

3.3 Standards for Treatment and Disposal as per BMWM Rules, 2016

3.3.1 Standards for Incineration

All incinerators shall meet the following operating and emission standards-

A. Operating Standards

1. Combustion efficiency (CE) shall be at least 99.00%.
2. The Combustion efficiency is computed as follows:

$$\text{C.E.} = \frac{\% \text{CO}_2}{\% \text{CO}_2 + \% \text{CO}} \times 100$$
3. The temperature of the primary chamber shall be a minimum of 800 °C and the secondary chamber shall be minimum of 1050°C + or - 500°C.
4. The secondary chamber gas residence time shall be at least two seconds.

B. Emission Standards

S. No.	Parameter	Standards	
		(3)	(4)
		Limiting concentration in mg Nm ³ unless stated	Sampling Duration in minutes, unless stated
1.	Particulate matter	50	30 or 1Nm ³ of sample volume, whichever is more
2.	Nitrogen Oxides NO and NO ₂ expressed as NO ₂	400	30 for online sampling or grab sample
3.	HCl	50	30 or 1Nm ³ of sample volume, whichever is more
4.	Total Dioxins and Furans	0.1ng TEQ/Nm ³ (at 11% O ₂)	8 hours or 5Nm ³ of sample volume, whichever is more
5.	Hg and its compounds	0.05	2 hours or 1Nm ³ of sample volume, whichever is more

C. Stack Height:

Minimum stack height shall be 30 meters above the ground and shall be attached with the necessary monitoring facilities as per requirement of monitoring of 'general parameters' as notified under the Environment (Protection) Act, 1986 and in accordance with the Central Pollution Control Board Guidelines of Emission Regulation Part-III.

Important considerations for Captive Incinerators

- a. The existing incinerators shall comply with the above revised emission norms within a period of two years from the date of notification.
- b. The existing captive incinerators shall comply with the standards for Dioxins and Furans of 0.1ngTEQ/Nm³, within two years from the date of commencement of these rules. To achieve the same, the existing secondary combustion chambers

of the incinerator and the pollution control devices shall be suitably retrofitted if required to achieve the emission limits.

- c. Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.
- d. Ash from incineration of biomedical waste shall be disposed of at common hazardous waste treatment and disposal facility. However, it can also be disposed of in municipal landfill, if the toxic metals in incineration ash are within the regulatory quantities as defined under the Hazardous Waste (Management and Handling and Transboundary Movement) Rules, 2008 as amended from time to time.
- e. Only low Sulphur fuel like Light Diesel Oil or Low Sulphur Heavy Stock or Diesel, Compressed Natural Gas, Liquefied Natural Gas or Liquefied Petroleum Gas shall be used as fuel in the incinerator.
- f. Shall monitor the stack gaseous emissions (during optimum operational capacity of the incinerator) once in three months through a laboratory approved under the Environment (Protection) Act, 1986 and record of such analysis results shall be maintained and submitted to the prescribed authority. In case of dioxins and furans, monitoring should be done once in a year.
- g. Shall install continuous emission monitoring system for parameters as stipulated by State Pollution Control Board or Pollution Control Committees in authorization and transmit the real time data should be transmitted to the servers at State Pollution Control Board or Pollution Control Committees and Central Pollution Control Board.
- h. Incinerators (combustion chambers) shall be operated with such temperature, retention time and turbulence, as to achieve Total Organic Carbon content in the slag and bottom ashes less than 3% or their loss on ignition shall be less than 5% of the dry weight.
- i. Shall use combustion gas analyzer to measure CO₂, CO and O₂ periodically so as to operate incinerator at suitable conditions to achieve desired combustion efficiency.

3.3.2 Operating and Emission Standards for Disposal by Plasma Pyrolysis or Gasification:

A. Operating Standards:

All the operators of the Plasma Pyrolysis or Gasification shall meet the following operating and emission standards:

1. Combustion Efficiency (CE) shall be at least 99.99 %.
2. The Combustion Efficiency is computed as follows.

$$\% \text{ CO}_2 \text{ C.E} = \frac{\text{.....}}{(\% \text{ CO}_2 + \% \text{ CO})} \times 100$$
3. The temperature of the combustion chamber after plasma gasification shall be 1050 ± 50°C with gas residence time of at least 2 (two) second, with minimum 3 % Oxygen in the stack gas.
4. The Stack height should be minimum of 30 m above ground level and shall be attached with the necessary monitoring facilities as per requirement of monitoring

of 'general parameters' as notified under the Environment (Protection) Act, 1986 and in accordance with the CPCB Guidelines of Emission Regulation Part-III.

