Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

Review on Bio-Medical Waste Management

Mr. Sahil Sanjeev Salvi[1], Shubhangi Waghmare[2], Vikas Thombare[3], Sagar Mandlik[4],
Saurabh Veer[5] , Prajwal Walke[6], Prathamesh Zambare[7]
Assistant Professor[1], Student[234567]
Department of Civil Engineering,
Pimpri Chinchwad Collage of Engineering and Research, Pune, India

***Abstract*—This review study aims at discussing the between COVID-19 and biomedical waste management. The ongoing COVID-19 pandemic has already turned healthy places around the world into a living hell with massive death tolls because of its fastest-spreading nature, and continuously leading to lockdowns in almost every part of the world. Amid all the problems so far it created, one significant problem that can create major havoc in this already devastating and contagious atmosphere in a densely populated city is, not handling medical waste properly. It was a systemic review study regarding the relationship between COVID-19 and biomedical waste management. We have gathered total 16 articles and newsletters related to COVID-19 and biomedical waste management using different search portal. After proper literature review only 10 articles and newsletters which were related to this study were taken for this systemic review purpose. If the massive number of medical wastages cannot be managed through maintaining proper and adequate guidelines, chances of community-based spreading of COVID-19 can exceed the limit and take more lives in the upcoming days. In simple term the preferred technique for the bio medical waste management is incineration. It is Adequate for all infectious waste, most chemical waste, and pharmaceutical waste.**

Keywords—Bio-medical waste management , pandamic covid - 19

I. INTRODUCTION

Many waste are produced as a result of human activities. Such waste may be dangerous and therefore need safe disposal. Industrial waste, sewage and agricultural waste pollute water, soil and air and it can also be dangerous to human beings and environment. Solid waste can be classified into different types depending on their source [1]. It includes (a) House hold waste (b) Industrial waste (c) Biomedical waste or hospital waste or infectious waste. Hospital waste is considered as hazardous because they contain toxic substances. This waste is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities in these fields. Liquid waste can be divided into two components (a) Liquid reagents/ chemicals discarded and (b) the cleaning and washing water channel ed into the drain [2]. Until recently, medical waste management was not generally considered an issue. In the 1980s and 1990s, concerns about exposure to human immunodeficiency virus (HIV) and hepatitis B virus (HBV) led to questions about potential risks inherent in medical waste. Thus, hospital waste generation has become a prime concern due to its multidimensional ramifications as a risk factor to the health of patients, hospital staff and extending beyond the boundaries of the medical establishment to the general population [3]. Hospital waste refers to all waste, biologic or non-biologic that is discarded and not intended for further use. Medical waste is a subset of hospital waste; it refers to the material generated as a result of diagnosis, treatment or immunization of patients and associated biomedical research. Biomedical waste (BMW) is generated in hospitals, research institutions, health care teaching institutes, clinics, laboratories, blood banks, animal houses and veterinary institutes Biomedical waste, also known as infectious waste or medical waste is defined as waste generated during the diagnosis, testing,
treatment, research or production of biological products for humans or animals. Biomedical
waste includes syringes, live vaccines, laboratory samples, body parts, bodily fluids and waste,
sharp needles, cultures and lancets [4]

According to the Medical Waste (Management and Processing) Rules 2008, "medical wastes could not be mixed with other wastes at any stage while producing inside hospitals, while collecting from hospitals, while transporting, and would be processed separately based on classification". The ongoing COVID-19 pandemic has already turned healthy places around the world into a living hell with massive death tolls because of its fastest spreading nature, and continuously leading to lockdowns in almost every part of the world. Amid all the problems so far it created, one significant problem that can create major havoc in this already devastating and contagious atmosphere in a densely populated city is not handling medical waste properly. China's Wuhan, the first of the cities that got viciously brutalized by the pandemic, is home to 11 million people. Its hospitals produced more than 240 tons of medical waste daily during the peak of the outbreak compared with 40 tones before the epidemic occurred, according to China's Ministry of Ecology and Environment's emergency office. To fight this enormous number of medical wastages, the central government deployed 46 mobile medical waste treatments facilitates to the city of Wuhan and built a new plant with a capacity of 30 tonnes within 15 days in March. Biomedical wastes are hazardous because they host potential virus particles that can be hidden beneath human tissues, items contaminated with blood bags, needles, syringes or any other sharp object, body fluids-remaining like dressings, plaster casts, cotton swabs, beddings contaminated with blood or body fluid etc. Experts say medical wastages are not like other wastes such as the household or industrial wastages. It can infect one directly through the skin or by ingestion and inhalation with objects like inhalers or ventilating pipes. Many contagious viruses including HIV and Hepatitis (B and C) can easily be generated from such wastes and can harm the ones who do not have the diseases. Germs and viruses, which are antibiotic-resistant (such as the COVID-19 at this point) can easily spread from medical waste. Biomedical wastes are

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

hazardous because they host potential virus particles that can be hidden beneath human tissues, items contaminated with blood bags, needles, syringes or any other sharp object, body fluids-remaining like dressings, plaster casts, and cotton swabs, beddings contaminated with blood or body fluid etc.1. The safe management of household waste is also likely to be critical during the COVID-19 emergency. Medical waste such as contaminated masks, gloves, used or expired medicines, and other items can easily become mixed with domestic garbage, but should be treated as hazardous waste and disposed of separately. These should be separately stored from other household waste streams and collected by specialist municipality or waste management operators2.

