OPEN ACCESS

International
Journal
Of Modern Engineering Research (IJMER)

An Empirical Research to Assess Knowledge, Perception, Practices Regarding "Biomedical Waste Management in Chandigarh"

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ABSTRACT

Biomedical and wellness sector waste management differs significantly from residential or industrial waste management. Biomedical waste management has become one of the greatest challenges facing humanity since it has an immediate effect on people's health. Because it is harmful in nature, it must be handled safely and properly.

The Bio-Medical Waste Rules, 2016, were published by the Ministry of Environment and Forests to ensure efficient biomedical waste disposal management. This assessment discusses hospital waste management and the environmental issues in Chandigarh. This study also looked at the challenges linked with biomedical waste.

In past decades, healthcare waste was frequently dumped in adjacent landfills along with municipal solid garbage. Environmental regulatory bodies have been working hard to handle biological waste more effectively in recent years.

India is experiencing a similar issue in the context of the global spread of the coronavirus disease (COVID-19). Given that India already lacks sufficient facilities for treating trash and that the rapid spread of the COVID-19 virus has caused a notable increase in the amount of biomedical waste (BMW), the safe disposal of vast amounts of waste has become a critical issue. This research offers a thorough evaluation of BMW of India both prior to and throughout the COVID-19 outbreak.

Additionally, this article focuses on the deficiencies in the application of BMW regulations in India. For instance, only eight states out of 35 States/UTs have authorization under BMW management rules; the government has also placed strict restrictions on the practice of deep burials, even though 23 States/UTs remain using deep burial methods for elimination of BMWs.

KEYWORDS:

Bio Medical Waste, COVID-19 Waste, Healthcare, Incineration, BMW Rules,2016, CPCC, CPCB

I. INTRODUCTION:

The World Health Organization deemed the infectious disease known as COVID-19, which had been identified in Wuhan, China, towards the end of December 2019, to be a pandemic. To minimize the effects of COVID-19 and stop the spread of the novel corona virus, the majority of nations, including India, have declared some form of lockdown. COVID-19 had been linked to significant harmful consequences for society and the environment, although there have also been positive effects noted in terms of air quality. The proactive measure used by India to impose a nationwide lockdown beginning on March 24, 2020, and lasting until May 30, 2020, along with sporadic lockdown periods, was essential in preventing the spread of this dangerous virus strain.

It has serious environmental, health, and safety consequences, particularly in developing countries, where indisposed ravage care and control are frequently burned or abandoned in unregulated dumps. A developing country, such as India, which is densely inhabited, confronts significant challenges in dealing with the threat of COVID-19, both in terms of environmental care and overall health. The environmental pollution caused by hazardous biomedical wastes, specifically carbon-containing compounds and solutions capable of absolving noxious substances from insecure transport and disposal. Emissions from Bio-Medical Waste Treatment Facility Centers (BMWTFCs) incinerators include harmful substances such as dioxins and furans, which must be reduced and regulated.

Biomedical waste is defined as material created during the diagnosis, treatment, or immunization of people or animals, as well as associated research projects, the production or testing of biological products, or health camps.Bio-Medical waste is any waste generated by a health-care facility that could have a negative impact on a person's health or the environment in general if not properly disposed of. All trash that has the potential to harm the environment or a person's health is deemed infectious and must be managed according to the BMWM Rules, 2016. Several studies have been published on this topic (8,9,10)

The amount of such waste generated by the Health Care Facility is around 10% to 15% of total waste generated. Materials that have come into contact with the patient's blood, secretions, contaminated parts, biological liquids such as chemicals, medical supplies, pharmaceuticals, lab discharge, sharps metallic and glassware, plastics, and so on make up this waste.

According to the World Health Organization (WHO,2018), the composition of bio-medical waste is as follows- non-hazardous waste (85%) and hazardous waste (15 %), with infectious waste accounting for 10 percent and radioactive or chemical waste accounting for 5 percent, every year, Over 5.2 million people worldwide, including 4 million children, are thought to have died from illnesses brought on by medical waste.

