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Biomedical Waste Management Using Incineration and Autoclave

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Abstract: ***Sanitarium wastes pose significant public health hazard if not duly managed. Hence, it's necessary to develop and borrow optimal waste management systems in the hospitals. Bio-medical waste (BMW) generated in our nation on a day-to-day base is immense and contains contagious and dangerous accoutrements. With the rise in COVID-19 cases, there are concerns about the disposal of huge amounts of biomedical waste. Tamil Nadu generated 35269.74 kg/per day of COVID-19 'bio-medical waste' between 2020 to 2021. This paper deals on managing the Bio-medical waste (BMW) using Incineration and Autoclaving.***
Keywords: Bio-medical waste (BMW), World Health Organization (WHO), Tamil Nadu Pollution Control Board (TNPCB), common bio-medical waste treatment and disposal facility (CBMWTF), Incineration, Autoclaving

I. INTRODUCTION

Bio-medical waste management is a sensitive issue around the world. Bio-medical waste are those generated from the diagnosis, treatment, or immunization of humans and animals. They are composed of two types, namely hazardous and non- hazardous waste. Mishandling these have created various environmental issues. According to WHO, 75-90% of bio-medical waste is non-hazardous, while the remaining percentage is hazardous. The bio-Medical waste consists of Human anatomical waste like tissues, organs and body parts, Animal wastes generated during research from veterinary hospitals, Microbiology and biotechnology wastes from laboratory, culture stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell culture used in research, Waste sharps like hypodermic needles, syringes, scalpels and broken glass, Discarded medicines and cytotoxic Medications that are outdated, contaminated, and discarded. Soiled waste such as cotton balls used while collecting blood or used for absorbing blood and body fluids, Solid waste such as dressing, bandages, plaster casts, material contaminated with blood, tubes and catheters Liquid waste from any of the infected areas.[1]

Categories	Waste description	Name of wastes
1	Human anatomical waste	Blood & blood products, Placenta, removed tumors and other surgically removed body parts, etc.,
2	Animal wastes	Not Found
3	Microbiology & biotechnical wastes	Culture media and plates, vaccine wastes, reagents used in microbiological laboratory studies
4	Waste sharps	Needles, syringes, scalpels, glass bits, broken ampoules
5	Discarded medicine & cytotoxic drugs	Discarded medicines, packaging material, cartons.
6	Soiled wastes	Solid cotton dressings, plaster casts, solid beddings, linen, gloves, masks.
7	Solid wastes	IV sets & tubings, catheters
8	Liquid wastes	Bleaching powder solution, Household phenyl solution.
9	Incineration ash	Incineration ash
10	Chemicals waste	Bleaching powder, DDT

Table 1. Categories of Bio Medical Waste [2]

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As per the Rules the wastes coming under ten categories shown in the Table 1 are to be placed in four different coloured containers. The waste has to be treated with techniques such as deep burial, incineration, and autoclaving. Yellow colour container is used for human anatomical waste, animal waste, bioengineering and microbiological waste, waste from laboratory, contaminated waste such as cotton, items with blood. Red coloured containers are used to dispose solid waste, infected plastic waste, and wastes generated from disposable items other than sharp items such as catheters, plastic syringes etc. Blue coloured containers are used to dispose sharp needles, scalpels which may cause cuts and puncture. Black coloured containers are used to dispose cytotoxic drugs, discarded medicine etc.

Colour Coding	Type of Container	Waste Category
Yellow	Plastic Bags	Category 1, Category 2, Category 3, Category 4
Red	Disinfected Container plastic bags	Category 3, Category 6
Blue/White	Plastic bags, Puncture proof containers	Category 4, Category 7
Black	DO	Category 5, Category 9, Category 10

Table 2. Colour code for categories of waste [3]

Covid-19 has been reported first in 2019 December at Wuhan, China that can be transmitted from one human being to another. In order to prevent the spread of the pandemic, global lockdown was implemented by WHO. While in Tamil Nadu, the lockdown was announced on 23rd March 2020 to reduce the spread of COVID-19 when the total number of positive cases rose. With alarming increase in the number of COVID-19 infections, the healthcare waste from healthcare centres such as hospitals, temporary quarantine centres, clinics and research laboratories in almost every part of the world started to increase [3]

II. METHODOLOGY

According to TNPCB, 'Bio-medical waste' generated from homes, hospitals and COVID-19 care centres, must be collected in yellow bags and they must be disposed safely either through deep burial or incineration. The civic bodies across Tamil Nadu followed the protocols evenly. The amount of healthcare waste was almost doubled during the rise of COVID-19.

