Bio-Medical Waste Management

A need to protect public health & environment

स्वच्छ भारत
एक कदम स्वच्छता की ओर

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01. Introduction

Bio-medical waste means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps. Bio-Medical waste generated by Healthcare Facilities, if not disposed properly could have adverse effect on human health or environment. Hence, management of biomedical waste by healthcare facility is important in eliminating the risks due to infection within healthcare facilities as well as outside its premises during handling and disposal. As per WHO study, around 10% to 15% of total waste generated from any Healthcare Facility is hazardous which may be infectious, toxic or radioactive.

Biomedical Waste is regulated since year 1998 when Government of India had notified the Biomedical Waste (Management & Handling) Management Rules, were notified vide notification number S.O. 630 (E) dated the 20th July, 1998 whereby a regulatory frame work for management of bio-medical waste

generated in the country was given.

Further, to implement these rules more effectively and to improve the collection, segregation, processing, treatment and disposal of these bio-medical wastes in an environmentally sound management thereby, reducing the bio-medical waste generation and its impact on the environment, Government of India has re-notified the said Rules as Biomedical Waste Management Rules vide notification number G.S.R. 343(E) dated 28th March, 2016. These Rules are also amended three times in the year 2018 and 2019.

The Biomedical Waste Management Rules (BMWM), 2016 are comprehensive and applicable to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form. These Rules shall apply to bedded and non-bedded Healthcare Facilities such as hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, ayush hospitals, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, first aid rooms of schools, forensic laboratories and research labs.

BMWM Rules, 2016 stipulates duties of Occupiers, duties of the operator of a Common Bio-medical Waste Treatment Facility and duties of different authorities. As per the said Rules, biomedical waste has been categorized into four categories namely Yellow, Red, Blue and White for which respective treatment & disposal options are given under Schedule I.

02. Segregation and Categorization of Biomedical Waste

BMWM Rules, 2016 categorizes the bio-medical waste generated from the health care facility into four categories based color code system given under Schedule I of said Rules. Various types of bio medical waste are further assigned to each one of the categories, as detailed below:

1.	Yellow Category
2.	Red Category
3.	White Category
4.	Blue Category

These categories are further divided as per the type of waste under each category as follows:

Human Anatomical Waste Human tissues, organs, body parts and fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time).

Animal Anatomical Waste Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.

Soiled Waste Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components.

Discarded or Expired Medicine Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.

Chemical Waste Chemicals used in production of biological and used or discarded disinfectants

Chemical Liquid Waste Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X - ray film developing liquid, discarded Formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house - keeping and disinfecting activities etc.

Discarded linen, mattresses, beddings contaminated with blood or body fluid, routine mask & gown.

Microbiology, Biotechnology and other clinical laboratory waste (Pre-treated) Microbiology, Biotechnology and other clinical laboratory waste: Blood bags, Laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures.

Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters,

urine bags, syringes without needles, fixed needle syringes with their needles cut, vacutainers and gloves

Waste Sharps including metals

Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other

contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps

Broken or discarded and contaminated glass including medicine vials and

ampoules except those contaminated with cytotoxic wastes.

Examples of Category and classification of Biomedical Waste as per BMWM Rules, 2016 are as follows:

Yellow (a) category waste : Human Anatomical Waste

Yellow (b) category waste: Animal Anatomical Waste

Yellow (c) category waste : Soiled Waste

Yellow (d) category waste: Expired or Discarded Medicines

Yellow (e) category waste : Chemical Waste

Yellow (f) category waste : Chemical Liquid Waste

Yellow (g) category waste: Discarded linen, mattresses, beddings contaminated with blood or body fluid routine mask and gown

Yellow (h) category waste: Microbiology, Biotechnology and other clinical laboratory waste

Red Waste category waste: Contaminated Waste (Recyclable)

White (Translucent Waste) category waste: Waste sharps including Metals

Blue (a) category waste : Glassware

Blue (b) category waste: Metallic Body Implants

03. Scientific methods of disposal of Biomedical Waste

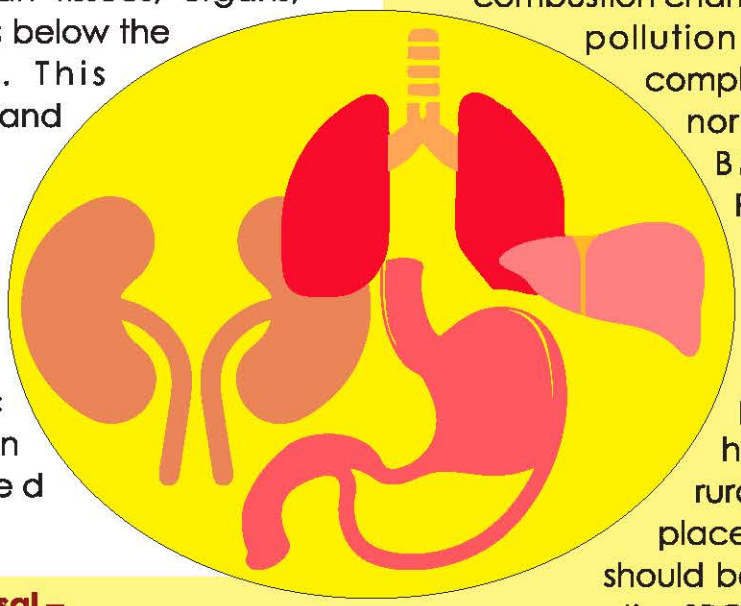
As per BMWM Rules, 2016 the treatment and disposal of BMW generated from the HCF must be carried out in accordance with Schedule I, and in compliance with the standards provided in Schedule II of BMWM Rules, 2016.

The collection, treatment, processing and disposal options for both the categories of healthcare facilities; having linkage with CBWTF or not having linkage with CBWTF, are detailed here as per Schedule I of BMWM Rules. 2016.

3.1.1. Yellow Category Waste

3.1.1.1. Yellow (a) Category Waste: Human Anatomical Waste

Segregation - Human tissues, organs, body parts and fetus below the viability period. This includes, placenta and extracted tooth.



Type of bag and container - Collect the waste in yellow colored non chlorinated plastic bag and store in yellow coloured container

Treatment and Disposal –

For HCF having linkage with CBWTF- No treatment of waste is required to be carried out at the health care facility except pre-treatment (sterilization) of Yellow (h) category waste by autoclaving/ microwaving/ hydroclaving or sterilize as per methods prescribed in WHO Blue book 2014. Yellow category waste along with pre-treated waste should be stored in central storage point and must be handed over to CBWTF. It is mandatory for each health care facility that dead fetus waste should be handed over to CBWTF in yellow bag with a copy of the official Medical Termination of Pregnancy (MTP) certificate from the Obstetrician or the Medical Superintendent/ SMO/ CMO of the HCF.