The necessity of managing biological waste

Risks listed below are the reason(s) behind the necessity or justification for investing a significant amount of funds, labour, supplies, and machinery in hospital waste management.

1. Sharps injuries that result in infection in all hospital staff groups and waste handlers.
2. Inadequate waste management and infection control procedures leading to nosocomial infections in patients.
3. Threat of infection for those who handle waste, scavenge, and sometimes members of the general public who live close to hospitals.
4. People managing trash at all levels run the risk of being exposed to dangerous substances and medications.
5. Risk of recycling "disposables" those deceitful individuals repackage and resell.
6. Repackaging of pharmaceuticals that have been disposed of poses a risk of fake drug sales to unwary consumers.
7. The potential for garbage to directly pollute the air, water, and land, or for improper incineration to produce pollutants and ash has been identified.

BIO-MEDICAL WASTE MANAGEMENT RULES, 2016

The following are steps in the handling of biomedical waste:

a) Generation
b) Segregation
c) Collection
d) Storage
e) Treatment
f) Transport
g) Disposal.

Thus, anybody who produces, separates, collects, receives, stores, treats, transports, disposes of, or handles biomedical waste in any form is subject to the Bio-medical Waste Management regulations.

The following waste categories are additionally governed by various other acts in addition to the Bio-Medical Waste Regulations of 2016:

1. Radioactive wastes (Atomic Energy Act, 1962).
2. Hazardous chemicals (Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989).
3. Lead acid batteries (Batteries (Management and Handling) Rules, 2001).
4. Hazardous wastes (Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016).
5. E-waste (e-waste (Management) Rules, 2016).
6. Municipal solid wastes (Solid Waste Management rules, 2016).
7. Hazardous microorganisms, genetically engineered microorganisms and cells (Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms, Genetically Engineered Micro-organisms or Cells Rules, 1989)

On the contrary, during the lockdown period, when stringent travel limits were imposed and constant monitoring of air pollutants via Continuous Ambient Air Quality Monitoring Stations was carried out, the ambient air quality of Chandigarh improved significantly. At several sites throughout Chandigarh, there are multiple display boards displaying the current air quality. Another issue being addressed is COVID-19 bio-medical waste generation, handling, treatment, disposal, and management. For this reason, the CPCB has recommended appropriate rules that take into account the safety of waste handlers, as well as a national level

data management android app called 'COVID19BWM' for the efficient management of COVID-19 bio-medical waste.

The Chandigarh Administration's COVID-19 Biomedical Waste Initiatives. To deal with the COVID-19 pandemic, the Central Pollution Control Board (CPCB) has established appropriate rules for the handling, treatment, and elimination of produced waste during COVID-19 waste treatment, diagnosis, and quarantine. In light of the foregoing, the Chandigarh administration took appropriate measures, including the establishment of quarantine centres/camps, isolation wards, sample collection centres and laboratories, and common biomedical waste treatment and disposal facilities, all of which are covered by the BMW Management Rules, 2016. The existing standards have been changed three times to address and incorporate activities on general solid waste and biomedical waste segregation. It also concerns the safety of waste handlers / sanitation personnel working for healthcare facilities, urban local bodies (ULBs), and Common Biomedical Waste Treatment Facilities (CBWTFs) in the management of biomedical waste and solid waste created by COVID-19 patients.

Biomedical waste is divided into four categories by the CPCB's current standards.

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

Covid trash is marked yellow and burnt since it is deemed potentially infectious. "We never know how much pollution we're causing... Our land-based pollution is being converted to water or air pollutants.