II. OBJECTIVES

A. To analyze the impact of coronavirus on the production of bio medical waste Maintaining the Integrity of the Specifications

B. To decide to use proper technique for the bio medical waste management.

III. LITERATURE REVIEW

1. COVID-19 PANDEMIC AND HEALTH CARE SOLID WASTE MANAGEMENT STRATEGY – A MINI-REVIEW [2]

Healthcare waste comprises the waste generated by healthcare facilities, medical laboratories and biomedical research facilities. Improper treatment of this waste poses serious risks of disease transmission to waste pickers, waste workers, health workers, patients, and the community in general through exposure to infectious agents. Poor management of the waste emits harmful and deleterious contaminants into society. However, contamination of highly contagious agents such as the COVID-19 virus has created enormous instability in healthcare waste handling and subsequent recycling because of the volume of the waste generated and its contagious nature. Several countries have adopted safety measures to combat this contamination and manage healthcare waste; however, these measures are insufficient and vary depending on the context of the country. In addition, the WHO has set out guidelines for management of healthcare waste. These guidelines are helping to manage the highly contagious healthcare waste resulting from the current pandemic. Proper healthcare waste management may add value by reducing the spread of the COVID-19 virus and increasing the recyclability of materials instead of sending them to landfill. Disinfecting and sorting out healthcare waste facilitates sustainable management and allows their utilization for valuable purposes. This review discusses the different healthcare solid waste management strategies practiced in different countries, the challenges faced during this management, and the possible solutions for overcoming these challenges. It also provides useful insights into healthcare solid waste management scenarios during the COVID-19 pandemic and a possible way forward.

2. Updates on biomedical waste management during COVID-19: The Indian scenario [11]

Biomedical waste poses various health and environmental hazards. Hence, it should be handled with the utmost care and disposed off safely. Several lacunas exist in the management of biomedical waste in India, and the pandemic posed by the coronavirus has made it even more challenging. The sudden outbreak of the virus led to an exponential rise in the quantity of biomedical waste. Furthermore, the poor infrastructure and lack of human resources have aggravated this situation. To combat this serious problem in a timely manner, the government has formulated various standard operating procedures and has amended the existing rules and guidelines.

3. Bacteriological Profile of Biomedical Waste: Management Guidelines [12]

Biomedical waste (BMW) is generated in hospitals, research institutions, health care teaching institutes, clinics, laboratories, blood banks, animal houses and veterinary institutes. Hospital waste management has been brought into focus in India recently, particularly with the notification of the BMW (Management and Handling) Rules, 1998. This study was conducted in Sharda hospital, Greater Noida with the aim to find out bacteriological profile of BMW with study of practices being followed in management and disposal of this waste with standard procedure. Total 500 cases of biomedical waste samples were taken in the study for bacterial culture, 136 samples of biomedical waste showed growth of bacteria. Pseudomonas species was the predominant bacteria isolated from these cultures. This study also suggests about the optimum practice which is to be followed in management of biomedical waste.

4. Medical waste management during COVID-19 pandemic, a review study [4.]

Medical waste management problems are rising due to the crisis brought upon by the coronavirus disease 2019 (COVID-19) as a worldwide pandemic. The security management of medical care worldwide increases their attention due to the high risk of COVID-19 medical waste. This paper gives a review of medical waste management during the COVID-19 pandemic around the world. Furthermore, an effort has been made to prepare a review of the characteristics, generation, collection, transportation, disposal, and treatment technologies of solid waste management worldwide. Detailed data on medical waste management practices, including collection, recovery, and disposal, have been presented. The poor medical waste management in Iraq before and during COVID-19 causes a huge environmental risk and can be a possible reappearing infection source. Hence, the study also points out some recommendations for handling COVID-19 pandemic medical waste properly to reduce possible secondary effects on health and the environment and manage any possible pandemics in the future.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

5. Assessment of bio-medical waste before and during the emergency of novel Coronavirus disease pandemic in India: A gap analysis [5]

Considering the widespread transmission of Coronavirus disease (COVID-19) globally, India is also facing the same crisis. As India already has inadequate waste treatment facilities, and the sudden outbreak of the COVID-19 virus has led to significant growth of Bio-medical waste (BMW), consequently safe disposal of a large quantity of waste has become a more serious concern.