B. Air Emission Standards and Air Pollution Control Measures

- I. Emission standards for combustion based incinerator shall be applicable for the Plasma Pyrolysis or Gasification also.
- II. Suitably designed air pollution control devices shall be installed or retrofitted with the 'Plasma
- III. Pyrolysis or Gasification to achieve the above emission limits, if necessary.
- IV. Wastes to be treated using Plasma Pyrolysis or Gasification shall not be chemically treated with any chlorinated disinfectants and chlorinated plastics shall not be treated in the system.

C. Disposal of Ash Vitrified Material

The ash or vitrified material generated from the 'Plasma Pyrolysis or Gasification shall be disposed at common hazardous waste treatment and disposal facility. However, it can also be disposed of in municipal landfill, if the toxic metals in incineration ash are within the regulatory quantities as defined at Schedule II under Hazardous and Other Waste Management and Handling Rules, 2016. Vitrified slag may be utilized as sub-surface material for road making with permission from concerned SPCB/PCCs.

3.3.3 Standards for Autoclave

The autoclave should be dedicated for the purposes of disinfecting and treating bio-medical waste.

- 1) When operating a gravity flow autoclave, medical waste shall be subjected to;
 - (i) a temperature of not less than 121° C and pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or
 - (ii) a temperature of not less than 135° C and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or
 - (iii) a temperature of not less than 149° C and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.
- 2) When operating a vacuum autoclave, medical waste shall be subjected to a minimum of three pre-vacuum pulse to purge the autoclave of all air. The air removed during the pre-vacuum, cycle should be decontaminated by means of HEPA and activated carbon filtration, steam treatment, or any other method to prevent release of pathogen. The waste shall be subjected to the following;
 - (i) a temperature of not less than 121°C and pressure of 15 psi per an autoclave residence time of not less than 45 minutes; or
 - (ii) a temperature of not less than 135°C and a pressure of 31 psi for an autoclave residence time of not less than 30 minutes;

- 3) Medical waste shall not be considered as properly treated unless the time, temperature and pressure indicators indicate that the required time, temperature and pressure were reached during the autoclave process. If for any reasons, time temperature or pressure indicator indicates that the required temperature, pressure or residence time was not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.
- 4) **Recording of operational parameters:** Each autoclave shall have graphic or computer recording devices which will automatically and continuously monitor and record dates, time of day, load identification number and operating parameters throughout the entire length of the autoclave cycle.
- 5) **Validation test for autoclave:** The validation test shall use four biological indicator strips, one shall be used as a control and left at room temperature, and three shall be placed in the approximate center of three containers with the waste. Personal protective equipment (gloves, face mask and coveralls) shall be used when opening containers for the purpose of placing the biological indicators. At least one of the containers with a biological indicator should be placed in the most difficult location for steam to penetrate, generally the bottom center of the waste pile. The occupier or operator shall conduct this test three consecutive times to define the minimum operating conditions. The temperature, pressure and residence time at which all biological indicator vials or strips for three consecutive tests show complete inactivation of the spores shall define the minimum operating conditions for the autoclave. After determining the minimum temperature, pressure and residence time, the occupier or operator of a common biomedical waste treatment facility shall conduct this test once in three months and records in this regard shall be maintained.
- 6) **Routine Test:** A chemical indicator strip or tape that changes colour when a certain temperature is reached can be used to verify that a specific temperature has been achieved. It may be necessary to use more than one strip over the waste package at different locations to ensure that the inner content of the package has been adequately autoclaved. The occupier or operator of a common bio medical waste treatment facility shall conduct this test during autoclaving of each batch and records in this regard shall be maintained.
- 7) **Spore testing:** The autoclave should completely and consistently kill the approved biological indicator at the maximum design capacity of each autoclave unit. Biological indicator for autoclave shall be *Geo-bacillus-tearo-thermophilus* spores using vials or spore Strips; with at least 1×10^6 spores. Under no circumstances will an autoclave have minimum operating parameters less than a residence time of 30 minutes, a temperature less than 121°C or a pressure less than 15 psi. The occupier or operator of a common bio medical waste treatment and disposal facility shall conduct this test at least once in every week and records in this regard shall be maintained.