For HCF without linkage to CBWTF - This waste should be disposed through Plasma Pyrolysis unit or twin chambered compact incinerator with 2 seconds retention time in secondary combustion chamber and adequate air pollution control devices to comply with revised emission norms prescribed under BMW Management Rules, 2016.

Disposal of the waste in the deep burial pit should not be practiced unless the hospitals is located in rural or remote isolated place. Use of deep burial pit should be as authorised by the respective SPCB/PCC.

Copy of official MTP certificate from the MO I/C for fetus below the vitality period must be kept with the HCF.

3.1.1.2. Yellow (b) Category Waste: Animal Anatomical Waste

Segregation - This waste includes experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.

Type of bag and container- Collect the waste in yellow colored non chlorinated plastic bag and store in yellow colored container.

Treatment and Disposal-

For HCF having linkage with CBWTF- No treatment of waste is required to be carried out at veterinary hospital except pretreatment (sterilization) of Yellow (h) category waste (if applicable) by autoclaving/ microwaving/ hydroclaving or sterilize as per methods prescribed in WHO Blue book 2014. Yellow category waste along with pre-treated waste should be stored in central storage point and must be handed over to CBWTF.

For HCF having own treatment and Disposal facility- Animal anatomical waste should be disposed through Plasma Pyrolysis unit or twin chambered compact incinerator with 2 seconds retention time in secondary combustion chamber and adequate air pollution control devices to comply with revised emission norms prescribed under BMW Management Rules, 2016.

Animal anatomical waste can also be disposed in captive deep burial pits only in case of those veterinary hospitals located in rural or remote isolated place. Use of deep burial pit should be as authorised by SPCB/PCC.

3.1.1.3. Yellow (c) Category Waste - Soiled Waste

Segregation - Items contaminated with blood/body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components. This includes used infectious material such as caps, shoe-cover, blotting paper/gauze, wooden swab stick, paraffin blocks, indicators tapes and disposable (single use non-linen based) masks and gowns.

Type of bag and container- Collect the waste in yellow coloured non chlorinated plastic bag and store in yellow coloured container

Treatment and Disposal-

For HCF having linkage with CBWTF- No treatment of waste is required to be carried out at the health care facility. Waste must be handed over to CBWTF

For HCF having own treatment and Disposal facility- Soiled waste should be disposed through Plasma Pyrolysis unit or in twin

chambered compact incinerator with 2 seconds retention time in secondary combustion chamber and adequate air pollution control devices to comply with revised emission norms prescribed under BMW Management Rules, 2016. In absence of above, soiled waste can also be treated by autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding for ultimate disposal through waste to energy plants.

Soiled waste can also be disposed in captive deep burial pits only in case of the hospitals located in rural or remote isolated place. Use of deep burial pit should be as authorised by SPCB/PCC.

3.1.1.4. Yellow (d) Category Waste - Expired and Discarded Medicine

Segregation - Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.. This includes cytotoxic drugs dispensed in dextrose / saline bottles and disposables used in delivery of cytotoxic drugs.

Type of bag and container- Collect all the expired and discarded medicines except for cytotoxic drugs waste in a separate yellow colored non chlorinated plastic bag (different form being used for human anatomical waste) and store in yellow colored container.

All the cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc must be collected in separate yellow colored non chlorinated plastic bag labeled as cytotoxic hazard.

Treatment and Disposal-

For HCF having linkage with CBWTF- No treatment of waste is required to be carried out at the health care facility. As per BMW Rules, 2016 all the expired and discarded medicines including cytotoxic drugs expired `cytotoxic drugs are either returned back to the manufacturer or are handed over to the CBWTF to be disposed of through incineration at temperature > 1200oC.

For healthcare facilities where there no

established system for returning the drugs to the manufacturer it is recommended that the expired and discarded medicines are handed over only to CBWTF for disposing of through incineration.

For HCF having own treatment and Disposal facility - Expired and discarded medicines are required to be sent back to manufacturer or can be disposed though nearest common biomedical Waste or Hazardous waste incinerators with prior intimation to SPCBs/PCCs.

This waste can also be disposed through twin chambered captive incinerator with 2 seconds retention time in secondary combustion chamber, which can withstand a temperature of 1200oC and having adequate air pollution control devices to comply with emission norms.

3.1.1.5. Yellow (e) Category Waste - Chemical Waste

Segregation - This waste comprises of chemicals used in production of biological, discarded containers of chemicals and disinfectants etc. This includes solid or liquid residual chemicals used in HCFs.

Type of bag and container- Collect solid chemical waste in yellow coloured containers or non-chlorinated yellow plastic bag. Collect un-used, residual or date expired liquid chemicals in yellow container.

Treatment and Disposal-

For HCF having linkage with CBWTF- No treatment is required to be carried out at the facility. The chemical waste (liquid or solid chemicals) should be collected into different yellow coloured plastic containers, whereas empty chemical containers with residual chemicals should be collected in yellow bags and handover to CBWTF operator for final disposal by incineration. It is required to specify the name of chemical on the yellow containers so that it would help CBWTF operator to decide whether to incinerate or transfer to Hazardous Waste TSDF for final disposal.

For HCF having own treatment and Disposal facility- This waste should be incinerated in captive incinerator or it can be sent to nearby Hazardous Waste TSDF for final disposal

3.1.1.6. Yellow (f) Category Waste - Chemical Waste

Segregation - Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, silver X Ray film developing liquid, discarded formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities, etc. Leftover, unused,

residual or date expired liquid chemicals shall not be discharged as chemical liquid waste.
Type of bag and container- Not applicable since this liquid waste containing waste chemicals is collected and pre-treated prior to disposal through Effluent Treatment Plant. However, recyclable liquid chemicals such as spent X-ray hypo should be collected in yellow containers and sold or given to only authorised recyclers for resource recovery.

Treatment and Disposal -

As per the BMWM Rules 2016, the chemical liquid waste of the hospital must be collected through a separate collection system for pre-treatment. Hospitals with large standalone labs shall install separate drainage system leading to pre-treatment unit prior to mixing the same with rest of the wastewater from hospital for further treatment. For middle and small healthcare facilities having no system of separate drainage/collection system, the liquid waste is required to collected on-site in containers for pre-treatment before mixing the same with other wastewater. Silver X ray film developing fluid should be given or sold to the authorized recyclers for resource recovery, else it should be handed over to CBWTF as yellow(e) chemical waste.

