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A. INTRODUCTION:

A Common Bio-medical Waste Treatment Facility (CBWTF) is a set up where bio-medical waste, generated from a number of healthcare units, is imparted necessary treatment to reduce adverse effects that this waste may pose. The treated waste may finally be sent for disposal in a landfill or for recycling purposes. Installation of individual treatment facilities by small healthcare units requires comparatively high capital investment. In addition, it requires separate manpower and infrastructure development for proper operation and maintenance of treatment systems. The concept of CBWTF not only addresses such problems but also prevents proliferation of treatment equipment in a city. In turn it reduces the monitoring pressure on regulatory agencies. By running the treatment equipment at CBWTF to its full capacity, the cost of treatment of per kilogram gets significantly reduced. Its considerable advantages have made CBWTF popular and proven concept in many developed countries.

CBWTF as an option has also been legally introduced in India. The Bio-medical Waste (Management & Handling) Rules, 1998, gives an option to the bio-medical waste generator that such waste can also be treated at the common bio-medical waste treatment facility. The Second Amendment of the Rules in June, 2000, further eased the bottleneck in upbrining the CBWTF by making Local Authority responsible for providing suitable site within its jurisdiction. The concept of CBWTF is also being widely accepted in India among the healthcare units, medical associations and entrepreneurs.

In order to set up a CBWTF to its maximum perfection, care shall be taken in choosing the right technology, development of CBWTF area, proper designing of transportation system to achieve optimum results etc. These key features of CBWTF have been addressed in the following sections and will form the guidelines for the establishment of CBWTFs throughout the country.

B. LOCATION

A CBWTF shall be located at a place reasonably far away from residential and sensitive area so that it has minimal impact on these areas. The CBWTF shall be located as near to its area of operation as possible in order to minimize the travel distance in waste collection, thus enhancing its operational flexibility. The location shall be decided in consultation with the State Pollution Control Board (SPCB)/Pollution Control Committee (PCC).

C. LAND REQUIREMENT

Sufficient land shall be allocated for CBWTF to provide all requisite systems. It is felt that a CBWTF will require minimum of 1 acre land area. So, preferably, a CBWTF be set up on a plot size of not less than one acre.

D. COVERAGE AREA OF CBWTF

In any area, only one CBWTF may be allowed to cater up to 10,000 beds at the approved rate by the Prescribed Authority. A CBWTF shall not be allowed to cater healthcare units situated beyond a radius of 150 km. However, in an area where 10,000 beds are not available within a radius of 150 km, another CBWTF may be allowed to cater the healthcare units situated outside the said 150 km.

E. TREATMENT EQUIPMENT

As per the provisions of Bio-medical Waste (Management & Handling) Rules, waste falling in most of the categories can be treated in systems based on non-burn technologies. Such waste account for about 90% of the total waste streams in a healthcare unit. In the brain storming session held during the workshop at Hyderabad (February 25-26, 2003), it was unanimously decided that the CBWTF should emphasize more on non-burn technologies. It is mandatory to impart incineration/deep burial (depending upon the population of town) to anatomical and other types of waste falling under categories 1 and 2. Therefore, an incinerator of adequate capacity to cater only categories 1 and 2 waste shall be installed. (If secured landfill is not available, category 5 may also be incinerated.)

The wastes falling under category 5 i.e. discarded medicines, cytotoxic drugs and category 10 i.e. chemical wastes (solids) can be disposed in a secured landfill.

A Common Bio-medical Waste Treatment Facility (CBWTF) shall have following treatment facilities:

- Incineration:
It is a controlled combustion process where waste is completely oxidized and harmful microorganisms present in it are destroyed/denatured under high temperature.
The guidelines for "Design & Construction of Bio-medical Waste Incinerators" prepared by CPCB shall be followed for selecting/installing a better bio-medical waste incinerator.
- Autoclaving/ Microwaving/ Hydroclaving:
Autoclaving is a low-heat thermal process where steam is brought into direct contact with waste in a controlled manner and for sufficient duration to disinfect the wastes. For ease and safety in operation, the system should be horizontal type and exclusively designed for the treatment of bio-medical waste. For optimum results, prevacuum based system be preferred against the gravity type system. It shall have tamper-proof control panel with efficient display and recording devices for critical parameters such as time, temperature, pressure, date and batch number etc.