S.No.	Category	Type of waste	Colour & Type of Container
1	Yellow Category	✓ Human Anatomical Waste ✓ Animal Anatomical Waste ✓ Soiled Waste ✓ Discarded or Expired Medicine ✓ Microbiology, Biotechnology and other clinical laboratory waste ✓ Chemical Waste (yellow-e) ✓ Chemical Liquid Waste	Yellow coloured non-chlorinated Plastic Bags Note: (i) Chemical   waste (yellow-e) comprising of un-used, residual or date expired liquid chemicals including spent hypo of X-Ray, should be stored in yellow container
2.	Red Category	Contaminated Waste (Recyclable)	Red Coloured Non-Chlorinated Plastic Bags (having thickness equal to more than 50 µ) and Containers  
3.	White Category	Waste Sharps including metals	White Coloured translucent, puncture proof, leak proof, Temper Proof containers 

4.	Blue Category	✓ Glassware ✓ Metallic Body Implants	Puncture proof, leak proof boxes or containers with blue coloured marking. 

CPCB GUIDELINES FOR COVID-19 WASTE:

✓ Keep separate colour coded bins/bags/ containers in hospital wards and maintain proper segregation of waste.
✓ Use of dedicated collection bin labelled as "Covid-19" to store waste
✓ As a precaution, double-layered bags should be used for collection of waste from Covid-19 isolation wards.
✓ General trash should be disposed of as solid waste as per SWM Rules,2016.
✓ Use dedicated trolleys and collection bins in isolation wards with a proper label.
✓ Collect used PPEs in red bag.
✓ Collect used masks, head cap, shoe cover, disposable linen gown, non-plastic or semi-plastic coverall in yellow bags.
✓ Ensure that waste produced in Covid-19 isolation wards is kept in a separate record.

Current practices of biomedical waste management in Chandigarh

According to a recent report given to the NGT by the Central Pollution Control Board, Chandigarh has topped the country in implementing the Bio-Medical Waste Management (BMWM) Rules, 2016. According to the report, which is part of the NGT's order dated January 18, Chandigarh received 21 out of a possible 24 points, placing it first in the country, ahead of Delhi, Himachal Pradesh, Puducherry, and West Bengal, all of which received 21 points.

Table: 1

Months	Waste WT
20-Apr	14207 kg
20-May	39710 kg
20-Jun	29492 kg
20-Jul	45734 kg
20-Aug	70793 kg
20-Sep	73746 kg
20-Oct	51322 kg
20-Nov	43808 kg
20-Dec	51220 kg
21-Jan	47646 kg
21-Feb	39112 kg
21-Mar	27820 kg
21-Apr	44647 kg
21-May	74639 kg

21-Jun	54782 kg
21-Jul	42797 kg

According to the data in table 1, may this year be followed by September and August last year, with 73,746 kg and 70,793 kg of garbage generated, respectively. The city's main three medical institutes, including PGI, GMCH-32, and GMSH-16, as well as other civil hospitals, quarantine Centres, and the municipal corporation, produced Covid bio medical waste.

The UT administration prepared the Covid-19-related report for the first-time last year in April and May. The Chandigarh Pollution Control Committee (CPCC) had previously written to institutes requesting that they provide a weekly report on how they handled Covid-19 biological waste, such as worn gloves, masks, and protective suits. For these procedural tails, the CPCC had written to the civic body, PGIMER, GMSH-16, and GMCH-32. The committee's questions were based on the CPCB's guidelines and the NGT's orders. The NGT had stated in a previous order that throwing Covid-19 trash in general bins or wastewater without proper protections was dangerous. It suggested that best practices and new ideas be used under strict supervision, as well as accumulating data from all sources to prevent spills and improve strategic planning.

