorders, etc. Records of daily inspection shall include the following items and any others which are considered to be necessary:

(i) inspection time and date;
(ii) descriptions of the items inspected;
(iii) observations made for each item inspected;
(iv) any test, maintenance repair or any other corrective measures taken during or after the inspection; and
(v) inspector's name, position and signature.

5.3.2 Hours of Operation, Waste, Ash and Residue Handling

Records of operation of the incinerator and its ancillary facilities in hours per day shall be maintained. Daily records shall be maintained, in terms of weight, of quantities of:

(i) waste shipments delivered and their sources of origin;

(ii) waste feed rate to the incinerator on an hourly basis or per batch, if the operation is in batch mode, and the number of batches per day; and

(iii) daily rates of bottom ash, fly ash and/or residue generation and treatment, if any, and disposal.

5.3.3 Auxiliary Burner Operation

Records shall be maintained of operation of auxiliary burner(s) and the rate of auxiliary fuel used in each burner on an hourly basis for a continuous operation or on an "as used" basis, with the duration of each period, when operated intermittently. If the auxiliary fuel used is oil, then its source, type and sulphur content shall also be recorded for each batch of oil supplied. In no event shall the sulphur content in the auxiliary fuel exceed the limit stipulated in the current edition of the Sulphur Content of Fuel Regulation of the *Waste Management Act*.

5.3.4 Emission Control Device

Records shall be maintained for emission control devices for removal of acid gases and/or particulates as follows:

(i) hourly average temperature at the inlet or outlet of the device, as the case may be, in degrees C;
(ii) frequency and duration of any period when the device is not fully operational, and appropriate description of each period of malfunction of any device, as well as of the rectifying measure taken in each case;
(iii) hourly average pressure drop in kPa across the wet scrubber and/or fabric filter;
(iv) reagent chemicals used in kg/h by chemical; and
(v) the volume of water used, if any in m3/h. The following additional records on an hourly basis shall be maintained for any separate particulates emission control device.

For fabric filter:

(i) average pressure drop in kPa across each module; and

(ii) number of compartments in use.

For electrostatic precipitator:

(i) number of fields in use;
(ii) applied voltage per field;
(iii) current flow per field in amperes; and
(iv) sparking rate per field.

5.4 Emission Control Device By-pass Conditions

Records of relevant operating conditions during any discharge of flue gases by-passing the emission control device and the duration of such discharge shall be maintained.

6. Reports

6.1 Monthly Reports

For records of monitoring of items under Sections 5.1, 5.3 and 5.4 above, monthly reports shall be submitted to the Regional Manager within 20 calendar days following the end of each month.

The report for item Section 5.1 shall include the following:

(i) data from each continuous monitor shall be tabulated in the specified averaging period for each parameter with both the minimum and maximum values recorded for each parameter during the corresponding averaging period. The monthly average, minimum and maximum values for each parameter shall also be reported. Prior to discarding this data the Regional Manager shall be contacted regarding archiving;
(ii) performance specifications and calibration data for each monitor;
(iii) percentage of availability of each monitor;
(iv) percentage of data capture for each monitor for the contaminants, oxygen and carbon dioxide;
(v) the number of exceedances above the specified limit for each gaseous parameter and opacity, and the number of occasions when such exceedances lasted more than 1 hour, or the stipulated rolling averaging period for any particular parameter, with appropriate comments about remedial measures taken in each case;
(vi) the number of occasions when the combustion temperature dropped below 1000°C, and for each occasion indicate the recorded minimum temperature reached, the duration of operation at sub-1000°C temperature, and the corrective measures taken; and
(vii) the number of occasions when the flue gas temperature at the inlet or outlet of the emission control device exceeded 140°C, and for each occasion indicate the recorded maximum temperature reached, the duration of operation above 140°C temperature, and the corrective measures taken.

The records of monitoring of items under Sections 5.3.1 to 5.3.4 and Section 5.4 inclusive shall be summarized for the whole month in appropriate formats and submitted to the Regional Manager.