The bio-medical waste generator and the operator of the CBMWTF are both responsible for the bio-medical waste's safe management and disposal. The State Department of Health will ensure that the regulation is followed in all health-care facilities. The health care facilities and the CBMWTF will receive authorization from the SPCB. It will keep track of how the regulations' various sections are being followed [4]. The TNPCB has approved 6261 private and government hospitals in the state so far. The CBMWTF has reached an agreement with all of these hospitals for the collection, transportation, treatment, and scientific disposal of biomedical waste. The CBMWTF is made of an autoclave, a shredder, an incinerator, and secure land disposal facilities. There are 11 CBMWTF's operating in Tamil Nadu.

A. Management Strategies

One of the primary difficulties is a lack of garbage treatment and disposal facilities. Human health and safety take precedence over all other concerns during pandemics. However, if proper care is not given, the pandemic trash will have serious environmental and health effects in the future. Though Tamil Nadu has responded effectively to many policy interventions based on its experience and has been fast to embrace TNPCB policy guidelines. It may take some time to determine how the additional garbage will affect the environment appropriately. [10]Furthermore, the BMW created during the epidemic might serve as a model for emergency and long-term waste management, allowing the state to build a better and healthier future. To cope with the garbage created during the worldwide pandemic, robust, feasible ways and strategies are required. Some ideas or efforts may demand immediate attention and action, while others may necessitate more time and effort in the long run. Autoclaving, Incineration is said to be effective management of biomedical waste [5].

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B. Incineration

[6]Incineration is a thermal procedure that converts medical waste into inorganic, non-combustible substance, reducing waste volume and weight significantly. Any medical waste incinerator's primary goal is to eradicate pathogens from waste and reduce it to ashes. Certain medical wastes, such as pharmaceutical or chemical wastes, require greater temperatures to be destroyed completely[7]. The majority of medical waste is burnt, which is a short-lived practise due to environmental concerns. Advantages and disadvantages of incineration are displayed in table 3. Image 1 shows Incineration rate in Tamil Nadu Districts.

Advantages	Disadvantages
decreases quantity by lowering the volume of garbage	Installation of incinerators is an expensive process.
saves on transportation as incineration plants can be near cities and towns	Incinerators produce poisonous smoke during the burning process.
Incineration can eliminate harmful germs and chemicals	Incinerators produce poisonous smoke during the burning process.
Incineration makes recycling of metals easier.	Health effects are common in areas where incinerator plants are built