Table: 2

Regular Bio Medical Waste (BMW) in kgs.					
MONTH	R	B	Y	W	TOTAL
20-Apr	15917	387	43112	501	59917
20-May	18072	5295	39718	80	63165
20-Jun	25830	2252	49952	173	78207
20-Jul	28546	12719	49907	228	91400
20-Aug	26309	6246	39693	194	72442
20-Sep	25151	5560	64334	263	95308
20-Oct	26206	8402	84232	442	119282
20-Nov	40832	7726	74359	245	123162
20-Dec	29475	9611	70549	253	109888
21-Jan	28923	10636	66701	388	106648
21-Feb	28261	9489	70362	315	108427
21-Mar	31552	10836	75828	416	118632
21-Apr	26676	8945	71321	509	107451
21-May	26258	7834	56473	471	91036
21-Jun	21875	10472	51937	15	84299
21-Jul	27926	9910	58817	178	96831

Figure: 1

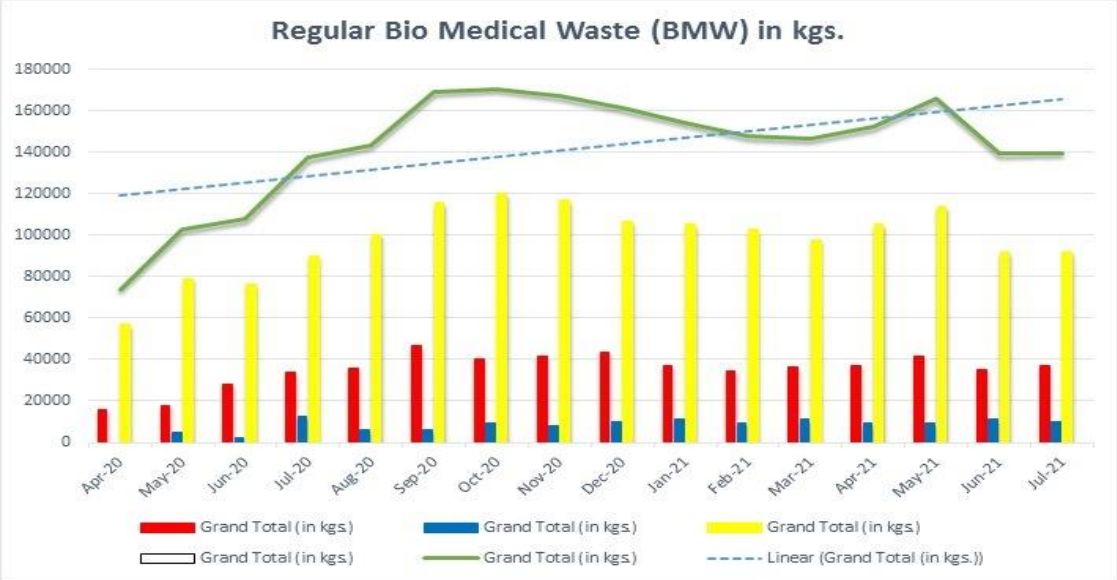


Table: 3

Covid-19 BMW (in kgs.)					
MONTH	R	B	Y	W	TOTAL
20-Apr	0	0	14207	0	14207
20-May	54	0	39656	0	39710
20-Jun	2592	82	26819	0	29493
20-Jul	5251	118	40365	0	45734
20-Aug	9699	143	60948	3	70793
20-Sep	21554	697	51465	30	73746
20-Oct	14539	814	35969	0	51322
20-Nov	811	419	42579	0	43809
20-Dec	14482	265	36473	0	51220
21-Jan	8168	841	38632	5	47646
21-Feb	6387	259	32466	0	39112
21-Mar	5284	320	22217	0	27821
21-Apr	10348	333	33966	0	44647
21-May	15744	1486	57461	2	74693
21-Jun	13895	1028	40368	91	55382
21-Jul	9047	249	33495	7	42798