6.2 Source Testing Report

A complete report for the Source Testing (Section 5.2) results, with the exception of trace organics, shall be submitted to the Regional Manager within 60 days of the completion of the actual testing. The results for trace organics shall be submitted to the Regional Manager within 90 days of the completion of actual testing.

6.3 Annual Performance Report

An annual report reviewing the performance of the incinerator shall be submitted to the Regional Manager within 90 days following the end of a calendar year. The report shall contain evaluation of at least the following aspects:

(i) the quantities of waste shipments received from different sources and waste processed at the site;

(ii) an overview of the plant performance describing the incinerator availability and the duration and causes of any non-availability; the status of operation and maintenance of various equipment and their adequacies; plant output, if any energy recovery is practiced; the quantities of bottom ash, fly ash and/or residue generated and their disposal methods; general housekeeping practices; incidence of any emergencies and the response measures implemented; incidence of emission control system by-passing; and

(iii) operation, performance and maintenance of emission control devices and continuous monitoring systems.

7. Start-up, Shutdown and Upset Condition Periods, and Spill Management

The owner or operator of an incineration facility shall prepare a detailed operating plan and procedures for the incinerator start-up, shutdown and upset condition periods, and submit it to the Regional Manager for approval prior to the issuance of a Permit. Such plan and procedures must be developed following the recommendations outlined in Appendix B and consultation with the equipment manufacturers, as necessary, so that the essential safety procedures for operation of any equipment are not overlooked or compromised.

Spill protection and/or reporting for the site shall be handled in accordance with the current edition of the Special Waste Regulation and/or Spill Reporting Regulation of the *Waste Management Act*.

8. General Requirements for the Facility

8.1 The waste unloading and storage area shall be enclosed and be designed and maintained on negative draft such that the air from this area is used as combustion air for the incinerator. The requirements for storage and refrigeration of the waste at the site shall be in accordance with the

Code of Practice for the Management of Biomedical Waste in Canada as and when approved by the Canadian Council of Ministers of the Environment.

8.2 The waste storage area shall be of sufficient capacity to store the delivered waste in the event of a shutdown of the incinerator due to malfunctions of equipment, labour dispute or any other interruption of operation.

8.3 The vehicular traffic areas at the facility shall be paved to minimize fugitive dust emissions.

8.4 Daily clean up at the facility must be practiced so that any spilled waste or any other material is collected on a regular basis.

8.5 A standby electrical power generator of sufficient capacity must be available at the site to supply necessary power to maintain full operation of the facility in the event of a failure of the general electric power supply system. The standby electric power supply must be provided until the general electric power supply is restored or the incinerator is shut down in a manner prescribed in Section 7 and Appendix B.

9. Requirement for Training of Incinerator Operator

All incineration facilities subject to these Emission Criteria must be operated by properly qualified personnel. Copies of certificates of the operating staff verifying the satisfactory completion of a training program shall be submitted to the Regional Manager.

All incinerator operators shall be trained by a recognized technical organization or an institution with capabilities to provide necessary training in the operating practices and procedures of all equipment. The content of the training program shall be submitted to the Regional Manager for approval. The training program shall include, but not be limited to, the following:

(i) the characteristics of biomedical waste and the procedures for its handling;
(ii) the basic principles of waste incineration and emission of contaminants there from;
(iii) knowledge of the Waste Management Permit requirements;
(iv) the basic features and location of the incinerator, emission control system, and other equipment at the facility;

(v) proper operation, functioning and maintenance of all mechanical, emission control and monitoring equipment;
(vi) detection of excessive emissions and procedures to be followed during such occasions; and
(vii) response procedures and measures to be taken during emergency situations.

This requirement does not eliminate the need for any staff involved with the facility from obtaining any other licenses or certificates necessary to carry out other duties as may be required by any other agencies.

10. Wastewater Management

Any wastewater generated at the site from the waste handling, storage and incineration area, any emission control system, ash and/or residue quench and conveyance systems, sanitary effluent, and from any other sources shall be treated and disposed of in a manner approved by the Regional Manager.