3.3.4 Standards of Microwaving

- 1) Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal carcasses, body parts and large metal items.
- 2) The microwave system shall comply with the efficacy test or routine tests and a performance guarantee may be provided by the supplier before operation of the limit.
- 3) The microwave should completely and consistently kill the bacteria and other pathogenic organisms that are ensured by approved biological indicator at the maximum design capacity of each microwave unit. Biological indicators for microwave shall be *Bacillus atrophaeus* spores using vials or spore strips with at least 1×10^4 spores per detachable strip. The biological indicator shall be placed with waste and exposed to same conditions as the waste during a normal treatment cycle.

3.3.5 Standards for Efficacy of Chemical Disinfection

Microbial inactivation efficacy is equated to "Log₁₀ kill" which is defined as the difference between the logarithms of number of test microorganisms before and after chemical treatment. Chemical disinfection methods shall demonstrate a 4Log₁₀ reduction or greater for *Bacillus Subtilis* (ATCC19659) in chemical treatment systems.

3.3.6 Standards for Dry Heat Sterilization

Waste sharps can be treated by dry heat sterilization at a temperature not less than 185°C, at least for a residence period of 150 minutes in each cycle, which sterilization period of 90 minutes. There should be automatic recording system to monitor operating parameters.

(i) Validation test for Sharps sterilization unit

Waste sharps sterilization unit should completely and consistently kill the biological indicator *Geobacillus Stearothermophilus* or *Bacillus Atropheaus* spores using vials with at least $\log 10^6$ spores per ml. The test shall be carried out once in three months

(ii) Routine test

A chemical indicator strip or tape that changes colour when a certain temperature is reached can be used to verify that a specific temperature has been achieved. It may be necessary to use more than one strip over the waste to ensure that the inner content of the sharps has been adequately disinfected. This test shall be performed once in week and records in this regard shall be maintained.

3.3.7 Standards for Liquid Waste

- 1) The effluent generated or treated from the premises of bedded HCFs before discharge into the sewer should conform to the following limits;

Parameters	Permissible Limits
pH	6.5-9.0
Suspended solids	100 mg/l
Oil and grease	10 mg/l
BOD	30 mg/l
COD	250 mg/l

Bio-assay test	90% survival of fish after 96 hours in 100% effluent.
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- 2) Sludge from Effluent Treatment Plant shall be given to common bio-medical waste treatment facility for incineration or to hazardous waste treatment, storage and disposal facility for disposal

Note –

- 1) Above limits are applicable to all bedded Health Care Facilities in case their;
- discharge line is connected to public sewerage network, which is not having terminal sewage treatment plant; or
 - discharge line is not connected to public sewers.

Health Care Facilities meeting above criteria but having less than ten beds are given time till 31st December, 2019 to set up suitable effluent treatment plants and to comply with above standards.

- 2) In case discharge from HCF is connected to a public sewerage network having terminal Sewage Treatment Plant, then general discharge standards as notified under the Environment (Protection) Act, 1986 (29 of 1986) shall be applicable (as given at Annexure 8);
- 3) Non-bedded occupiers shall dispose infectious liquid wastes only after treatment by disinfection as per Schedule – II (6) of the principal rules.\

3.4 Standards for Deep Burial

- Yellow (a), (b) and (c) wastes namely human anatomical, animal anatomical and soiled waste are permitted for deep burial only in rural or remote areas where there is no access to common bio-medical waste treatment facility after obtaining authorization from SPCB/PCCs.
- A pit or trench should be dug about two meters deep. It should be half filled with waste, and then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.
- It must be ensured that animals do not have any access to burial sites. Covers of galvanized iron or wire meshes may be used.
- On each occasion, when wastes are added to the pit, a layer of 10 cm of soil shall be added to cover the wastes.
- Burial must be performed under close and dedicated supervision.
- The deep burial site should be relatively impermeable and no shallow well should be close to the site.