This study provides a comprehensive assessment of BMW of India before and during the COVID-19 pandemic. Additionally, this article highlights the gaps in the implementation of BMW rules in India. This study uses various government and non-government organizations, reports and data specifically from the Central Pollution Control Board (CPCB). The finding of the study demonstrated that most of the States/Union Territories (UTs) of India are lacking in terms of COVID-19 waste management. India has generated over 32,996mt of COVID-19 waste between June and December 2020. During this period, Maharashtra (789.99mt/month) is highest average generator of COVID-19 waste, followed by Kerala (459.86mt/month), Gujarat (434.87mt/month), Tamil Nadu (427.23mt/month), Uttar Pradesh (371.39mt/month), Delhi (358.83mt/month) and West Bengal (303.15mt/month), and others respectively. We draw attention to the fact that many gaps were identified with compliance of BMW management rules. For example, out of all 35 States/UTs, health care facilitates (HCFs), only eight states received authorization as per BMW management rules. Moreover, the government strictly restricted the practice of deep burials; however, 23 States/UTs are still using the deep burial methods for BMW disposal. The present research suggests that those States/UTs generated on an average of 100mt/month COVID-19 waste in the last 7months (June–December 2020) should be considered as a high priority state. These states need special attention to implement BMW rules and should upgrade their BMW treatment capacity

6. Knowledge and awareness regarding biomedical waste management in dental teaching institutions in India- A systematic review [1]

Objectives: Proper handling, treatment and disposal of biomedical wastes are important elements in any health care setting. Not much attention has been paid to the management of Biomedical Waste (BMW) in recent years, in dental colleges and hospitals in India. The present systematic review was conducted to assess knowledge and awareness regarding BMW management among staff and students of dental teaching institutions in India.

Material and Methods: A systematic review of relevant cross-sectional studies was conducted regarding BMW management in India in dental teaching institutions in India. Six studies were finally included in the present review after conducting both electronic and manual search like PubMed, EMBASE etc. and after making necessary exclusions. Potential biases were addressed and relevant data was extracted by the concerned investigators.

Results: Six studies were finally included in the review. Color coding of wastes was not done by 67% of the subjects in one of the studies conducted in Haryana. Almost all the subjects agreed to the fact that exposure to hazardous health care waste can result in disease or infection in another study. According to another study reports, none of the respondents was able to list the legislative act regarding BMW when asked.

Conclusions: The results of the present review showed that knowledge and awareness level of subjects was inadequate and there is considerable variation in practice and management regarding BMW. There is a great need for continuing education and training programmers to be conducted in dental teaching institutions in India.

7. A Study: Biomedical Waste Management in India [7]

The amount of biomedical waste generated per day is increasing day by day with increase in the healthcare facilities. This paper presents an analysis study of various techniques used for biomedical waste management along with the knowledge and attitude of people and healthcare workers. Along with this the scenario of biomedical waste management in various hospitals in India is discussed. This waste is sometimes very hazardous and can lead to dreadful effects. So, the waste is needed to be treated using adequate treatment method

8. Effect of COVID-19 pandemic on medical waste management: a case study [8]

Covid-19 Pandemic leads to medical services for the society all over the world. The Covid-19 pandemic influence the waste management and especially medical waste management. In this study, the effect of the Covid-19 outbreak on medical waste was evaluated via assessing the solid waste generation, composition, and management status in five hospitals in Iran. The results indicated that the epidemic Covid-19 leads to increased waste generation on average 102.2 % in both private and public hospitals. In addition, the ratio of infectious waste in the studied hospitals increased by an average of 9 % in medical waste composition and 121 % compared with before COVID-19 pandemic. Changes in plans and management measurement such as increasing the frequency of waste collection per week leads to lower the risk of infection transmission from medical waste in the studied hospitals. The results obtained from the present research clearly show the changes in medical waste generation and waste composition within pandemic Covid-19. In addition, established new ward, Covid-19 ward with high-infected waste led to new challenges which should be managed properly by change in routine activities.

9. Covid-19 pandemic and healthcare solid waste management strategy [10]

To discusses the different healthcare solid waste management strategies practiced in different countries, the challenges faced during this management, and the possible solutions for overcoming these challenges.