11. Ash and Residue Management

To minimize fugitive emissions of ash and residue particles, adequate precautions shall be taken at the time of handling, conveyance and storage of these materials. Wind-sheltered, enclosed storage areas shall be provided for these materials. As some of these materials may be classified as special waste, the final disposal methods for these materials must be approved by the Regional Manager. The disposal methods shall be determined after testing these materials in accordance with the procedures outlined in Special Waste Regulation of the current edition of the Waste Management Act.

Table 1. Stack Emission Limits for Biomedical Waste Incinerators

(Concentrations corrected to 11% 02 at reference conditions of dry gas at 20°C and 101.3 kPa)

Contaminant	Limit	Averaging Monitoring-Period	Method

• Total Particulate 20 mg/m^3 (1) (2) • Carbon Monoxide 55 mg/m^3 4-hour rolling continuous average monitoring • Sulphur Dioxide 180 mg/m^3 (1) (2) • Nitrogen Oxides 380 mg/m^3 (1) (2) (NOx as NO2) • Hydrogen Chloride 50 mg/mg/m^3 8-hour rolling continuous or 90% average monitoring removal • Hydrogen Fluoride 4 mg/m^3 (1) (2) • Total Hydrocarbons 32 mg/m^3 (1) (2) (as Methane CH4) • Arsenic (3) 4 µg/m^3 (1) (2) • Cadmium (3) 100 µg/m^3 (1) (2) • Chromium (3) 10 µg/m^3 (1) (2) • Lead (3) 50 µg/m^3 (1) (2) • Mercury (3) 200 µg/m^3 (1) (2) • Chlorophenols 1 µg/m^3 (1) (2) • Chlorobenzenes 1 µg/m^3 (1) (2) • Polycyclicaromatic 5 µg/m^3 (1) (2) Hydrocarbons • Polychlorinated Biphenyls 1 µg/m^3 (1) (2) • Total PCDDs & PCDFs (4) 0.5 ng/m^3 (2) Opacity 5% 1-hour average from continuous data taken every 10 monitoring seconds
(1) To be averaged over the approved sampling and monitoring method.
(2) All sampling and monitoring methods, including continuous monitors, are to be approved by the Regional Manager.
(3) The concentration is total metal emitted as solid and vapour.
(4) Expressed an Toxicity Equivalents. The value shall be estimated from isomer specific test data and toxicity equivalency factors by following a procedure approved by the ministry.

Table 2. Design and Operation Requirements for Biomedical Waste Incinerators and Emission Control Systems

Incinerator Type **Parameter Modular [Excess Air and Mass Burn Starved Air]**
• Incinerator

• Minimum Incineration 1000 degrees C at fully mixed determined by Temperature height overall design review • Minimum Residence Time 1 second after final 1 second calculated from the point secondary air injection ports where most of the combustion has been completed and the incineration temperature fully developed • Primary Air (Underfire) Utilize multi-port injection Use multiple plenums to minimize waste individual air flow control distribution difficulties • Secondary Air (Overfire) Up to 80% of total air At least 40% of total air required (1) Overfire Air Injector That required for penetration and Design and coverage of furnace cross-section • Auxiliary Burner Secondary burner 60% of total output, and that Capacity rated heat capacity, and that required to meet start-up and part-load temperatures • Oxygen Level at the 6 to 12% 6 to 12% Incinerator Outlet • Turndown Restrictions 80 to 110% of designed 80 to 110% of designed capacity capacity • Maximum CO Level 55 mg/m^3 @ 11% 02 (4-h 55 mg/m3 @ 11% 02 (4-h rolling rolling average) average) • Combustion Efficiency 99.9% (8-h rolling average) • Emission Control Systems • Flue Gas Temperature Not to exceed 140 degrees C Inlet or Outlet of Emission Control Device (2) • Opacity Less than 5%
(1) For excess air type - as required by design
(2) The flue gas temperature at the inlet or outlet will depend on the type of emission control device in use.