- The pits should be distant from habitation, and located so as to ensure that no contamination occurs to surface water or ground water. The area should not be prone to flooding or erosion.
- The location of the deep burial site shall be authorized by the prescribed authority i.e CPCB/ SPCB or District Pollution Control Board Office.
- The institution shall maintain a record of all pits used for deep burial.
- The ground water table level should be a minimum of six meters below the lower level of deep burial pit.

3.5 Suggested method for design of concrete pit for waste sharps.

If required, a sharp pit must be constructed within the hospital premise to dispose of the sharp waste generated from the facility. Prior to disposal in concrete pit, sharps waste should be disinfected and treated in following methods;

- Autoclaving along with sharp containers followed by shredding or mutilation; or
- Combination of shredding cum autoclaving along with sharp containers
- Sharp pit must be a 1m ×1m×1m concrete lined circular or rectangular pit as shown in figure 4.
- Pit can be dug and lined with brick, masonry or concrete rings.
- The pit should be covered with a heavy concrete slab, in which a galvanized steel pipe of about 1.0m height and suitable diameter is fixed to feed the shredded or mutilated sharps waste.
- The top opening of the steel pipe shall have a provision of locking after the treated waste sharps has been disposed in.
- Once the pit filled up to 3/4th capacity, it can be encapsulation with binding material like cement. Once encapsulated mass is dry, sharp pit is sealed and another sharp pit is created for further use.

- For high water table regions where water table is less than 6m beneath bottom of the pit, a tank with above mentioned arrangements shall be made above the ground.

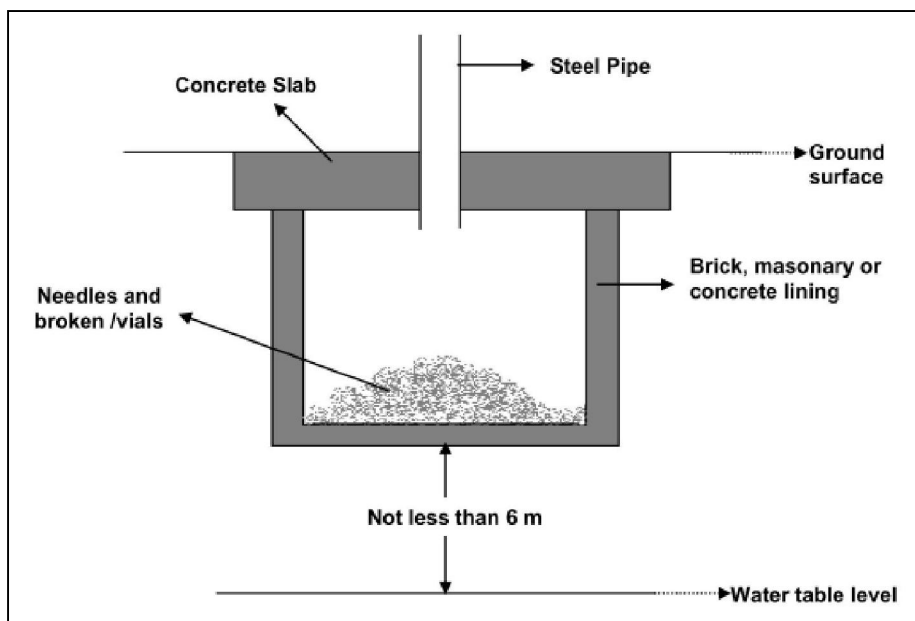


Figure 4: Layout of Sharp Pit for disposal for Sharp Waste

3.6 Effluent Treatment Plant

Effluent Treatment Plant should be provided in every HCF to treat the wastewater generated from the hospital in order to comply with the effluent standards prescribed under the BMW Rules, 2016. Sources of wastewater generation from the hospital are wards, laboratories, used disinfectants, floor washing, washing of patients area, hand washing, laundry, discharge of accidental spillage, firefighting, bathroom/toilet etc. Liquid waste generated due to use of chemicals or discarded disinfectants, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities should be collected separately and pre-treated prior to mixing with rest of the wastewater from HCF.