Figure: 2

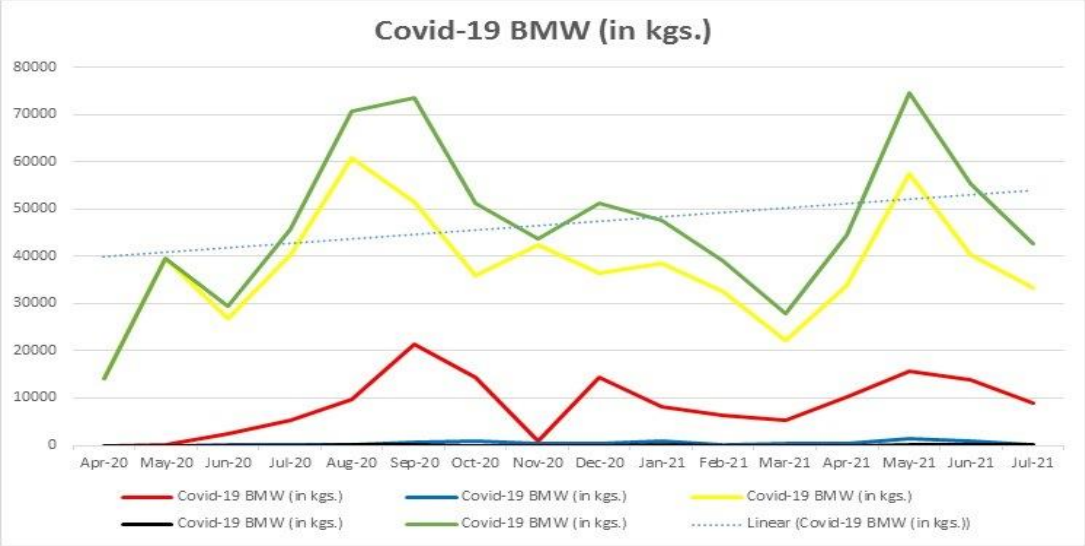


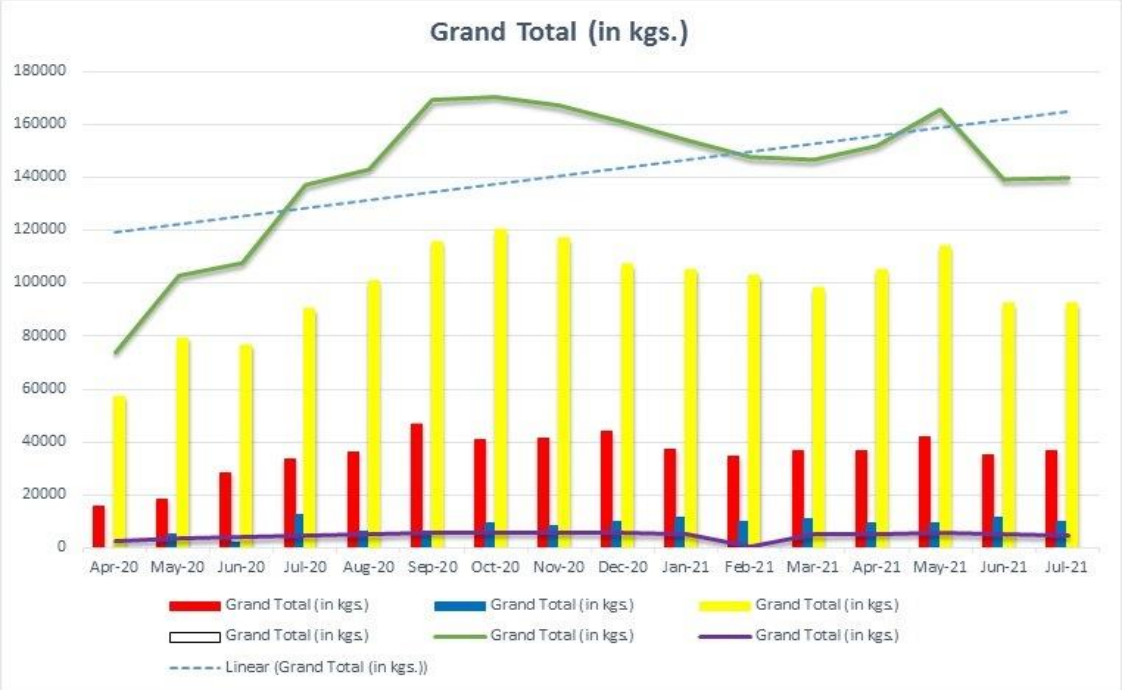
Table: 4

Grand Total (in kgs.)						
MONTH	R	B	Y	W	TOTAL	Per Day
20-Apr	15917	387	57319	501	74124	2471
20-May	18127	5295	79373	80	102875	3319
20-Jun	28422	2333	76772	173	107700	3590
20-Jul	33798	12837	90272	228	137135	4424
20-Aug	36009	6388	100641	197	143235	4620
20-Sep	46705	6257	115800	293	169055	5635
20-Oct	40745	9216	120201	442	170604	5503
20-Nov	41643	8144	116938	245	166970	5566
20-Dec	43957	9875	107022	253	161107	5197
21-Jan	37090	11477	105334	393	154294	4977
21-Feb	34648	9748	102827	315	147538	526
21-Mar	36836	11156	98044	416	146452	4724
21-Apr	37024	9277	105287	509	152097	5070
21-May	42002	9320	113994	473	165789	5346
21-Jun	35170	11500	92305	106	139081	4636
21-Jul	36973	10159	92312	183	139627	4504

Common Bio-medical Waste Treatment Facility (CBWTF)

A Common Bio-medical Waste Treatment Facility (CBWTF) is a facility where biomedical waste generated by a number of healthcare units (govt. and private hospitals) is given the treatment it needs to reduce the negative impacts it can have. Finally, the garbage may be disposed off in a landfill or recycled. Biomedical waste management and disposal entities with which the state has signed a Memorandum of understanding. There is now only one agency (ALLIANCE ENVIROCARE CO PRIVATE LIMITED) in Chandigarh's industrial phase 1. "This cater cluster collects biomedical and Covid garbage, which is separated at the collection point. Covid garbage is classified separately," according to guidelines, and vehicles that collect biomedical and Covid waste are equipped with GPS tracking systems and must collect waste on a daily basis.

Figure: 3



Transportation of Biomedical Waste

The facility operator must take the following actions before treated biomedical waste (CBWTF-Common Bio-medical Waste Treatment Facilities) leaves the facility for ultimate disposal at a **Waste disposal site:**

- Notify the operator of the garbage disposal facility in writing of the amount of waste and the estimated time of arrival.