In microwaving, microbial inactivation occurs as a result of the thermal effect of electromagnetic radiation spectrum lying between the frequencies 300 and 300,000 MHz. Microwave heating is an inter-molecular heating process. The heating occurs inside the waste material in the presence of steam.

Hydroclaving is similar to that of autoclaving except that the waste is subjected to indirect heating by applying steam in the outer jacket. The waste is continuously tumbled in the chamber during the process.

Though chemical disinfection is also an option for the treatment of certain categories of bio-medical waste but looking at the volume of waste to be disinfected at the CBWTF and the pollution load associated with the use of disinfectants, the use of chemical disinfection for the treatment of bio-medical waste at CBWTF is not recommended.

- Shredder:
Shredding is a process by which waste are deshaped or cut into smaller pieces so as to make the wastes unrecognizable. It helps in prevention of reuse of bio-medical waste and also acts as identifier that the waste have been disinfected and are safe to dispose off. A shredder to be used for shredding bio-medical waste shall conform to the following minimum requirements:

1. The shredder for bio-medical waste shall be of robust design with minimum maintenance requirement
2. The shredder should be properly designed and covered to avoid spillage and dust generation. It should be designed such that it has minimum manual handling.
3. The hopper and cutting chamber of the shredder should be so designed to accommodate the waste bag full of bio-medical waste.
4. The shredder blade should be highly resistant and should be able to shred waste sharps, syringes, scalpels, glass vials, blades, plastics, catheters, broken ampoules, intravenous sets/ bottles, blood bags, gloves, bandages etc. It should be able to handle/ shred wet waste, specially after microwave/ autoclave/hydroclave.
5. The shredder blade shall be of non-corrosive and hardened steel.
6. The shredder should be so designed and mounted so as not to generate high noise & vibration.
7. If hopper lid or door of collection box is opened, the shredder should stop automatically for safety of operator.
8. In case of shock-loading (non-shreddable material in the hopper), there should be a mechanism to automatically stop the shredder to avoid any emergency/accident.
9. In case of overload or jamming, the shredder should have mechanism of reverse motion of shaft to avoid any emergency/accident.
10. The motor shall be connected to the shredder shaft through a gear mechanism, to ensure low rpm and safety.
11. The unit shall be suitably designed for operator safety, mechanical as well as electrical.
12. The shredder should have low rotational speed (maximum 50 rpm). This will ensure better gripping and cutting of the bio-medical waste.
13. The discharge height (from discharge point to ground level) shall be sufficient (minimum 3 feet) to accommodate the containers for collection of shredded material. This would avoid spillage of shredded material.
14. The minimum capacity of the motor attached with the shredder shall be 3 kW for 50 kg/hr, 5 kW for 100 kg/hr & 7.5 kW for 200 kg/hr and shall be three phase induction motor. This will ensure efficient cutting of the bio-medical wastes as prescribed in the Bio-medical Waste (Management & Handling) Rules.

- Sharp pit/ Encapsulation:

A sharp pit or a facility for sharp encapsulation shall be provided for treated sharps. An option may also be worked out for recovery of metal from sharps in a factory.

- Vehicle/Container Washing Facility:

Every time a vehicle is unloaded, the vehicle and empty waste containers shall be washed properly and disinfected. It can be carried out in an open area but on an impermeable surface and liquid effluent so generated shall be collected and treated in an effluent treatment plant. The impermeable area shall be of appropriate size so as to avoid spillage of liquid during washing.

- Effluent Treatment Plant:

A suitable Effluent Treatment Plant shall be installed to ensure that liquid effluent generated during the process of washing containers, vehicles, floors etc. is disposed after treatment. The treated effluent shall comply with the stipulated regulatory requirements.

All the treatment equipment installed at the CBWTF shall comply with the standards stipulated in the Bio-medical Waste (Management & Handling) Rules, 1998.