Table 3. Advantages and Disadvantages of Incineration

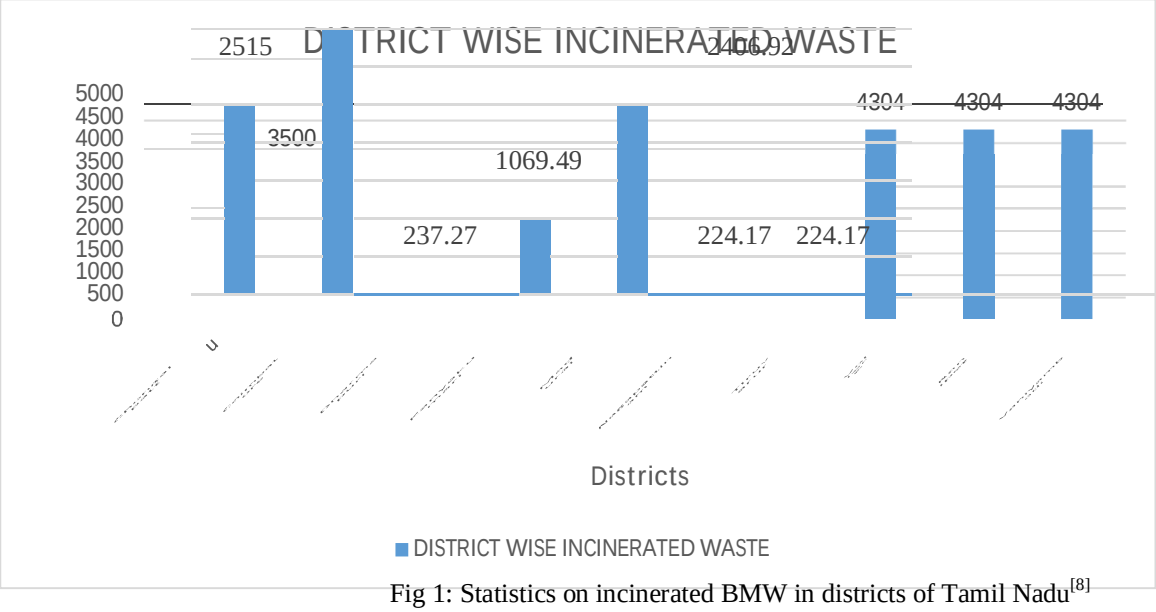


Fig 1: Statistics on incinerated BMW in districts of Tamil Nadu[8]

C. Autoclaving

Autoclaves are enclosed chambers that sanitise medical equipment by applying heat, pressure, and steam over time. Autoclaves have been used to sanitise medical devices to reuse them for over a century. Surgical knives and clamps, for example, are sterilised in autoclaves. Autoclaves can be used as heat treatment processing units to eliminate germs in medical waste before disposal in a regular landfill or further treatment [8]. Autoclaves are batch rather than continuous processes.

Autoclave is a chemical free process. Chemical-free refers to the absence of chemicals. Advantages and disadvantages of incineration are displayed in table 4. Image 2 shows Incineration rate in Tamil Nadu Districts.

Advantages	Disadvantages
Economical in cost	Moisture continues to stay on the surface
Takes short procedure time to finish a batch of waste	Carbon steel can get damaged due to moisture exposure
No additional chemicals are required to sterilize the waste	Only stainless steel instruments and plastic can bear the heat sterilized

Table 4. Advantages and Disadvantages of Autoclaving[9]