Depending on type of chemical effluent generated, pre-treatment should comprise of neutralization/precipitation, followed by disinfection prior to mixing with rest of the wastewater from hospital. Prior to mixing with rest of the hospital effluent, disinfection should be done preferably by passing the effluent through UV sterilizer rather than using disinfecting chemicals since use of chemicals may affect performance of biological treatment in down-stream.

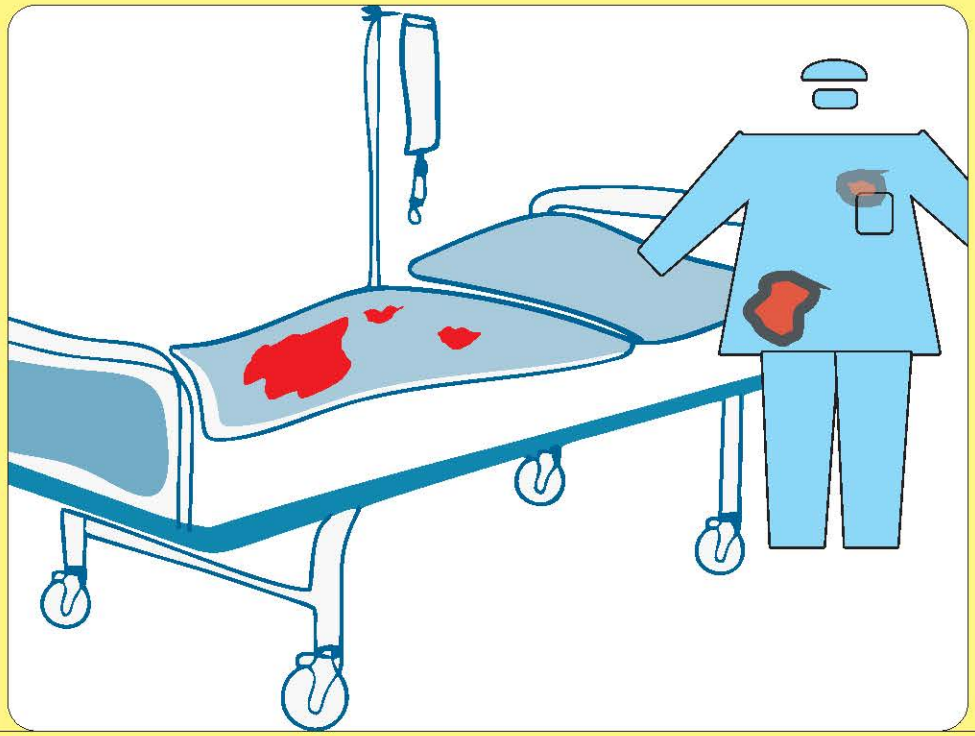
3.1.1.7. Yellow (g) Category Waste - Discarded Linen, Mattresses, bedding contaminated with Blood, body fluids, routine mask and gown.

Segregation - This includes discarded linen from bedsheets, beddings, re-usable routine masks and gowns.

Type of bag and container- Collect the waste in yellow coloured non-chlorinated plastic bag and store in yellow coloured container

Treatment and Disposal-

For HCF having linkage with CBWTF- Disinfect the waste linen with non-chlorinated chemical disinfection and hand over to the



CBWTF operator for final disposal by incineration. The waste mattresses should be cut into pieces and disinfected and can be sent to the CBWTF operator for final disposal by incineration. Alternatively, waste mattresses can be cut into pieces and disinfected with non-chlorinated chemicals for disposal as general waste (dry-waste) for energy recovery in cities having waste to energy plants or RDF (Refuse Derived Fuel) plants.

The waste mattresses shall not be sold or auctioned. Used bed sheets that are not soiled and re-usable can be sold or auctioned only after washing and disinfection. Disposable (single use non-linen based) masks and gowns, after use shall be treated as yellow-c (soiled waste).

For HCF having own treatment and Disposal facility- The waste mattresses after cutting into pieces and disinfected with non-chlorinated chemicals and can be incinerated in captive incinerator or can be disposed as General waste in dry bins in cities having RDF or waste to Energy Plants.

3.1.1.7. Yellow (h) Category Waste - Microbiology, Biotechnology and Other Clinical Laboratory Waste

Segregation - Microbiology, Biotechnology and other clinical laboratory waste, waste blood bags (containing date expired or contaminated blood), Laboratory cultures, stocks or specimen of micro- organisms, live or attenuated vaccines, human cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures. This includes plastic culture plates and other highly infectious wastes.

Type of bag and container- Collect the waste in yellow coloured non chlorinated plastic bag and store in yellow coloured container

Treatment and Disposal-

For HCF having linkage with CBWTF- Pre-treatment by disinfection before handing over the waste to CBWTF operator. Pretreatment can be done by autoclave / microwave / Hydroclave.

Pre-treatment can also be done by using non-chlorinated chemical disinfectants like aldehydes, lime based powders or solutions, ozone gas, ammonium salts and phenolic compounds.

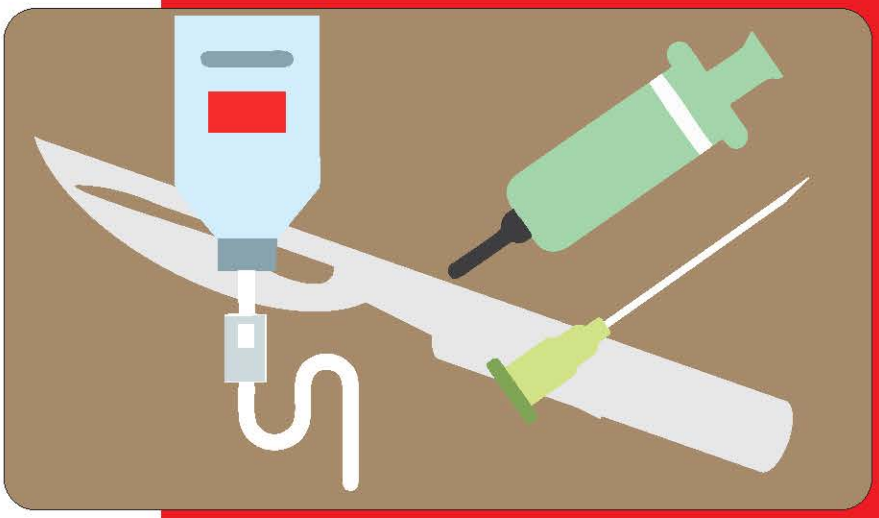
The pre-treated waste bags should be handed over to CBWTF operator on daily basis.