F. INFRASTRUCTURE SET UP :

The CBWTF shall have enough space within it to install required treatment equipment, incoming and out going waste storage area, vehicle-parking and washing area, Effluent Treatment Plant (ETP), staff room etc. The required area for CBWTF would depend upon the projected amount of bio-medical waste to be handled by it. A CBWTF shall have the following infrastructure:

Treatment Equipment Room:

A separate housing may be provided for each treatment equipment at the CBWTF such as incinerator room, autoclave room, microwave room etc, as applicable. Each room shall have well-designed roof and walls. Such room shall be well ventilated and easy to wash. The floor and interior finishing of the room shall be such that chances of sticking/harboring of microorganisms is minimized. This can be attained by providing smooth & fine floor and wall surfaces (to a height of 2 metre from floor) preferably of tiles. The number of joints in such surfaces shall be minimal.

The equipment room shall also have a separate cabin, to supervise the operation of the equipment and to record the waste handling and equipment operational data. Attached to each equipment room, there shall be two waste storage rooms, one for storage of untreated wastes and another for treated wastes. The storage room shall have provisions similar to that of equipment room being well-ventilated with easy to wash floors & walls, smooth and fine surfaces etc.

Main Waste Storage Room:

This shall be provided near the entry point of the CBWTF to unload and store all bio-medical wastes that have been transported to the facility by vehicle. The size of the room shall be adequate to store all wastes transported to the CBWTF. The front portion of the room shall be utilized for unloading the wastes from the vehicle and back or side portion shall be utilised for shifting the wastes to the respective treatment equipment. In the front of the room where vehicle is parked for unloading, the floor shall be made impermeable so that any liquid spilled during unloading does not percolate into the ground. The liquid generated during handling of wastes and washing, shall be diverted to the inlet of ETP.

In the main storage room, wastes shall be stacked with clear distinction as per the color coding of the containers. From here, the coloured containers may be sent to the respective treatment equipment. The main storage room too shall have provisions similar to that of equipment room such as roofing, well ventilated, easy to wash floors & walls, smooth and fine surfaces etc.

Treated Waste Storage room:

This is the room where wastes treated in different treatment units shall be stored. The wastes shall be stored in separate group as per the disposal options. Other provisions in the room shall be similar to the main storage room.

Administrative Room:

This room shall be utilized for general administration, record keeping, billing etc.

Generator Set:

Every CBWTF shall have generator set as standby arrangement for power, with sufficient capacity to run the treatment equipment during the failure of power supply. The generator set shall comply with the necessary requirements under the Environment (Protection) Rules, 1986.

Site Security:

High walls, fencing and guarded gates shall be provided at the facility to prevent unauthorized access to the site by humans and livestock.

Parking:

Provision shall be made within the confines of the site for parking of required number of vehicles, loading and unloading of the vehicles meant for transporting waste to and from the facility, etc.

Sign Board:

An identification board of durable material and finish shall be displayed at the entrance to the facility. This shall clearly display the name of the facility, the name, address and telephone number of the operator and the prescribed authority, the hours of operation and the telephone numbers of the personnel to be contacted in the event of an emergency.

Green Belt:

The open area within the CBWTF shall be developed into greenbelt.

Washing Room:

A washing room shall be provided for eye washing/hand washing/bathing etc.

Besides above, following important provisions should be made in a CBWTF:

- A telephone shall be provided and maintained at the facility.
- A First Aid Box shall be provided and maintained at the CBWTF.
- Proper lighting shall be provided at the facility.
- Proper care shall be taken to keep the facility and surroundings free from odours.
- Proper fire fighting facilities and emergency alarm shall be installed.
- Measures shall be implemented to control pests and insects at the site.
- Measures shall be implemented to control the escape of litter from the site.
- Necessary provision shall be made to prevent and control noise generated, if any, due to the activities at the site.
- Necessary protective gear for the waste handlers shall be provided.

Every CBWTF operator shall submit a work-plan to the Prescribed Authority. The work-plan should include the details of facilities at the CBWTF, the collection, transportation & storage of the bio-medical wastes, operational details etc.

G. RECORD KEEPING:

Maintenance of records for all operations carried out at the CBWTF is very important to monitor overall operation of the CBWTF. It also helps in submission of the required information to be submitted to the Prescribed Authority by the 31st January of every year. A well-maintained record of all the activities at the CBWTF also enables the facility operator to produce all information of the activities on demand of the concerned Authority. The record should include all information related to each activity at the CBWTF site, however, minimum requirement has been outlined below:

Records of Waste Movements:

Daily records shall be maintained for the waste accepted and treated waste removed from the site. This record shall include the following minimum details:

1. Waste Accepted: - Waste Collection Date, Name of the healthcare unit, Waste category as per the Rules, Quantity of waste, Vehicle number and Receiving date (at site).
2. Treated Waste Removed:- Date, Treated waste type, Quantity, Vehicle number and location of disposal.