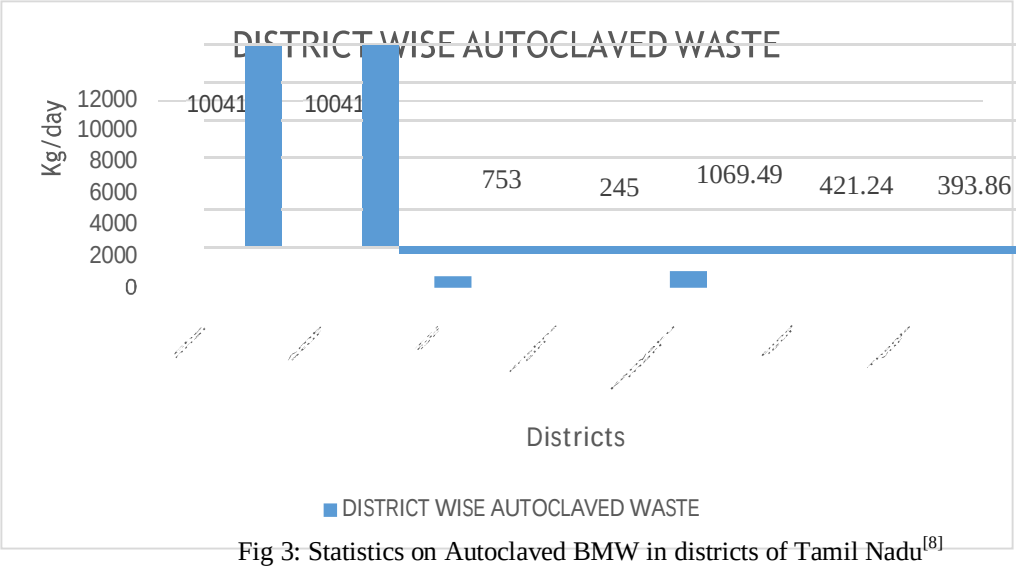


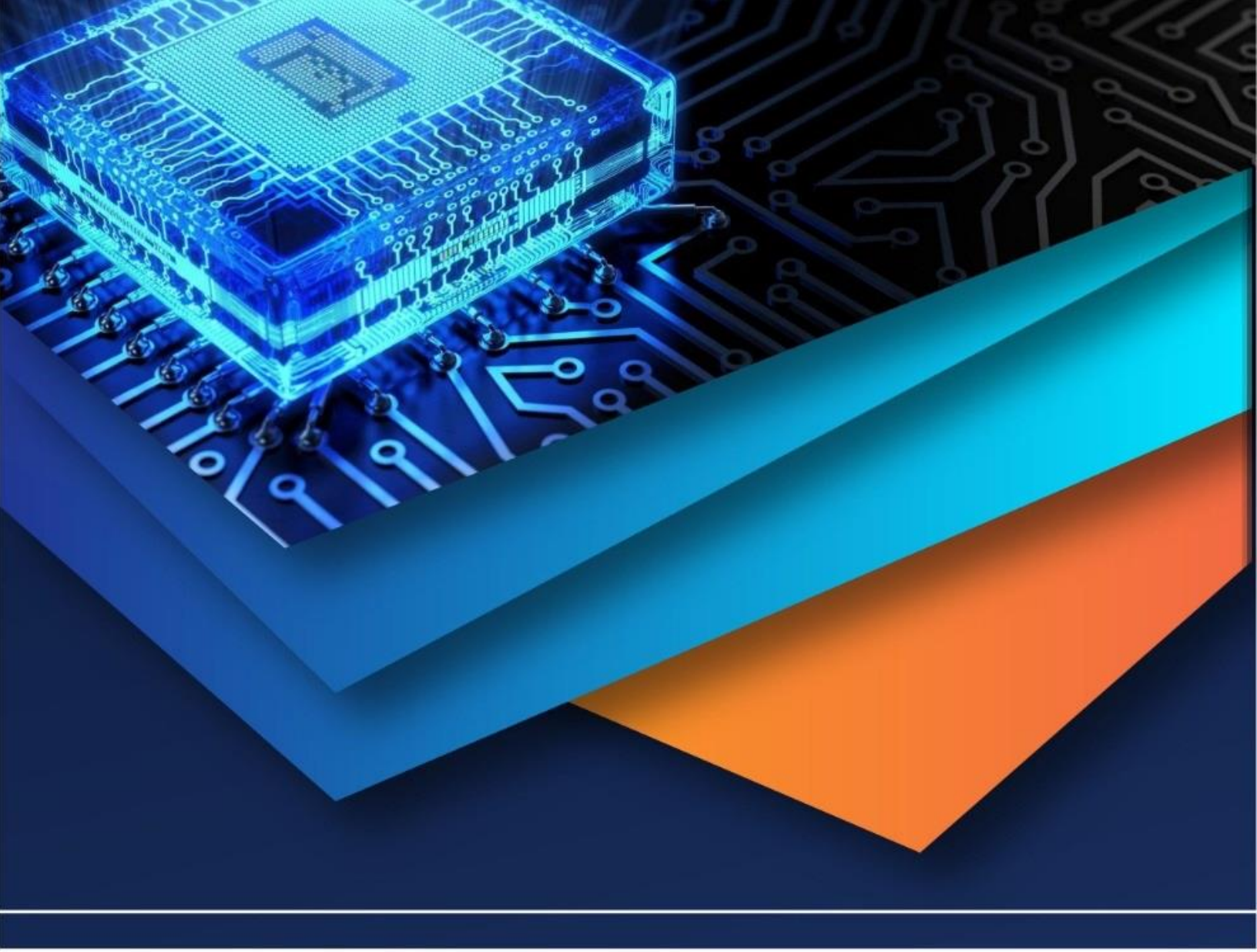
Fig 3: Statistics on Autoclaved BMW in districts of Tamil Nadu[8]

III.CONCLUSION

When comparing the two procedures of incineration and autoclave, it is possible to conclude that each has advantages and disadvantages over the other. Overall, it appears that the autoclave system is preferable to incineration due to significant environmental benefits and simpler operation.

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