Several countries have adopted safety measures to combat this contamination and manage healthcare waste; however, these measures are insufficient and vary depending on the

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

context of the country. In addition, the WHO has set out guidelines for management of healthcare waste. These guidelines are helping to manage the highly contagious healthcare waste resulting from the current pandemic provides useful insights into healthcare solid waste management scenarios during the COVID-19 pandemic and a possible way forward

10. Existing problems of BMW and crisis during COVID-19 pandemic [6]

The most populous cities like Delhi, Mumbai, Bangalore, Chennai, Hyderabad, etc. are the most affected cities by COVID-19. According to data published by NDTV on September 18, 2020, the country is generating a considerable amount (Above 100 tones/day) of COVID-19 related biomedical waste in the country. Maharashtra contributes for approximately 17% of total COVID-19 related BMW. Now the national daily waste generation is reaching around 850 tones/day.10,11 The details on the monthly generation of COVID-19 related BMW across several state of India (From June 2020–December 2020) is referenced in Table 1. The country does not have sufficient infrastructure and human resources to handle this huge amount of BMW. The presence of 198 CBMWFs and 225 captive incinerators was insufficient to dispose off 700 tonnes of waste generated in a day. This additional BMW stirred up havoc in the disposal of BMW. The workers involved in BMW management are pitching in extra hours to cater to this need.11 According to the Supreme Court report, there is an increment in the quantity of BMW ranging from 25 to 349tonnes/day during the month of May–July and it is expected to have doubled during the months of August–October. Presently, there is a poor practice of segregation at the site of generation due to the exponential rise in the generation, thus elevating the risk to the environment. Additionally, inadequate safety measures for the BMW workers continue to remain another major challenge in the Indian

Details on the generation of COVID-19 related BMW in Indian States/UTs from June 2020 to December 2020.

S. No.	States/UTs	Generated BMW (In tons)							Total Number of CBMWFs (Till December 2020)
		June 2020	July 2020	August 2020	September 2020	October 2020	November 2020	December 2020	
1	Andaman & Nicobar[a]	0.42	INP	INP	0.42	0.434	0.42	0.43	0[a]
2	Andhra Pradesh[a]	165.48	182.81	118.82	112.35	116.095	317.91	328.51	11
3	Arunachal Pradesh[a]	3.36	3.36	3.80	3.36	3.472	3.36	3.47	0
4	Assam	28.38	20.68	12.57	62.61	51.739	50.07	23.41	1
5	Bihar	6.84	20.76	41.54	45.36	44.64	28.08	23.31	4
6	Chandigarh[a]	29.85	5.65	55.34	43.02	73.191	70.83	73.19	1
7	Chhattisgarh[a]	11.19	INP	13.39	9.3	9.61	9.3	9.61	4
8	Daman & Diu	0	INP	0.00	0.48	2.387	1.08	1.15	1[b]
9	Delhi	333.42	389.58	296.14	382.5	365.893	385.47	321.32	2
10	Goa[a]	0.81	0.81	INP	15	7.75	5.43	5.39	0[a]
11	Gujarat	350.79	306.14	360.04	622.89	545.879	423.51	479.57	20
12	Haryana	75.33	184.18	210.69	278.31	238.452	239.4	209.93	11
13	Himachal Pradesh	3.81	12.50	4.94	25.2	28.117	30.03	48.24	2
14	Jammu & Kashmir	10.71	9.77	51.77	57.39	59.303	44.82	35.12	2
15	Jharkhand[a]	INP	INP	2.59	4.8	4.96	4.8	11.63	4
16	Karnataka[a]	84	540.28	588.03	168	218.023	210.99	218.02	26
17	Kerala	141.3	293.32	588.05	494.1	641.979	600.39	542.47	1
18	Lakshadweep[a]	0.3	INP	INP	0.3	0.31	0.3	0.31	0[a]
19	Madhya Pradesh	224.58	56.40	106.59	339	308.419	208.65	249.49	13
20	Maharashtra	524.82	1180	1359	524.82	542.314	609	629.30	29
21	Manipur	5.13	0.20	2.09	5.13	5.301	5.13	9.27	1
22	Meghalaya	5.1	1.74	6.34	9.9	12.028	7.65	8.56	2
23	Mizoram[a]	4.2	INP	INP	4.2	3.224	3012	3.22	0[a]
24	Nagaland[a]	3.6	3.4	3.10	2.85	3.317	1.86	2.29	0
25	Odisha	31.86	106.63	109.19	134.01	183.458	222.66	125.58	5
26	Puducherry	18.63	35.82	41.54	63	58.652	28.74	17.11	1
27	Punjab	48	35.59	21.19	234.42	149.606	96.51	86.99	5
28	Rajasthan	177	7.15	50.43	145.08	171.554	141.93	105.93	8
29	Sikkim	6	0.20	0.30	6	4.216	3.69	2.45	0
30	Tamil Nadu	312.3	401.29	481.10	543.78	524.179	300.75	251.22	8
31	Telangana	12.3	10.50	24.04	188.82	144.801	103.89	68.82	11
32	Tripura[a]	0.45	INP	INP	0.45	0.465	0.45	0.47	0[a]
33	Uttarakhand	0.45	0.82	41.45	21.72	108.996	56.76	76.26	2
34	Uttar Pradesh	210	307.54	408.86	507.15	478.082	316.71	276.46	18
35	West Bengal	195	136.37	235.12	434.76	486.793	330.84	279.06	6
Total		3025.41	4253.46	5238.45	5490	5597	4864.53	4527.55	198