Logbook for the Equipment:

A logbook shall be maintained for each treatment equipment installed at the site and shall include the following:

1. The weight of each batch.
2. The categories of waste as per the Rules.
3. The time, date and duration of each treatment cycle and total hours of operations.
4. The complete details of all operational parameters during each cycle

Site Records:

Site records shall include the following:

1. Details of construction or engineering works
2. Maintenance schedule, breakdowns/trouble shootings and remedial actions
3. Emergencies
4. Incidents of unacceptable waste received and the action taken
5. Details of site inspections by the officials of the regulatory Agency and necessary action on the observations

Daily, monthly and annual summary records of all the above shall be maintained and made available at the site for inspection whenever required by an authorised officer of regulatory Agency.

H. COLLECTION AND TRANSPORTATION OF BIO-MEDICAL WASTES

The collection and transportation of bio-medical waste shall be carried out in a manner so as to avoid any possible hazard to human health and environment. Collection and transportation are the two operations where the chances of segregated bio-medical waste coming in contact with the public, rag pickers, animals/birds, etc are high. Therefore, all care shall be taken to ensure that the segregated bio-medical waste, handed over by the healthcare units, reach CBWTF without any damage, spillage or unauthorized access by public, animals etc. A responsible person from the CBWTF operator shall always accompany the vehicle to supervise the collection and transportation of bio-medical waste.

H.1 Collection of bio-medical waste:

Generator of the bio-medical waste is responsible for providing segregated waste to the CBWTF operator. The wastes shall be segregated as per the provisions of the Bio-medical Waste (Management & Handling) Rules, 1988. The CBWTF operator shall not accept the non-segregated waste and such incident shall be reported to the Prescribed Authority. Temporary storage at healthcare unit shall be designated. The coloured bags handed over by the healthcare units shall be collected in similar coloured containers with cover. Each bag shall be labeled as per the Schedule III & IV of the Bio-medical Waste (Management & Handling) Rules, so that at any time, the healthcare units can be traced back that are not segregating the bio-medical wastes as per the Rules. The coloured containers should be strong enough to withstand any possible damage that may occur during loading, transportation or unloading of such containers. These containers shall also be labeled as per the Schedule III of the Rules. Sharps shall be collected in puncture resistant container. The person responsible for collection of bio-medical wastes shall also carry a register with him to maintain the records such as name of the healthcare unit, the type and quantity of waste received, signature of the authorised person from the healthcare unit side, day and time of collection etc.

H.2 Transportation of the collected bio-medical waste to the CBWTF:

The bio-medical waste collected in coloured containers shall be transported to the CBWTF in a fully covered vehicle. Such vehicle shall be dedicated for transportation of bio-medical waste only. Depending upon the volume of the wastes to be transported, the vehicle may be a three-wheeler, light motor vehicle or heavy duty vehicle. In either case, the vehicle must possess the following:

1. Separate cabins shall be provided for driver/staff and the bio-medical waste containers.
2. The base of the waste cabin shall be leak proof to avoid pilferage of liquid during transportation.
3. The waste cabin may be designed for storing waste containers in tiers.
4. The waste cabin shall be so designed that it is easy to wash and disinfect.
5. The inner surface of the waste cabin shall be made of smooth surface to minimize water retention.
6. The waste cabin shall have provisions for sufficient openings in the rear and/or sides so that waste containers can be easily loaded and unloaded.
7. The vehicle shall be labeled with the bio-medical waste symbol (as per the Schedule III of the Rules) should display the name, address and telephone number of the CBWTF.

Depending upon the area to be covered under the CBWTF, the route of transportation shall be worked out. The transportation routes of the vehicle shall be designed for optimum travel distance and to cover maximum number of healthcare units. As far as possible, the transportation shall be carried out during non-peak traffic hours. If the area to be covered is very large, a satellite station may be established to store the bio-medical waste collected from the adjoining areas. The wastes so stored at satellite station may then be transported to the CBWTF in a big vehicle. It shall be ensured that the total time taken from generation of bio-medical waste to its treatment, which also includes collection and transportation time, shall not exceed 48 hours.

