

# Bio Medical Waste

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## Design and construction of BMW incinerator

### 1. General

1. These guidelines shall be applicable only to the new installation of incinerators. However, the existing incinerator shall be retrofitted with Air Pollution Control Device as mentioned in these guidelines.
2. Incinerator shall be allowed only at Common Bio-medical Waste Treatment Facility (CBWTF).
3. Installation of individual incineration facility by a healthcare unit shall be discouraged as far as possible but approval may be granted only in certain inevitable situations where no other option is available.

### 2. Incinerator

Following design criteria may be adopted for better performance:

- i. The incinerator shall be designed for capacity more than 50 kg/hr. For 50 kg/hr capacity, the minimum hearth area shall be 0.75 sq. m (8 sq. feet) and the minimum flow of the flue gas in the secondary chamber shall be 0.6m<sup>3</sup>/sec at 1050°C. Each incinerator must be installed with an air pollution control system (as specified in the section 3).
- ii. The size of the opening through which the waste is charged shall be larger than the size of the waste bag to be fed. The volume of the primary chamber shall be at least five times the volume of one batch.
- iii. The double chamber incinerator shall preferably be designed on "controlled-air" incineration principle, as particulate matter emission is low in such incinerator. Minimum 100% excess air shall be used for over all design. Air supply in the primary and secondary chamber shall be regulated between 30%-80% and 170%-120% of stoichiometric amount respectively. Primary air shall be admitted near / at the hearth for better contact. Flow meter / suitable flow measurement device shall be provided on the primary & secondary air ducting. The combustion air shall be supplied through a separate forced draft fan after accounting for the air supplied through burners.  
*Optional:* For higher capacity incinerators, typically above 250 kg/hr, other design e.g. Rotary Kiln shall be preferred.
- iv. A minimum negative draft of 1.27 to 2.54 mm of WC (Water Column) shall be maintained in the primary chamber to avoid leakage of gaseous emissions from the chamber and for safety reasons. Provision shall be made in the primary chamber to measure the Water Column pressure.
- v. The waste shall be fed into the incinerator in small batches after the fixed interval of time in case of fixed hearth incinerator and continuous charging using appropriate feeding mechanism in case of rotary kiln incinerator or as recommended by the manufacturer. The size of the hearth i.e. primary chamber shall be designed properly.
- vi. The sides and the top portion of the primary and secondary chambers shall preferably have rounded corner from inside to avoid possibility of formation of black pockets/dead zones.
- vii. The size of the secondary chamber shall be properly designed so as to facilitate a minimum of one second of residence time to gas flow. For the estimation of residence time in the secondary chamber its volume shall be calculated starting from the secondary burner tip to the thermocouple.
- viii. The refractory lining of the chamber shall be strong enough to sustain minimum temperature of 1000° C in the primary chamber and 1200° C in the secondary chamber. The refractory & insulation bricks shall have minimum 115 mm thickness each & conform to IS:8-1983 & IS:2042-1972 respectively.
- ix. The Incinerator shell shall be made of mild steel plate of adequate thickness (minimum 5 mm thick) & painted externally with heat resistant aluminum paint suitable to withstand temperature of 250°C with proper surface preparation. Refractory lining of the hot duct shall be done with refractory castable (minimum 45 mm thick) & insulating castable (minimum 80 mm thick). Ceramic wool shall be used at hot duct flanges & expansion joints.

- x. The thermocouple location shall be as follows:  
In Primary chamber- Before admission of secondary air  
In Secondary chamber - At the end of secondary chamber or before admission of dilution medium to cool the gas
- xi. There shall be a separate burner each for the Primary & Secondary chamber. The heat input capacity of each burner shall be sufficient to raise the temperature in the primary and secondary chambers as  $800\pm 50^{\circ}\text{C}$  and  $1050\pm 50^{\circ}\text{C}$  respectively within maximum of 60 minutes prior to waste charging. The burners shall have automatic switching "off/on" control to avoid the fluctuations of temperatures beyond the required temperature range.
  - a. Each burner shall be equipped with spark igniter and main burner.
  - b. Proper flame safeguard of the burner shall be installed.
  - c. Provide view ports to observe flame of the burner.
  - d. Flame of the primary burner
    - i. shall be pointing towards the centre of the hearth.
    - ii. shall be having a length such that it touches the waste but does not impinge directly on the refractory floor or wall.
  - e. The secondary burner shall be positioned in such a way that the flue gas passes through the flame.
- xii. There shall not be any manual handling during charging of waste in to the primary chamber of the incinerator. The waste shall be charged in bags through automatic feeding device at the manufacturer's recommended intervals ensuring no direct exposure of furnace atmosphere to the operator. The device shall prevent leakage of the hot flue gas & any backfire. The waste shall be introduced on the hearth in such a way so as to prevent the heap formation. Suitable raking arrangement shall be provided for uniform spreading of waste on the hearth.
- xiii. A tamper-proof PLC (Programmable Logic Control) based control system shall be installed to prevent:
  - o Waste charging until the required temperature in the chambers are attained during beginning of the operation of the incinerator.
  - o Waste charging unless primary & secondary chambers are maintained at the specified temperature range.
  - o Waste charging in case of any unsafe conditions such as - very high temperature in the primary & secondary chambers; failure of the combustion air fan, ID fan, recirculation pump; low water pressure & high temperature of the flue gas at the outlet of air pollution control device.
- xiv. The incineration system must have an emergency vent. The emergency vent shall remain closed i.e. it shall not emit flue gases during normal operation of the incinerator.
- xv. Each incineration system shall have graphic or computer recording devices which shall automatically and continuously monitor and record dates, time of day, batch sequential number and operating parameters such as temperatures in both the chambers. CO, CO<sub>2</sub>, and O<sub>2</sub> in gaseous emission shall also be measured daily (at least ½ hour at one minute interval).
- xvi. The possibility of providing heat recovery system/heat exchanger with the incinerator shall also be considered wherever possible.
- xvii. Structural design of the chimney / stack shall be as per IS:6533-1989. The chimney/stack shall be lined from inside with minimum of 3 mm thick natural hard rubber suitable for the duty conditions and shall also conform to IS:4682 Part I-1968 to avoid corrosion due to oxygen and acids in the flue gas.
- xviii. The location and specification of porthole, platform ladder etc. shall be as per the Emission Regulations, Part-3 (COINDS/20/1984-85), published by CPCB.