Appendix A

Acid Gases:

- Hydrogen chloride

- Hydrogen fluoride
- Oxides of nitrogen
- Oxides of sulphur

Chlorobenzenes (CBs):

- Cl-2 benzene
- Cl-3 benzene
- Cl-4 benzene
- Cl-5 benzene
- Cl-6 benzene

Chlorophenols (CPs):

- Cl-2 phenol
- Cl-3 phenol
- Cl-4 phenol
- Cl-5 phenol

Polycyclic Aromatic Hydrocarbons (PAHs):

- Acenaphythylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- Fluoranthene
- Pyrene
- Chrysene
- Benzo [a] anthracene
- Benzo [e] pyrene
- Benzo [a] pyrene
- Benzo [b] fluoranthene
- Benzo [k] fluoranthene
- Perylene
- Indeno [1,2,3-cd] pyrene
- Dibenzo [a,h] anthracene

- Benzo [g,h,i] perylene
- Benzo [l] phenanthrene

Polychlorinated Biphenyls (PCBs)

Polychlorinated dibenzo-para-dioxins (PCDDS) and polychlorinated dibenzofurans (PCDFs) in the following homologue groups:

- T - tetra
- Pe - penta
- Hx - hexa
- Hp - hepta
- O - octa

Appendix B: Recommendations for an Operating Plan and Procedures for Incinerator Start-up, Shutdown, and Upset Condition Periods

1. Incinerator Start-up and Shutdown

Without limiting the scope of the plan, provisions for the following must be included in the detailed plan and procedures:

1.1 Waste Charging System

The plan and procedures must incorporate the requirements listed under Section 4.1.

1.2 Continuous Monitoring and Emission Control Systems

The continuous monitoring systems for combustion and emission parameters and emission control systems must be in proper operating conditions: (a) prior to any waste charging to the system during start-up; (b) during normal operation of the incinerator; and (c) until the burndown cycle is complete at the time of any planned shutdown.

The emission control systems shall not be by-passed at any time when the incinerator is in operation, except under the following circumstances, if necessary, and during start-up and shutdown:

(i) when the temperature of the flue gas at the emission control device is below or above that specified by the manufacturer; and

(ii) during an emergency shut down, for example, due to fire hazard or the failure of the induced draft fan.

2. Upset Condition Periods

Some variations in the incinerator operating parameters and in the emission control parameters are to be expected; however, during normal operation of the incinerator the specified average values of these parameters can be maintained. Common indications of upset conditions may include but not be limited to:

(i) an operating parameter which varies consistently for any unusual duration; and/or

(ii) the development of a trend towards a higher or lower value, as the case may be, than that specified for any particular parameter.

The incinerator operators must be trained to recognize abnormal operations as well as to take corrective actions in a systematic manner. A suggested list of potential measures is provided below; however, these measures should be reviewed with the manufacturers' specifications for the particular equipment installed at the facility.

2.1 Continuous Monitoring Systems

All continuous monitors and recorders should be checked for their performance and calibration by zero and full scale span as applicable.

2.1.1 Combustion Parameters

In the event of low combustion temperature, low oxygen level and/or high carbon monoxide level, the following checks should be made:

(i) auxiliary burner(s) operation, including the fuel and air supplies;

(ii) the waste feed system;

(iii) combustion air supplies to the incinerator;

(iv) visual inspection of the incinerator grates; and

(v) other ancillary equipment which could influence the incinerator performance.

2.1.2 Opacity and Emission Control Parameters

During any exceedances of the flue gas temperature at the inlet or outlet of emission control device, of opacity, and of hydrogen chloride the following checks should be necessary:

(i) the normalcy of the incinerator operation;

(ii) the flue gas conditioning system, if any, upstream of the emission control device;

(iii) particulates emission control device; and

(iv) acid gas scrubbing system.

2.2 Emergency Shutdown

Emergency shutdown procedures should be followed if the malfunctioning of the incinerator or emission control system persists even after implementation of the corrective measures to rectify any upset conditions.