Total waste generated from June–December 2020 = 28,747.91tonnes

IV. METHODOLOGY

Generally, the waste generated from healthcare facilities, research centers, and laboratories relating to medical procedures is considered healthcare waste. Approximately 75–90% of healthcare solid waste is similar to waste produced in households, and is thus categorized as 'non-hazardous' or 'general healthcare' waste. In reality, this waste is generated from the administrative, kitchen, and housekeeping functions of medical and healthcare facilities. The remaining 10–25% of waste is designated 'hazardous waste', which poses serious environmental and health risks (Yves charter et al., 2014). It has been observed that the composition of healthcare solid waste during the COVID-19 pandemic is more or less similar to that produced in normal circumstances, except for the generation of a huge quantity of plastics/ micro-plastics. However, the pandemic has seen the generation of a vastly increased quantity of waste (Singh et al., 2020a). As observed during normal circumstances, the composition of healthcare solid waste is very important, as this dictates its ability to be recycled and sustainably managed, which is vital during the current pandemic

Hazardous healthcare waste

1. Chemical waste

Chemicals are omnipresent in healthcare facilities. As major consumers of chemicals, the chemical waste these facilities generate can have deleterious impacts on health and the environment. This type of waste accounts for about 3% of waste originating from healthcare activities (Ilyas et al., 2020). Waste that contains chemical substances, i.e. laboratory reagents, film developing reagents, expired/unused disinfectants, solvents, and waste containing heavy metals (batteries, broken thermometers, blood-pressure gauges, etc.) is considered chemical
healthcare waste (Yves charter et al., 2014). Due to serious health concerns, a growing number of hospitals have substituted some of their most hazardous substances with safer alternatives and adopted careful management strategies. However, there are plenty of facilities in both
developing and developed countries that still use these toxic chemicals and have poor chemical waste management strategies.

2. Infectious waste

Waste that contains infective pathogens, resulting in disease incidence and progression, is defined as infectious healthcare waste; it comprises materials contaminated with blood and body fluids, human excreta, laboratory cultures, and microbiological products (Askari net al., 2010; Yves charter et al., 2014). PPE, i.e., boots, long-sleeved gowns, heavy-duty gloves, masks, goggles, and face shields are also considered infectious waste, and waste generated from these materials has increased by a substantial amount during the COVID-19 pandemic
(WHO, 2020b). Therefore, there is a tremendous challenge in managing this type of waste during the pandemic (Rowan and Laffey, 2021).

3. Pathological waste

Pathological waste is typically a smaller portion, part, or slice of any tissue, organ, or body part, taken from surgical or microbiological specimens from animal or human bodies

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

(Yves charter et al., 2014). This type of waste originates from tissues or samples of tissues that are
inspected and/or examined in a laboratory to diagnose or study abnormality or diseased tissues. In essence, this type of waste is similar to infectious waste, and careful handling is required to manage it during the current pandemic. It can spread infection in a similar fashion to infectious waste because of the presence of infective viral particles in the tissue samples (WHO, 2020b)

4. Radioactive waste

Radioactive waste is a by-product of various nuclear technologies used in healthcare facilities, including nuclear medicine, radiotherapy, and reagents for research. This waste contains radioactive substances, i.e., unused liquids from radiotherapy or laboratory research. Radioactive contaminated glassware, packages/absorbent paper, urine, and excreta from patients treated or tested with unsealed radionuclides also constitute radioactive waste (Yves Chertier et al., 2014). Exposure to radioactive elements can cause serious health problems and also poses a risk to the environment if not managed properly. The outbreak of the COVID-19 pandemic has compromised the containment of radioactive waste, and special measures need to be put in place to manage this toxic waste so that its exposure to humans and the environment can be minimized.

5. Sharps waste

Sharps waste is another type of healthcare solid waste; it is composed of used 'sharps' including used or unused hypodermic, intravenous, or other needles, auto-disable syringes, syringes with attached needles, infusion sets, scalpels, pipettes, knives, blades, and broken glasses (Askari an et al., 2010; Halogenide et al., 2018; Mato and Cassena, 1997; Yves Chertier et al., 2014). Generated sharps healthcare waste should be treated with extra care and properly managed during the COVID-19 pandemic (WHO, 2020b), as it has been found that SARS-CoV-2 can survive on different surfaces for a certain period. Waste workers could be easily infected by sharps contaminated with the virus, and this could increase community transmission.