For HCF having own treatment and Disposal facility- Pre-treated waste should be disposed off by a HCF by installing twin chambered compact incinerator with 2 seconds retention time in secondary combustion chamber and adequate air pollution control devices to comply with revised emission norms prescribed under BMW Management Rules, 2016.

Pre-treated waste can be disposed in captive deep burial pits in case of the hospitals located in remote in rural or isolated places. Use of deep burial pit should be as authorised by SPCB/PCC.

3.1.2. Red Category Waste

Segregation - Red category waste is contaminated recyclable waste containing primarily plastics generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and fixed needle syringes with their needles cut), vacutainers and gloves. This includes waste pipette tips, plastic pipette, eppendorf, rubber teats, drains, oxygen mask, thick plastic splash proof gowns, rubber apron, ICT test cards, ELISA plate and vials not containing blood samples.



Type of bag and container- Collect the waste in red coloured non chlorinated plastic bag and store in red coloured container

Treatment and Disposal-

For HCF having linkage with CBWTF - Contaminated recyclable waste containing mainly plastics and rubber shall be put in red coloured non chlorinated plastic bags and containers. Syringes after removing/cutting the needles should also be put in this category. Vacutainers/vials with blood samples should be pre-treated as given at section 3.1.1.h and disposed as yellow-h category waste.

No onsite treatment of Red category waste is required. All such waste is needed to be sent to CBWTF for final treatment and disposal

For HCF having own treatment and Disposal facility- All the recyclable waste generated from the HCF must be sterilised using autoclaving/microwaving / hydro-calving followed by shredding or mutilation or combination of sterilisation and shredding. Recyclable waste must never be disposed of along with general waste in dry stream and same is required to be disposed of only through registered or authorised recyclers or to waste to energy plants or plastics to diesel or fuel oil or for road making, whichever is possible.

3.1.3 White Category Waste

Segregation- This waste comprises of needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes waste sharps such as lumbar puncture needle, trocar cannula, IABP cannula, arthroscopy blade, insulin pen needle, lancet needle, removac needle, eye needle, Cardioplegia needle and surgical stab knife.

Type of bag and container- Collect the waste in white translucent, puncture proof, leak proof, tamper proof container.

Treatment and Disposal-

For HCF having linkage with CBWTF- After collection in puncture proof, leak proof, tamper proof container, handover the waste to CBWTF without any alteration or onsite treatment.

For HCF having own treatment and Disposal facility- Sharps waste should be disinfected either with autoclaving or dry-heat sterilization or a combination of autoclaving cum shredding; for each of these options, the methods for disposal are as below;
In case there is difficulty in sending treated

Method of Disinfection	Treatment	Options for final disposal
Autoclaving	Shredding; or Mutilation; or Encapsulation in cement concrete	Concrete pit; or sanitary landfill or steel foundry
Dy-heat sterlization	encapsulation in metal container	
Autoclaving cum shredding as single unit operation	None	

sharps waste to sanitary landfills for final disposal (such as apprehension of local bodies to pick such waste), it is recommended to adopt the option of final disposal either through concrete pit or sending for recycling in steel furnace/foundry.

3.1.4.1. Blue (a) category waste: Glassware

Segregation - Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes. This includes glass slides and glass pipettes.

Type of bag and container- Puncture proof, leak proof boxes or containers with blue coloured marking

Treatment and Disposal -

For HCFs having linkage with CBWTF- Dispose of the empty glass bottles by handing over to CBWTF without any onsite treatment. The residual chemicals in glass bottle should be collected as chemical waste in yellow coloured container / bags and over to CBWTF as yellow(e) waste.

For HCFs having own treatment and Disposal facility- The waste glass bottles / broken glass has to be sterilized or disinfected (either by autoclaving or microwaving or hydroclaving or by Sodium Hypochlorite Solution) followed by soaking & washing with detergent prior to sending it for recycling. Broken glass should also be disinfected and if the same cannot be given/or sold for recycling it can be disposed in sharps pit. The residual chemical in glass bottle should be collected as chemical waste in yellow coloured container / bags as yellow(e) waste and send the same to either a CBWTF or common hazardous waste Treatment and Disposal Facility.

Glass vials with positive controls should be pre-treated and disposed as yellow(h) waste.

3.1.4.2. Blue (b) Metallic Body Implants

Segregation - Implants used for orthopaedic surgeries. This include metal sternal wire, Gigli saw wire and Orthopaedic Splint.

Type of bag and container- Puncture proof, leak proof boxes or containers with blue coloured marking.

Treatment and Disposal -

Dispose of the waste by handing over to CBWTF. In case of no access to CBWTF, metallic body implants should be disinfected (either by autoclaving or microwaving or hydroclaving or by Sodium Hypochlorite Solution) and later washed with detergent prior to sending/sold to metal recyclers.

04. Present scenario of Bio-medical Waste Management in the Country

Biomedical Waste Management Rules, 2016 notified by Government of India stipulates provisions for treatment and disposal of biomedical waste generated by Healthcare Facilities (bedded & non-bedded). As per Rule 13 of BMWM Rules, 2016, State Pollution Control Boards/Pollution Control Committees have to submit Annual Report on Biomedical Waste Management for their respective State/Union Territory, every year. Further, CPCB has compiled the Annual Report on Biomedical Waste Management for the year 2019.

As per Annual Report for the year 2019, there are 3,22,425 no. of Health Care Facilities (HCFs) out of which 1,06,796 no. of HCFs are bedded and 2,15,780 no. of HCFs are non-bedded. Out of 3,22,425 nos. of HCFs only 1,53,885 no. of HFCs have obtained authorization under BMWM Rules, 2016. 619 tonnes per day of biomedical waste is generated by these HCFs out of which 544 tonnes per day of biomedical waste is treated and disposed off. There are 202 nos. of Common Biomedical Waste Treatment Facilities and 18,015 nos. of captive treatment facilities installed by HCFs, available for the treatment & disposal of biomedical waste. There are 35 nos. of CBWTFs which are under construction. Brief scenario of biomedical waste management is given below:

No. of HCFs	3,22,425
No. of bedded HCFs	1,06,796
No. of non-bedded HCFs	2,15,780
No. of beds	24,86,327
No. of CBWTFs	202
No. of HCFs granted authorization	1,53,885
No. of HCFs having Captive Treatment Facilities	18,015
No. of Captive Incinerators Operated by HCFs	136
Quantity of bio-medical waste generated in Tonnes/day	619
Quantity of bio-medical waste treated in Tonnes/day	544
No. of HCFs violated BMW Rules	29,062
No. of Show Cause Notices/Directions issued to defaulter HCFs/CBWTFs	17,435

05. Biomedical waste Management Scenario since 2007

CPCB is continuously pursuing and requesting all SPCBs/PCCs to take necessary steps to ensure that Bio Medical Waste generated from various Hospitals/Nursing Homes and other Health Care Units are disposed of in an environmentally sound manner so as to prevent spread of diseases and infections. Due to regular pursuance, the bio-medical waste in India is reported to be treated as per provisions of BMW Rules as compared to about 57% in the year 2007.