I. DISPOSAL OF TREATED BIO-MEDICAL WASTE

The treated bio-medical waste shall be disposed as per the following table:

Sl. No.	Waste Category	Disposal Method
1.	Plastic wastes after disinfection and shredding	Recycling or municipal landfill
2.	Disinfected Sharps (except syringes)	
	(i) If encapsulated	Municipal landfill
	(ii) If non-encapsulated	Municipal landfill/ Possibility of recycling shall be explored
3.	Incineration ash	Secured landfill
4.	Other treated solid wastes	Municipal landfill
5.	Oil & grease	Incineration
6.	Treated waste water	Sewer/drain or recycling

J. COST TO BE CHARGED BY THE CBWTF OPERATOR FROM THE HEALTHCARE UNITS

Cost to be charged from the healthcare units plays an important role in sustaining the project. The cost shall be so worked out that neither it becomes a monopoly of the CBWTF operator nor the interest of the CBWTF operator is overlooked. Accordingly, it is recommended that cost to be charged from the healthcare units shall be worked out in consultation with the State Pollution Control Board/Pollution Control Committee and the local Medical Association.

K. SETTING UP AND OPERATION OF CBWTF

Setting up and operating a CBWTF requires compliance with a number of regulatory requirements/provisions. The important requirements/provisions are listed below:

1. Municipal Corporations, Municipal Boards or Urban Local Bodies, as the case may be, shall be responsible for providing suitable common disposal/incineration sites for the bio-medical waste generated in the area under their jurisdiction and in areas outside the jurisdiction of any municipal body, it shall be the responsibility of the occupier generating bio-medical waste/operator of a bio-medical waste treatment facility to arrange for suitable sites individually or in association, so as to comply with the provisions of these rules (Bio-medical Waste (Management & Handling) Rules).
2. The local body such as a Municipal Body or any Private Entrepreneur, whoever wishes to set up a CBWTF, shall submit a detailed work-plan of proposed CBWTF to the concerned State Pollution Control Board (SPCB)/Pollution Control Committee (PCC) for evaluation and issue of "Consent To Establish". The work-plan should include complete details of the project such as site details, coverage area, infrastructure set up, transportation of bio-medical waste, operating procedure etc.
3. The SPCB/PCC upon receipt of such work-plan shall, review the proposal and "Consent to establish" shall be issued to the proponent with the required conditions.
4. Once the proponent establishes the necessary infrastructure, the site and the resources shall be inspected by the SPCB/PCC for the adequacy of the facility/equipment. Upon satisfactory recommendation, the authorization under the Bio-medical Waste (Management & Handling) Rules, shall be issued with necessary condition to the proponent.
5. The SPCB/PCC shall ensure the operation of the CBWTF as per the stipulated conditions and work-plan submitted by the proponent. The SPCB/PCC shall also ensure regular inspection of the CBWTF.
6. It is the duty of the healthcare units to hand over the segregated bio-medical waste to the CBWTF operator as per the Bio-medical Waste (Management & Handling) Rules as well as compatible with treatment facilities at CBWTF as suggested by the operator. The CBWTF operator shall list out daily such healthcare units that are not handing over the segregated bio-medical waste and the same shall be communicated to the SPCB/PCC every week. The SPCB/PCC shall take an immediate action against the defaulter healthcare units of such violation.
7. The CBWTF operator shall carry out following tests atleast quarterly from the approved laboratory and submit the quarterly report of the same to the SPCB/PCC:
 - a. Stack Emission Monitoring Test of the incinerator for parameters such as Particulate Matter, HCl, NO_x, CO, CO₂, O₂ and combustion efficiency as required under the Bio-medical Waste (Management & Handling) Rules. The test for VOC in incineration ash shall also be carried out.
 - b. Validation test of autoclave/microwave/hydroclave.
 - c. The applicable parameters of any effluent being discharged from the CBWTF.