6. Pharmaceutical waste

Pharmaceutical waste can be generated from many activities and locations in healthcare facilities, i.e., pharmacies, distribution centers, and hospitals. Expired and contaminated pharmaceutical products are considered pharmaceutical waste (Yves Chertier et al., 2014). Used biological products for therapy and transdermal patches, and contaminated pharmaceuticals including vaccines, are also listed as pharmaceutical waste (Mascaro, 2020). The amount of pharmaceutical waste has increased substantially during the COVID-19 pandemic due to the increased number of hospital admissions. Waste workers who collect this type of waste from pharmacies, distribution centers, and hospitals can easily be infected with SARS-CoV-2 if they come into contact with COVID-19 patients and virally contaminated pharmaceutical waste during its collection from designated treatment units.

Non-hazardous healthcare waste

Used plastic water bottles, office paper, magazines, newspapers, food waste, and food packaging are considered non-hazardous healthcare solid waste (Askari an et al., 2010; Halogenide et al., 2018) if not contained alongside hazardous waste. Non-hazardous waste is comparable to domestic waste and can be recycled for sustainable waste management. It is probable that both asymptomatic and symptomatic COVID-19 patents generate a huge amount of non-hazardous SARS-CoV-2 contaminated healthcare waste during their daily actions in healthcare facilities, which poses a serious risk of community transmission.

Other waste

The test kits and waste generated from different diagnostic methods for COVID-19 are another additional type of healthcare waste that has been generated in substantial amounts during the COVID-19 outbreak, as global transmission and prevalence have necessitated the detection of infections to aid with appropriate social distancing and quarantine measures. The use of rapid test kits for identifying an infected person produces additional waste in the waste stream, as each kit is used only once. There is always a chance that this waste could be contaminated with SARS-CoV-2 and contribute to further spread if not managed properly

Treatment and disposal techniques for biomedical waste

There are several methods that have been successful in the treatment of infectious waste. The following are the methods that will show the treatment that may be available at your facility. The methods are: Autoclaving, Incineration, Thermal inactivation, Gas/Vapor Sterilization, Chemical Disinfection etc.

1. Autoclave

Autoclaves are closed chambers that apply both heat and pressure, and sometimes steam, over a period of time to sterilize medical equipment. Autoclaves have been used for nearly century to sterilize medical instruments for reuse. Autoclaves are used to destroy microorganisms that may be present in medical waste before disposal in a traditional landfill. Autoclaves can be used to process up to 90% of medical waste, and are easily scaled to meet the needs of any medical organization [15]. Small counter-top autoclaves are often used for sterilizing reusable medical instruments while large autoclaves are used to treat large volumes of medical waste. Steam sterilization is most effective with low-density material such as plastics, metal pans, bottles, and flasks [16]. High-density polyethylene and polypropylene plastic should not be used in this process because they do not facilitate steam penetration to the waste load. Plastic bags should be placed in a rigid container before steam treatment to prevent spillage and drain clogging. Bags should be opened and caps and stoppers should be loosened immediately before they are place in the steam sterilizer. Care should be taken to separate infectious wastes from other hazardous wastes. Infectious waste that contains noninfectious hazards should not be steam-sterilized [17]. Waste that contains anti neoplastic drugs, toxic chemicals, or chemicals that would be volatilized by steam should not be steam-sterilized.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

2. Incineration

This is proved in which there is increase temperature causes dry oxidation. To reduce organic & combustible waste to inorganic incombustible to reduce volume & weight that cannot be reviled, reused or disposed in outer land fields [18]. The drawbacks to incineration include the large capital and operating costs for modern technologies. The advantage of incineration is no Pretreatment is required and suitable for low heating volume above 2000 Kcal/Kg for single chamber & 3500 Kcal/Kg for double-chamber. The waste should be less moisture as less than 30% and also combustible [19]

3.Thermal inactivation

Thermal inactivation involves the treatment of waste with high temperatures to eliminate infectious agents. This method is usually used for large volumes [20]. Liquid waste is collected in vessel and heated by heat exchangers or a steam jacket surround the vessel. The types of pathogens in the waste determine the temperature and duration of treatment. After treatment, the contents can be discharged into the sanitary sewer in a manner that complies with State, Federal, and local requirements. This method requires higher temperatures and longer treatment cycles than steam treatment.

4.Gas/vapor sterilization

Gas/vapor sterilization uses gaseous or vaporized chemicals as the sterilizing agents. Ethylene oxide is the most commonly used agent, but should be used with caution since it is a suspected human carcinogen. Because ethylene oxide may be adsorbed on the surface of treated materials, the potential exists for worker exposure when sterilized materials are handled [20].