- Notify the waste carrier in writing that every waste item in the shipment has been handled.
- The CBWTF operator may not sublet or use contract cars.
- All vehicles owned by the CBWTF operator and used solely for the collection of bio-medical waste from member health care facilities should be registered under the Motor Vehicle Act .
- For the collection of biomedical waste from member health care facilities, vehicle numbers should be registered with the appropriate SPCB/PCC.

Vehicle Standards:

- Vehicles must be appropriately designed and should have storage compartment.
- A GPS system that enables the driver to track the location of the vehicle is required for every transportation vehicle.
- Separate cabins for the driver and employees, as well as for storing the necessary color-coded bio-medical waste containers, must be provided.
- Two-wheeler registered under the Motor Vehicle Act shall be permitted for collection of bio-medical waste only from the clinics or dispensaries located in places where the lanes are narrow and not easily accessible to four-wheeler vehicles.

Such two-wheeler vehicle (s) should have a provision of a suitable fixed waste collection box marked with bio-hazard symbol, contact details, proper lid, first aid kit, emergency spill collecting process, and manifest record in compliance with BMWM Regulations

- To prevent the theft of liquids during transit, the waste cabin's base needs to be waterproof.
- It is recommended that the garbage cabin be equipped with illumination and could be planned to store waste containers in levels.
- The trash cabin needs to be built with easy-to-clean and disinfect surfaces.
- The inner surface of the waste cabin shall be made of smooth surface to minimize water retention
- 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.
- The vehicle shall be labeled with the bio-hazard symbol (as per Schedule IV of the BMWM Rules) and should display the name, address and contact telephone and mobile number of the CBWTF.