The Bio-medical waste generation as well as treatment & disposal scenario during the years 2007 to 2019 is given in the Figure 1. The figure shows that after enforcement of BMWM Rules, 2016, gap between

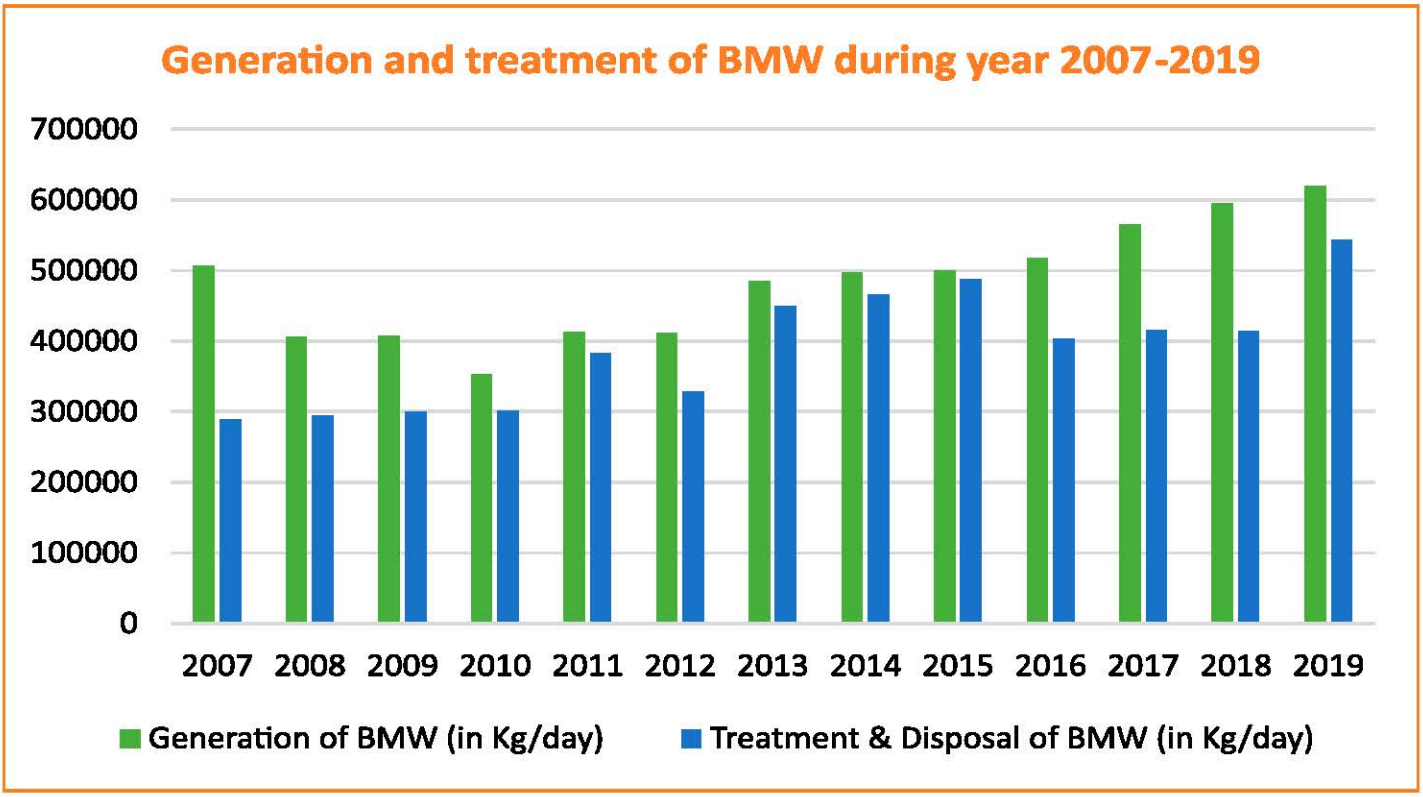


Figure 1. A comparison in total Quantity of Bio-medical Generation as well as Treatment & Disposal Scenario during the years 2007-2019

over the period (i.e. 2016 to 2018), it is observed that there is a significant decrease in gap between biomedical waste generation and treatment, which is due to significant improvement in segregation of bio-medical waste at the source of generation. In the year 2019, about 87 % of biomedical waste generation and treatment has been increased which may be due to improved inventorization of HCFs generating biomedical waste, its treatment and disposal.

5.1. Health Care Facilities (HCFs) in the Country

As per annual report of SPCBs/PCCs for year 2019, total no. of HCFs is 3,22,425 out of which no. of bedded HCFs is 1,06,796 and no. of non-bedded HCFs is 2,15,780. Bedded HCFS have bed strength of 24,86,327. Since 2008, there has been a consistent growth in number of HCFs in the country and which is directly proportional to population growth and the concern for providing health services. As per BMWM Rules, 2016, every HCF is required to obtain authorisation from concerned SPCB/PCCs as to ensure segregation, collection, storage, handling, transportation, treatment and disposal of biomedical waste in line with provisions under BMWM Rules, 2016.

5.1.1. Authorization Status of HCFs

Healthcare Facilities in Form II prescribed under BMWM Rules, 2016 apply for authorisation to concerned SPCB/PCC. Further, based on inventory conducted by SPCBs/PCCs there has been an increase in number of applications for authorisation. Authorization status of HCF is given in Figure 2.

As the numbers of HCFs are increasing since 2007, the applications for authorization under BMW Rules are also increasing at the same pace and accordingly, authorization granted to such HCFs by the respective SPCB/PCC is increased. However, there is still gap between number of HCFs applied for authorization to SPCBs/PCCs and number of HCFs which have been granted authorization under BMW Rules by the respective SPCB/PCC.