5. Chemical disinfection

Chemical disinfection is the preferred treatment for liquid infectious wastes. Consider the following: Type of microorganism, Degree of contamination, Amount of proteinaceous material present, Type of disinfectant, Contact time, Other relevant factors such as temperature, pH, mixing requirements, and the biology of the microorganism [20]**.** Ultimate disposal of chemically treated waste should be in accordance with State and local requirements

Disposal of treated waste:

Infectious waste that has been effectively treated is no longer biologically hazardous and may be mixed with the disposed of as ordinary solid waste, provided the waste does not pose other hazards that are subject to federal or state regulations.

EPA recommends:

· Contacting state and local governments to identify approved disposal options.

· Discharge of treated liquids and pathological wastes (after grinding) to the sanitary sewer system.

· Approval of the local sewer authority must be obtained.

Health hazard from biomedical waste

The improper management of bio-medical waste causes serious environmental problems in terms of air, water and land pollution. The nature of pollutants can be classified into biological, chemical and radioactive. Environment problems can arise due to the mere generation of bio-medical waste and from the process of handling, treatment and disposal [9]

Air Pollution can be caused in both indoors and outdoors. Bio-Medical Waste that generates air pollution is of three types - Biological, Chemical and Radioactive. Indoor air pollutants like pathogens present in the waste can enter and remain in the air in an institution for a long period in the form of spores or as pathogens itself. Chemical Pollutants that cause outdoor air pollution have two major sources- open burning and incinerators [21]. Open burning of biomedical waste is the most harmful practice and should be strictly avoided

Water Pollution is another major threat from Bio-medical waste. If the waste is dumped in low-lying areas, or into lakes and water bodies, can cause severe water pollution. Water pollution can either be caused due to biological, chemicals or radioactive substances [22]. The pathogens present in the waste can leach out and contaminate the ground water or surface water. Harmful chemicals present in bio-medical waste such as heavy metals can also cause water pollution.

Land Pollution is caused by the final disposal of all bio-medical waste. Even liquid effluent after treatment is spread on land. Hence, pollution caused to land is inevitable. Open dumping of bio-medical waste is the greatest cause for land pollution [22]

Challenges of biomedical waste in India

(Bio-medical Waste (Management and Handling) Rules. Ministry of
Environment and Forests Notification, New Delhi. 1998)

· To treat 420561 kg per day of bio medical waste in accordance with Bio-Medical Waste Rules.

· Number of Common Bio Medical Wastes Treatment Facility (CBMWTF) to be increased manifold. Presently there are 157 facilities which are not adequate to handle all the bio medical wastes generated

· CBMWTF is to be set up under public private partnership mode.

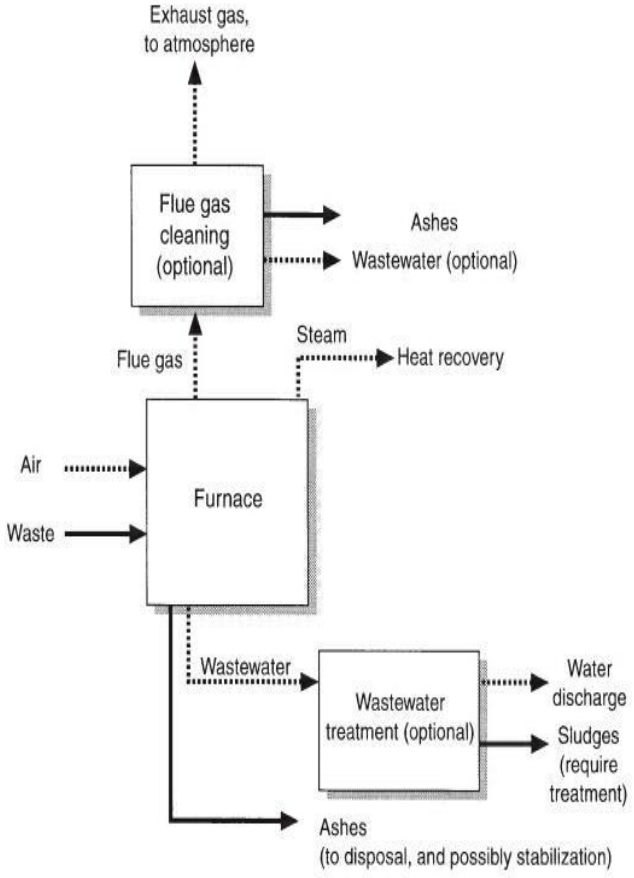
· New technologies to be promoted for destruction of toxic bio medical wastes.

Which treatment is preferable?

Incineration is a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a very significant reduction of waste volume and weight. This process is usually selected to treat wastes that cannot be recycled, reused, or disposed of in a landfill site. The process flow is illustrated schematically in. The combustion of organic compounds produces mainly gaseous emissions, including steam, carbon dioxide, nitrogen oxides, and certain toxic substances (e.g. metals, halogenic acids), and particulate matter, plus solid residues in the form of ashes. If the conditions of combustion are not properly controlled, toxic carbon monoxide will also be produced. The ash and wastewater produced by the process also contain toxic compounds, which have to be treated to avoid adverse effects on health and the environment. Most large, modern incinerators include energy-recovery facilities. In cold

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

climates, steam and/or hot water from incinerators can be used to feed urban district-heating systems, and in warmer climates the steam from incinerators is used to generate electricity. The heat recovered from small hospital incinerators is used for preheating of waste to be burnt.