### 3. Air Pollution Control Device

It is not possible to comply with the emission limit of 150 mg/Nm<sup>3</sup> (corrected to 12% CO<sub>2</sub>) for Particulate Matter, without Air Pollution Control Device (APCD). Therefore, a bio-medical waste incinerator shall always be equipped with APCD.

- i. No incinerator shall be allowed to operate unless equipped with APCD.
- ii. The incinerator shall be equipped with High Pressure Venturi Scrubber System as ordinary APCD such as wet scrubber or cyclonic separator cannot achieve the prescribed emission limit. For the facilities operating for 24 hrs a day, APCD in terms of dry lime injection followed by bag filter can be considered. The details of High Pressure Venturi Scrubber System are given in ANNEXURE-I.

#### **4. Incinerator room and waste storage room**

- i. The incinerator structure shall be built in a room with proper roofing and cross ventilation. There shall be minimum of 1.5 m clear distance in all the directions from the incinerator structure to the wall of the incinerator room.
- ii. Adjacent to the incinerator room, there shall be a waste storage area. It shall be properly ventilated and so designed that waste can be stored in racks and washing can be done very easily. The waste storage room shall be washed and chemically disinfected daily.
- iii. The floor and inner wall of the incinerator and storage rooms shall have outer covering of impervious and glazed material so as to avoid retention of moisture and for easy cleaning.
- iv. The incineration ash shall be stored in a closed sturdy container in a masonry room to avoid any pilferage. Finally, the ash shall be disposed in a secured landfill.

#### **5. Operator of the incinerator**

- i. A skilled person shall be designated to operate and maintain the incinerator. The operator shall have adequate qualification in relevant subject and shall be trained and certified by the incinerator supplier in operation & maintenance of the incinerator.
- ii. There shall be at least one assistant designated at the incinerator plant to keep track of the wastes, records of incinerator operation, cleanliness of the surrounding area and incinerator & waste storage room. They shall also take care of waste charging and incineration ash disposal.
- iii. All the staff at the incinerator plant shall put on protective gears such as gumboots, gloves, eye glasses, etc. for safety reasons.
- iv. Any accident occurred shall immediately be reported to the facility operator. The facility operator shall have well defined strategies to deal with such accident/emergency.

*[The guidelines will help in selection/installation of better incinerator system. However, it shall be ensured that the incinerator shall comply with the standards stipulated in the Bio-medical Waste (Management & Handling) Rules, 1998.]*

#### **ANNEXURE-I**

##### **Details of High Pressure Venturi Scrubber System**

1. The venturi scrubber shall have minimum pressure drop of 350 mm WC to achieve the prescribed emission limit. The temperature of the flue gas at the outlet of the venturi scrubber shall be approx 70-80° C to ensure the saturation of the flue gas.
2. The venturi scrubber shall preferably be made of stainless steel - 316L grade or better material or mild steellined with acid resistant bricks to avoid corrosion.
3. The water to be used in venturi scrubber shall be added with caustic soda solution to maintain the pH of the scrubbing liquid above 6.5.
4. The scrubbing medium shall be circulated @ 2-2.5 ltrs/m<sup>3</sup> of saturated flue gas at venturi outlet. This shall be done using a pump & piping made of stainless steel - 316 grades or better material. The scrubbing medium shall be recirculated as far as possible.
5. Venturi scrubber shall be followed by centrifugal type droplet separator to remove water droplets from flue gas.
6. The material of construction of the droplet separator and interconnecting ducting from venturi scrubber to droplet separator, droplet separator to ID fan & ID fan to stack, shall be mild steel lined from inside with minimum 3 mm thick natural hard rubber suitable for the duty conditions and shall also conform to IS:4682 Part I-1968 to avoid corrosion due to oxygen and acids in the wet flue gas.
7. The wastewater generated from the air pollution control device shall be properly handled so as to avoid any non-compliance of the regulatory requirements.
8. Stack emission monitoring and ash analysis as per the requirement of the Bio-medical Waste (Management & Handling) Rules, 1998, shall be done quarterly i.e. once in every three months and record shall be maintained by the facility operator.