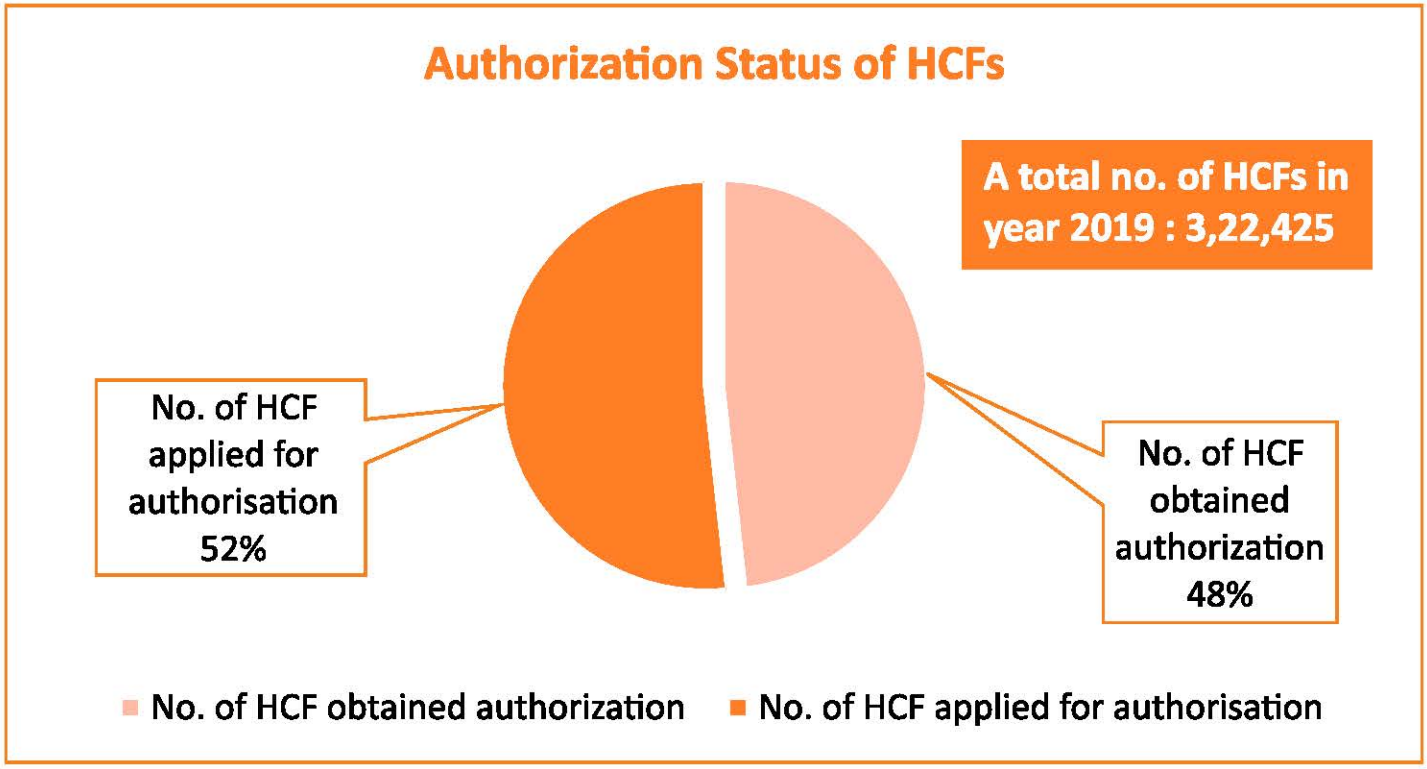


Figure 2: No. of HCFs , No. of HCFs applied for authorization and No. of HCFs obtained authorization in year 2019

5.1.2. HCFs utilizing Common Bio-medical Waste Treatment Facilities

As per BMWM Rules, 2016, Healthcare Facilities are not allowed to have their own captive treatment facilities; however those captive facilities which are operated before notification of BMWM Rules, 2016 are still in operation with condition to comply with new standards prescribed under said Rules. Majorly, HCFs are utilizing the facility of Common Biomedical Waste Treatment Facilities for disposing generated biomedical waste. As per annual inventory for the year 2019, there are 2,35,571 out of 3,22,425 HCFs are utilizing the CBWTFs. Trend in increasing the no. of HCFs utilizing the CBWTFs is given in the Figure 3.

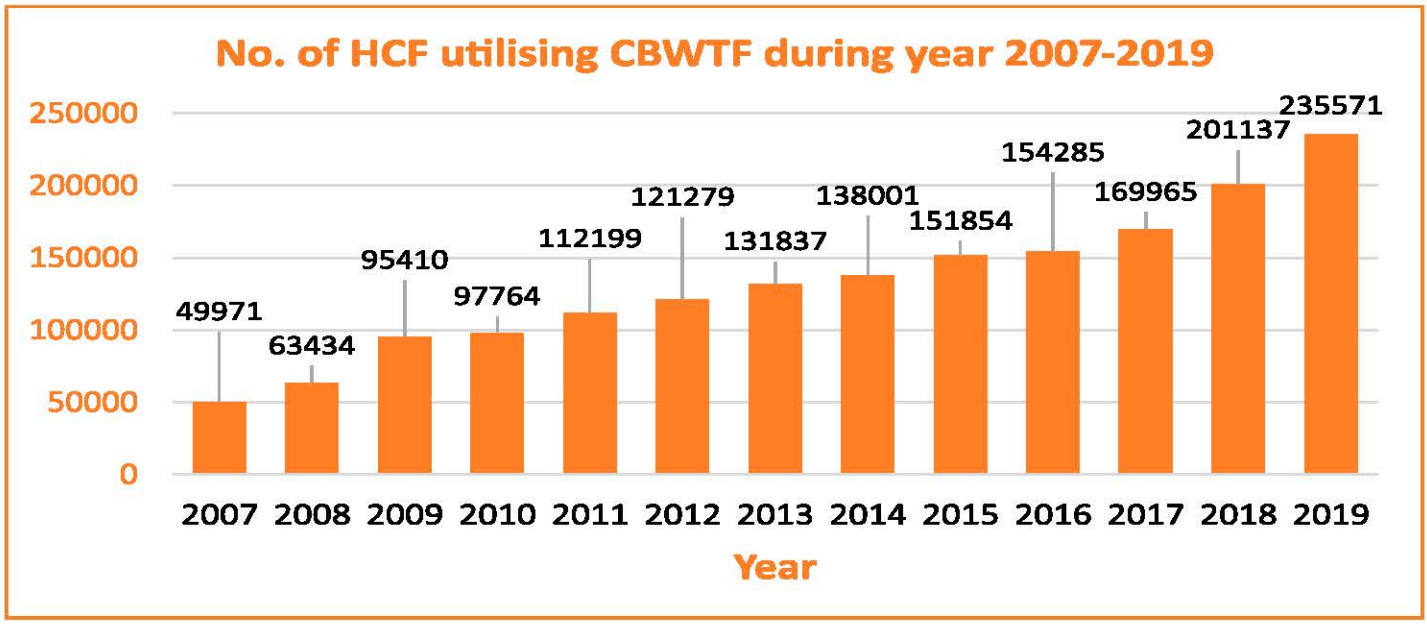


Figure 3: No. of HCFs which are utilizing CBWTFs/Private Agencies during the years 2007-2019