BWM Relevance To Civil Engineering

Bio medical waste in itself is a huge problem. As developing countries are making transition into developed countries, need for healthcare is increasing and due to such economic advancements, BMW waste generation is also increasing at rapid pace.

In India BMW is a huge problem. There is lack of awareness and absence of stringent rules and regulations l, it is sometimes found that hospitals are dumping waste into ground or river which is very dangerous because it contains hazardous and infected substance like blood, skin, imputed organs, syringe, needles, etc.

As an aware citizen and a civil engineer, it is our responsibility to find efficient ways to properly treat BMW.

As a civil engineer we need to work towards making structures so that BMW is properly treated so that the damage footprint is least on river or land. Our job is to make product reusable by transforming it into usable product.

BMW is directly related to waste management which is indeed related environmental engineering as this target's environmental safety.

Objective of environmental engineering is to ensure societal development and use of land, water and air resources are sustainable. These targets are achieved by managing these resources so that environmental pollution and degradation is minimized.

CONCLUSION

The ongoing COVID-19 pandemic has already turned healthy places around the world into a living hell with massive death tolls because of its fastest-spreading nature, and continuously leading to lockdowns in almost every part of the world. Amid all the problems so far it created, one significant problem that can create major havoc in this already devastating and contagious atmosphere in a densely populated city is, not handling medical waste properly.

If the massive amount of medical wastages cannot be managed through maintaining proper and adequate guidelines, chances of community-based spreading of COVID-19 can exceed the limit and take more lives in the upcoming days In simple term the preferrable technique for the bio medical waste management is incineration. It is Adequate for all infectious waste, most chemical waste, and pharmaceutical waste and also very high disinfection efficiency.

REFERENCES

[1] Daljit Kapoor , Ashutosh Nirola , Vinod Kapoor , Ramandeep-Singh Gambhir 4 Journal of Environmental Health Science and Engineering (2021) 19:831–836 https://doi.org/10.1007/s40201-021-00650-9

[2] Dr Irin Hossain*1, Dr Ashekur Rahman Mullick2, Dr Shazly Bari3,Mohammad Tahsin Islam4 Dr Irin Hossain et al JMSCR Volume 08 Issue 05 May 2020

[3] Kerkar, S. S., and S. S. Salvi. "Application of eco-enzyme for domestic waste water treatment." International Journal for Research in Engineering Application and Management 5.11 (2020): 114-116.

[4] Lee B K, Ellenbecker M J and Moure-Ersaso R 2004 Alternatives for treatment and disposal cost reduction of regulated medical wastes, *Waste management* **24**(2):143-51.

[5] Michael Ugom, 2020 Managing Medical Wastes During the Covid-19 Pandemic in Nigeria,

[6] Prüess A, Giroult E, Rushbrook P 1999 Safer management of wastes from Medical care Activities.World Health Organization, Geneva.

[7] Ritchie H, Ortiz-Ospina E, Beltekian D, Mathieu E, Hasell J, Bobbie Macdonald B,Charliem Giattino C and Roser M 2020 Coronavirus (COVID-19) deaths. https://ourworldindata.org/covid-deaths

[8] Rutala WA, Weber DJ. Disinfection, sterilization and control of hospital waste. In: Mandell, Douglas and Bennett's Principles andpractice of infectious diseases 2005; (6th Ed.). Elsevier Churchill Livingstone Publication. Pg: 3331-47.

[9] Salvi, Sahil & Mantute, Komal & Sabale, Rutuja & Lande, Siddhi & Kadlag, Akash & Professor, Assistant. (2021). A STUDY OF WASTE PLASTIC USED IN PAVING BLOCK. 2320-2882.

[10] Sharma M. Hospital waste management and its monitoring, 2002; (1st Ed.), Jaypee Brothers Medical Publication.

[11] Tudor T L, Noonan C L and Jenkin L E 2005 Medical care waste management: a case study from the National Health Service in Cornwall, United Kingdom, *Waste management* **25**(6): 606-15.

[12] Vichal Rastogi, Pooja Rastogi, Shalini Bhatia. J Indian Acad Forensic Med. April-June 2011/ Vol. 33/ No. 2 ISSN 0971-0973

[13] V. N. Kalpana, D. Sathya Prabhu, S. Vinodhini and Devirajeswari V. Journal of Chemical and Pharmaceutical Research, 2016, 8(4):670-676 Review Article ISSN 0975-7384 CODEN(USA)