CHECK LIST FOR DEVELOPMENT OF COMMON BIO-MEDICAL WASTE TREATMENT FACILITY

The criteria for development of CBWTF have been discussed in detail in the previous chapters. However, to have at a glance check in developing CBWTF, following checklist is reproduced for convenience:

1. Treatment Facility

(I) Following treatment facilities shall be provided in any common facility:

- a. Autoclave (Pre-vacuum horizontal feeding) / Hydroclave / Microwave.
- b. Incineration (for waste belonging to categories 1,2 and 5 only.)
- c. Shredder
- d. Sharp pit (with drawing details) / Encapsulation /Recovery of metal in some factory may be looked into
- e. Facility for bin washing, floor washing, vehicle washing
- f. Effluent Treatment Plan
- g. Secured land fill (Untill a secured land fill comes up in the area, space within the CBWTF facility shall used)

(II) Only waste category 1 & 2 shall be incinerated (if secured landfill is not available, waste category 5 may also be incinerated).

(III) All other infected waste shall be imparted autoclaving/ hydroclaving/ microwaving as applicable under the Bio-medical Waste (Management & Handling) Rules, 1998.

(IV) Incinerator, Autoclave/Hydroclave/Microwave shall be PLC based with tamper-proof control panel and recording devices.

2. Location

(I) Reasonably away from residential and sensitive area

3. Land

(I) Preferably not less than one acre land may be required to set up all the requisite facilities

4. Coverage area

(I) In any area, only one CBWTF may be allowed to cater up to 10,000 beds at the approved rate by the Prescribed Authority. A CBWTF shall not be allowed to cater healthcare units situated beyond a radius of 150 km. However, in an area where 10,000 beds are not available within a radius of 150 km, another CBWTF may be allowed to cater the healthcare units situated outside the said 150 km.

5. Segregation

- i. Segregation shall be as per the Bio-medical Waste (Management & Handling) Rules as well as compatible with treatment facilities at CBWTF as suggested by the operator
- ii. Generator is responsible for providing segregated waste to the operator
- iii. The operator shall not accept un-segregated waste and report the matter to the prescribed authority.

6. Collection

- i. Respective coloured bags should be kept in similar coloured container i.e coloured bags shall not be directly kept in vehicle.
- ii. Sharps shall be collected in puncture resistant containers.
- iii. Temporary storage at healthcare unit shall be designated.

7. Transport Vehicle

- i. Dedicated vehicle for the collection of Bio-Medical Waste.
- ii. Separate cabins shall be provided for driver/staff and the bio-medical waste containers.
- iii. The base of the waste cabin shall be leak proof to avoid pilferage of liquid during transportation.
- iv. The waste cabin may be designed for storing waste containers in tiers.
- v. The waste cabin shall be so designed that it is easy to wash and disinfect.
- vi. The inner surface of the waste cabin shall be made of smooth surface to minimize water retention.
- vii. The waste cabin shall have provisions of sufficient openings in the rear and/or sides so that waste containers can be easily loaded and unloaded.
- viii. The vehicle shall be labeled with the bio-medical waste symbol (as per the Schedule III of the Rules) and should display the name, address and telephone number of the CBWTF.

8. Storage

- i. Sufficient ventilated storage space for untreated and treated bio-medical waste shall be provided.
- ii. The flooring and walls (to a height of 2M from floor) shall be finished with smooth and fine material. There shall be minimum number of joints.

9. Record Keeping

- i. Documents such as collection advice taken from health care units for each category of waste, records of waste movements, logbook for the equipment and site records shall be maintained.

- ii. All the record shall be available at the CBWTF site for inspection.

10. Disposal

- i. Incineration ash - Secured landfill
- ii. Treated solid waste - Municipal landfill
- iii. Plastic waste after disinfection and shredding - Recycling or municipal landfill
- iv. Sharps, after disinfection (if encapsulated) - Municipal landfill
- v. Treated wastewater - Sewer/drain or recycling
- vi. Oil & grease - incineration

11. Setting up and Operation of CBWTF

- i. The proponent shall submit detailed work-plan of the proposed CBWTF to the Prescribed Authority for issuance of "Consent to Establish". The work-plan should include complete details of the project such as site details, coverage area, infrastructure set up, transportation of bio-medical waste, operating procedure etc.
- ii. The CBWTF operator shall carry out stack emission test of incinerator, incineration ash test, validation test of autoclave/microwave/hydroclave and applicable parameters of any effluent being discharged from the CBWTF, atleast quarterly from the approved laboratory and submit the quarterly report of the same to the SPCB/PCC.