The combined wastewater should be treated in the ETP having three levels of treatment; primary, secondary and tertiary;

- Primary Treatment: equalisation, neutralization, precipitation and clarification
- Secondary Treatment: High rate aerobic biological treatment, secondary settling tank
- Tertiary Treatment: Pressure Filtration, Disinfection and disposal to drain/sewer

Typical flow chart for the Effluent Treatment Plant is given below:

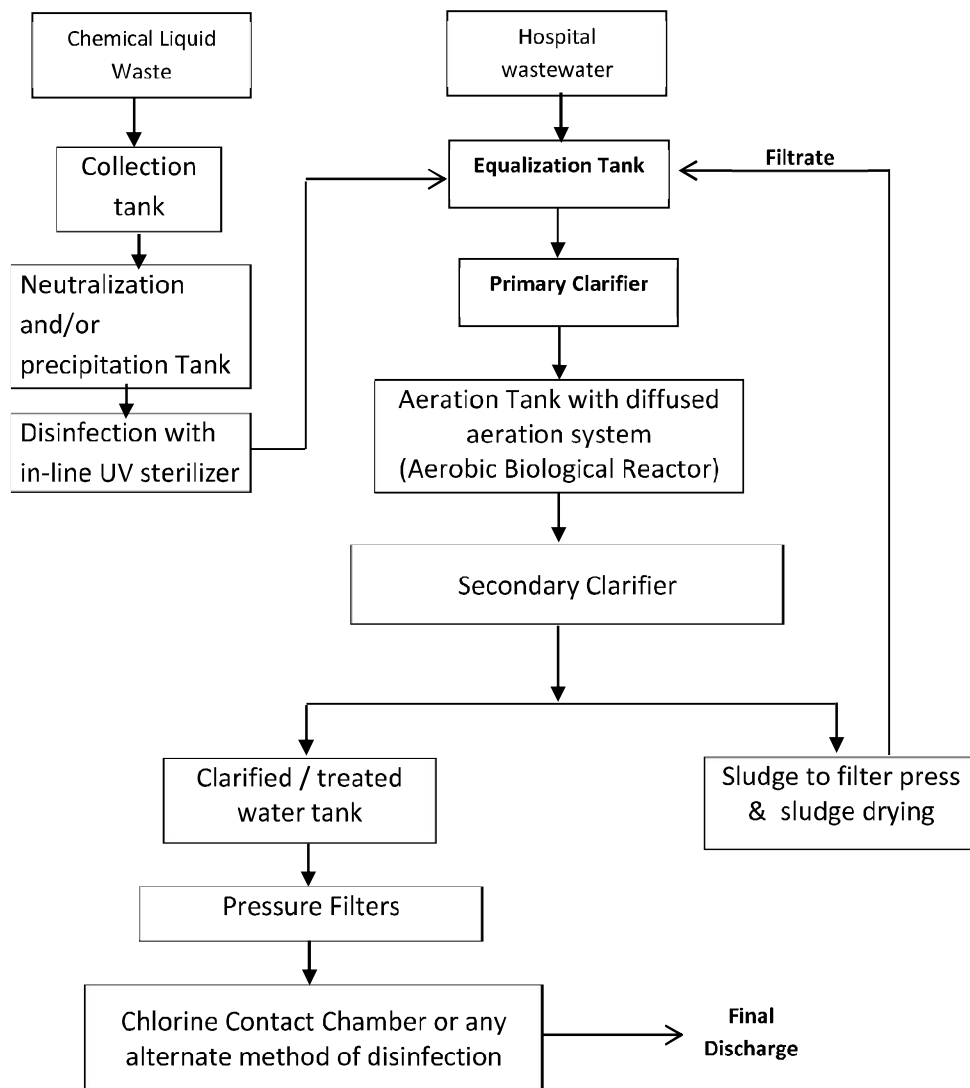


Figure 4: Scheme for Wastewater

Options for reuse of treated wastewater: Wastewater generated from the HCF is treated in the ETP and shall be disposed into drain / sewer or could be reused in: Flushing, Horticulture, and Scrubber.