- The vehicle driver should carry always valid registration of the vehicle obtained from the concerned transport authority and also carry valid 'pollution under control certificate' issued by the authorized certificate issuing agency.
- The method of conveyance will be determined based on the area to be covered under the CBWTF. The vehicle's transportation routes must be designed to cover all of the CBWTF's member healthcare units while remaining within a reasonable travel distance.
- The CBWTF operator shall ensure that the SPCB/PCC and CPCB have access to online and real-time tracking and monitoring facilities (GPS provision) with passwords so that they can cross-check the movement of transportation vehicles at any time. Transportation should take place during off-peak traffic hours wherever possible.
- If the region to be covered is large enough, a satellite station could be built to store bio-medical waste gathered from nearby places.
- The wastes that have been stored in the satellite station will be transferred in a large vehicle to the CBWTF. The overall time taken from the formation of bio-medical waste to its treatment, including collection and transportation, must not exceed 48 hours.

INCINERATION:

Medical waste generated by hospitals, veterinary clinics, and medical research facilities is burned in CBWTF facilities. These wastes consist of both non-infectious regular housekeeping trash and infected medical wastes (yellow bagged wastes).

Working principle of Incinerator

In the incineration process, the waste is thermally decomposed in the primary chamber at a temperature of 800±50 C. The secondary chamber's high temperature (1050±50 C), intense turbulence, prolonged residence duration (at least 2 seconds), and 100% surplus air lead to the complete oxidation of the gaseous products (volatile material).

- The flame port that allows gases to move from the primary chamber to the secondary chamber is sized to provide high velocity, which results in optimal mixing of the combustion air and gases.
- Both the chambers are fitted with burners to fire support fuel for initial heating up of chambers to required temperatures as well as maintain these temperatures.
- The end product of incineration process in the form of ash residue.

Stack Height: In accordance with the criterion for monitoring "general parameters," the minimum stack height is 30 meters above the ground, and it must be equipped with the required monitoring facilities.

The Autoclave is used in CBWTF to sterilizing, which is a technique that uses high pressure and high temperature steam to remove or kill all types of microbiological organisms (fungi, bacteria, viruses, spore forms, and so on). Sterilization present on a surface, in a fluid, or in a chemical in biomedical waste, such as biological culture media. Approximately 90% of total waste generated from hospitals are easily sterilized by autoclave. Autoclave is used for especially reusable equipment or materials.

WORKING:

- Bags of collected waste are positioned in autoclave vessel under pressure and temperature for a specified time approximately 45 minutes.
- After sterilizing segregation of waste done by the segregator.
- After segregation of waste the recyclable plastic waste transfer to the recycling unit for further processing (Alliance Envirocare collaboration with Govind Enterprises).
- In Chandigarh, the recycling unit (Govind Enterprises) is in industrial phase 1.

STANDARDS FOR AUTOCLAVING OF BIO-MEDICAL WASTE

(i) a minimum autoclave residence period of 60 minutes at a temperature of 121° C and a pressure of 15 pounds per square inch (psi); or

(ii) a minimum autoclave residence duration of 45 minutes at a pressure of 31 psi and a minimum temperature of 135° C; or

(iii) minimum autoclave residence time of 30 minutes at 149° C minimum temperature and 52 psi minimum pressure.

II. CONCLUSION:

The mixing of biomedical waste is a critical issue, and healthcare waste creation has always been one of the key issues that might have negative consequences for the environment and human health. Unmanaged biomedical waste disposal poses major health risks to humans and gives rise to a variety of harmful microorganisms.

Since the COVID-19 arrived, there has been an upsurge in biomedical waste. The garbage from the COVID-19 epidemic has since increased the global amount of healthcare waste. The increased garbage has wreaked havoc on the waste management business.