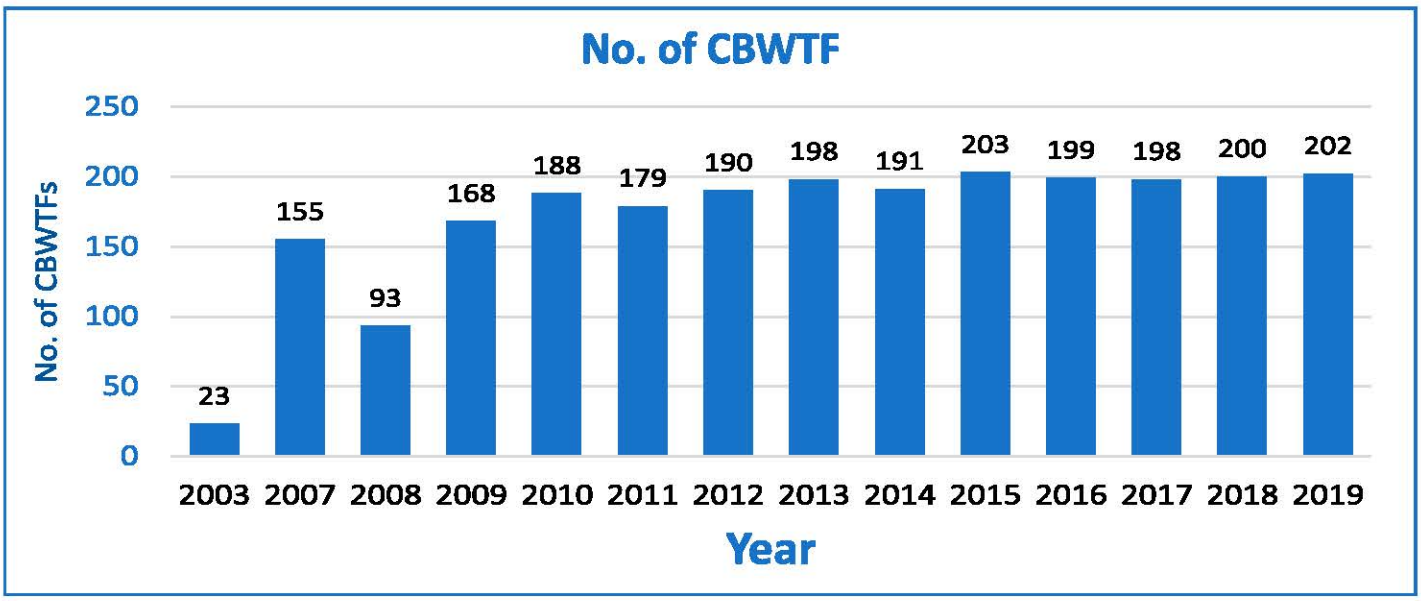


Figure 4: No. of CBWTFs in Operation during the years 2003-2019

5.2. Treatment Facilities in the Country

A. Common Bio-medical Waste Treatment Facilities (CBWTFs)

There are 202 numbers of Common Biomedical Waste Treatment facilities operated in the Country to cater services of treatment and disposal of biomedical waste generated by Healthcare Facilities. Apart from these, 35 nos. of CBWTFs are under construction in different States. CBWTFs are operated in every State except Andaman & Nicobar, Arunachal Pradesh, Goa, Lakshadweep, Mizoram, Nagaland & Sikkim.

As per Annual Report Information for the year 2019, State-wise no. of CBWTFs is given in **Table 2**.

Table 2: State-wise Status of CBWTF in the Country.
(As submitted by the SPCBs/PCCs & DGAFMS for the year 2019)

S.No.	Name of the State/UT and	CBWTFs	
		Operational	Under construction
1	Andaman Nicobar	0	Nil
2	Andhra Pradesh	12	2
3	Arunachal Pradesh	0	Nil
4	Assam	1	Nil
5	Bihar	4	1
6	Chandigarh	1	Nil
7	Chhattisgarh	4	4
8	Daman &Diu and Dadra & Nagar Haveli	Sent to Surat CBWTF	Nil
9	Delhi	2	Nil
10	Goa	0	Nil
11	Gujarat	20	2
12	Haryana	11	Nil
13	Himachal Pradesh	2	1
14	Jharkhand	4	1
15	J & K	3	NIL
16	Karnataka	27	2
17	Kerala	1	Nil
18	Lakshadweep	0	Nil
19	Madhya Pradesh	12	1
20	Maharashtra	31	1
21	Manipur	1	Nil
22	Meghalaya	1	Nil
23	Mizoram	0	Nil
24	Nagaland	0	Nil
25	Orissa	5	2
26	Puduchemy	1	Nil
27	Punjab	5	1
28	Rajasthan	8	7
29	Sikkim	0	Nil
30	Tamil Nadu	8	2
31	Telengana	11	Nil
32	Tripura	1	1
33	Uttarakhand	2	Nil
34	Uttar Pradesh	18	Nil
35	West Bengal	6	7
	Total	**202**	**35**

CBWTFs are widely accepted by healthcare facilities and increasing in its number continuously because of various advantages such as reduced capital investment, reduced cost of treatment, no operation & maintenance, checks mushrooming of treatment equipment in cities, easy implementation by the regulatory bodies etc.

Ministry of Environment, Forests and Climate Change (MoEF & CC) has a scheme namely "Creation of Management Structure for Hazardous Substances" which facilitates the biomedical waste stakeholder for setting up of CBWTF be providing financial assistance to them.