The Biomedical Waste Guidelines were published by the CPCB. Because biomedical waste increased during COVID-19, the CPCB issued COVID-19 rules as well. These guidelines contain all the measures to be taken in management of COVID-19 wastes. The guidelines provide the duties of SPCBs/PCCs, Urban Local Bodies (ULBs), and CBMWTF that they have to follow in proper management of the COVID-19 wastes. Proper segregation, transportation, disinfection and treatment of the wastes are required. Treatment methods like incineration, pyrolysis etc. are used by treatment facilities that have been proven effective to reduce the amount of virus containing waste and minimize the transmission. Recycling of COVID-19 wastes are still a challenge as most of the recycling facilities has been closed due to lockdown and the wastes can contain traces of virus and there is a risk of transmission. There are still so many challenges in proper waste management of COVID-19 wastes, and

these challenges should be looked forward for a better future. Other methods should also be discovered so that if there is another pandemic occurs like this then we can have different measures for proper management of hazardous healthcare waste.

I also like some thinks that's to complement this effort, the Ministry of Health & Family welfare, Government of India is launching a National Initiative to give Awards to those public health facilities that demonstrate high level of cleanliness, hygiene and infection control.

In Chandigarh

PGI Chandigarh wins KayaKalp award. Not only this, the hospital has won the cash reward of Rs 1 crore for the maintenance of good hygiene.

The hospital offers tertiary care to the patients, who not only come from neighbouring states for treatment but also distant states like Bihar and Madhya Pradesh.

Facilities:

- Offers all the latest facilities including all specialties, super specialties and sub specialties.
- Offers educational, medical and training facilities to student
- Comparatively inexpensive

Also Government Medical College and Hospital (GMCH 32)

Government Medical College and Hospital (GMCH) is another leading medical and research institution in Chandigarh. It was established in 1991. The institute has consistently ranked among the top 25 medical institutions in the country.

It offers postgraduate courses in Dermatology, Anatomy, Paediatrics, Gynaecology, Psychiatry, Orthopaedics and more. The institute also offers wide-ranging health care facilities to all the residents of North India. The institute provides specialized round-the-clock emergency services in basic and general specialities at a very reasonable cost.

Facilities:

- Offers inexpensive medical services
- Consistently ranked among the top 25 medical institutions

- Round-the-clock emergency services

REMARKS:

As our team investigated Biomedical waste in hospitals of Chandigarh, we found that a majority of the hospitals follow to Biomedical waste guidelines as outlined in the notification. However, some hospitals do not follow to them. As far as we could tell, the majority of the hospital containers were not properly covered or labelled and there is one common problem in all the hospitals that is mixing of waste.

As per CPCB guidelines we suggest to the segregation staff of the hospitals as follows:

a) Always wear personal protective gears while handling waste.

b) Wearing head gears, eye covers (glasses), mask, apron, gloves and boots these constitute the barrier for transmission of infections.

c) Taking immunization against Hepatitis B and Tetanus are important universal precautions.

In Chandigarh we observed all the hospitals were follow the biomedical waste guidelines regards:

TREATMENT AND DISPOSAL:

If a CBMWTF is located within 75 km, no healthcare establishment may set up on-site BMW treatment facilities.

SEGREGATION, PACKING, STORAGE AND TRANSPORT:

1. Four groups have been established for biomedical waste, according to the available treatments.
2. Biomedical waste that has not been processed cannot be combined with other waste.
3. Waste materials related to biotechnology, animals, humans, or other processes that involve discoloration or contamination cannot be kept in storage for longer than 48 hours.
4. If storage is needed for more than 48 hours, the occupier must make sure it doesn't harm people's health and notify the SPCC of the situation.

All the hospitals follow the guidelines of CPCB that is, the role played by hospital management in providing workers with regular training sessions that inform them of new policies. Additionally, at the time of induction and then once a year after that, all of its healthcare staff and other participants in the treatment of biomedical waste must receive training, and records of this must be kept.

Overall, all the hospitals were following the biomedical waste guidelines as per given by CPCB.

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