In order to help the CBWTF operators to comply with the provisions of the Bio-medical Waste Management Rules, 2016 Central Pollution Control Board has prepared following guidelines:

i. Revised Guidelines for Common Bio-medical Waste Treatment and Disposal Facilities; and
ii. Guidelines for Barcode System for Effective Management of Biomedical Waste
iii. Guidelines for verification of Two Seconds Residence Time in Secondary Combustion Chamber of incinerator

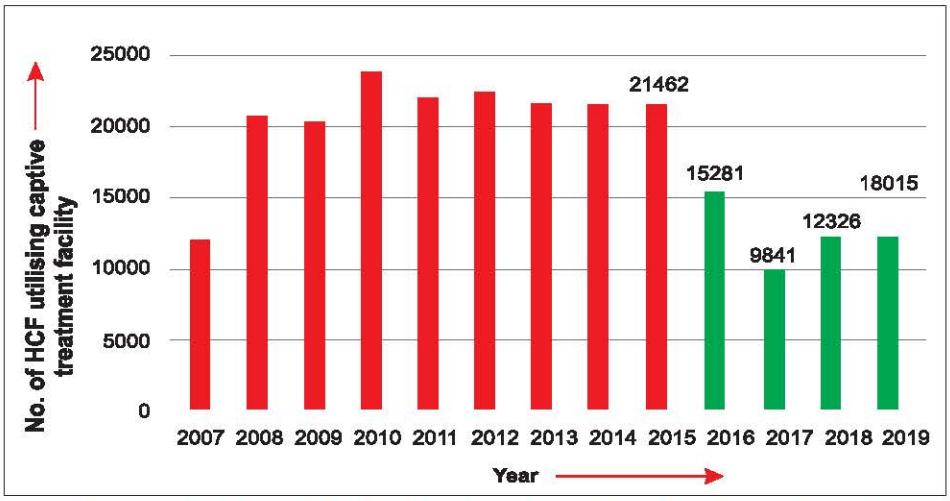


Figure 5 : No. of HCFs Having Captive Treatment and Disposal Facilities during the years 2007-2019

B. Captive Treatment Facilities of Healthcare Facilities

Apart from Common Treatment Facilities, Healthcare Facilities also operated captive treatment facilities for treatment and disposal of biomedical waste generated by them. However, BMWM Rules, 2016 does not allow to operate captive treatment facilities in case service of CBWTF is available at distance of 75 Km. Currently, there are 18,015 captive treatment facilities which must have operated before notification of BMWM Rules, 2016 with condition to comply with new standards prescribed under BMWM Rules, 2016. Figure showing trend in number of captive facilities since 2007 is given in Figure 5. The decline in number of Captive Treatment Facilities since year 2016 is due to above said stipulation.

06. Standards for Treatment and Disposal of Bio-medical Waste

Bio-medical waste shall be treated and disposed of in accordance with Schedule-I, and in compliance with the standards prescribed in Schedule-V of the BMW Rules. Standards for incineration, autoclaving, and microwaving and disposal by deep burial have been prescribed in the Rules, which are detailed below:

6.1. Standards for Incineration:

A. Operating Standards

1) Combustion efficiency (CE) shall be at least 99.00%.

2) The Combustion efficiency is computed as follows:

$$C.E.= \frac{\%CO_2}{\%CO_2 + \%CO} \times 100$$

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 - 50° C.

4) The secondary chamber gas residence time shall be at least two seconds.

B. Emission Standards

S. No.	Parameter	Standards	
		Limiting concentration in mg/ Nm3 unless stated	Sampling Duration in minutes, unless stated
(1)	(2)	(3)	(4)
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	0.1ngTEQ/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

6.2. Standards for Waste 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:

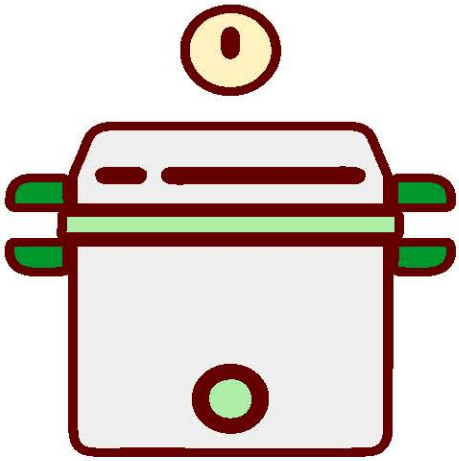
(I) a temperature of not less than 121°C and pressure of 15 psi per an autoclave residence time of not less than 45 minutes; or

(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 Geobacillusstearothermophilus spores using vials or spore Strips; with at least 1X106 spores. Under no circumstances will an autoclave have minimum operating parameters less than a residence time of 30 minutes, a temperature less than 121o 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.

6.3 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 atrophaeusspores using vials or spore strips with at least 1 x 104sporesper detachable strip. The biological indicator shall be placed with waste and exposed to same conditions as the waste during a normal treatment cycle.

6.4. Standards For Liquid Waste:

The effluent generated or treated from the premises of occupier or operator of a common bio medical waste treatment and disposal facility, 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.

"Note–

1. Above limits are applicable to the occupiers of Health Care Facilities (bedded) which are either connected with sewerage network without terminal sewage treatment plant or not connected to public sewers.

2. For discharge into public sewers with terminal facilities, the general standards as notified under the Environment (Protection) Act, 1986 (29 of 1986) shall be applicable.

3 Health Care Facilities having less than ten beds shall have to comply with the output discharge standard for liquid waste by 31st December, 2019.

4 Non-bedded occupiers shall dispose infectious liquid wastes only after treatment by disinfection as per Schedule – II (6) of the principal rules."

6.1. Standards For Deep Burial:

(1) A pit or trench should be dug about two meters deep. It should be half filled with waste, then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.

(2) It must be ensured that animals do not have any access to burial sites. Covers of galvanised iron or wire meshes may be used.

(3) On each occasion, when wastes are added to the pit, a layer of 10 cm of soil shall be added to cover the wastes.

(4) Burial must be performed under close and dedicated supervision.

(5) The deep burial site should be relatively impermeable and no shallow well should be close to the site.

(6) 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.

(7) The location of the deep burial site shall be authorized by the prescribed authority.

(8) The institution shall maintain a record of all pits used for deep burial.

(9) The ground water table level should be a minimum of six meters below the lower level of deep burial pit.

Deep burial is not recommended for CBWTFs. It may be permitted only in avoidable circumstances such as in rural or remote areas where there is no access to common bio-medical waste treatment facility. Further, deep burial pits should be constructed as per the authorization from SPCBs/PCCs

People vulnerable to risks of BMW

Improper management of Bio medical waste may have risk to people involved in handling of waste and even general public who directly don't deal with it.

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Better safe than sorry!