Technologies in Bio-Medical Waste Management

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Abstract

Biomedical waste can be defined as any liquid or solid waste which is produced during any procedure pertaining to diagnosis, treatment and immunization which may be toxic or hazardous if not disposed off properly. Every day relatively large amount of waste is being generated through hospitals and health care centers. Injudicious disposal of these potentially hazardous wastes can lead to serious environment threat. The present review discusses the importance of biomedical waste management and the various techniques used in it.

Keywords: Bio-medical waste , health hazards, inceniration, autoclaving, microwave irradiation.

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Introduction

Bio-medical waste' means any waste generated during diagnosis, treatment or immunization of human beings or animals. Management of healthcare waste is an integral part of infection control and hygiene programs in healthcare settings. These settings are a major contributor to community-acquired infection, as they produce large amounts of biomedical waste.[1]

Biomedical waste management has recently emerged as an issue of major concern not only to hospitals, nursing home authorities but also to the environment. The bio-medical wastes generated from health care units depend upon a number of factors such as waste management methods, type of health care units, occupancy of healthcare units, specialization of healthcare units, ratio of reusable items in use, availability of infrastructure and resources etc.[2]

The management of bio-medical waste is still in its infancy all over the world. There is a lot of confusion with the problems among the generators, operators, decision-makers and the general community about the safe management of bio-medical waste. The reason may be a lack of awareness[3]

Types of Biomedical Waste

A part from these the WHO classified medical waste into 8 categories such as General Waste, Pathological, Radioactive, Chemical, Infectious to potentially infectious waste, Sharps, Pharmaceuticals, Pressurized containers Whereas, In India, Ministry of Environment and Forest, Government of India (1998) has notified Bio-medical Waste (Management & Handling) Rules -1998, which describes ten categories shown in table 1.

Category	Type
1	Human Anatomical Waste
2	Animal Waste
3	Microbiology waste & Laboratory waste
4	Waste Sharps
5	Discarded medicines
6	Solid Waste
7	Infectious Solid waste
8	Chemical Waste
9	Liquid Waste
10	Incineration ash

Processes of Biomedical Waste Management

The various processes involved in biomedical waste management includes[2]

1. Waste collection
2. Segregation
3. Transportation and storage
4. Treatment & Disposal
5. Transport to final disposal site
6. Final disposal

Waste Collection

This process involves use of different types of containers . They should be placed in such a way that 100 % collection is achieved. Sharp objects should be always kept in puncture proof containers to avoid injuries to the workers.[5]

Colour coding-biomedical waste (management and handling) rules, 1998 (schedule II)

Colour Coding	Type of Container	Waste Categories
Yellow	Plastic bags	Cat 1 human anatomical waste, Cat 2 animal waste, Cat 3 microbiology waste, Cat 6 soiled waste.
Red	Disinfected containers plastic bags	Cat 3 Microbiological Cat 6 soiled Cat 7 solid waste (Waste IV tubes catheters, etc.
Blue/White	Plastic bag/puncture proof container	Cat 4 waste sharps Cat 7 plastic disposable tubings, etc.
Black	-do-	Cat 5 discarded medicines Cat 9 incineration ash Cat 10 chemical waste

Segregation

This step involves the separation of different categories of waste generated at source. Effective segregation process prevents the mixing of medical waste with general municipal waste. It is most important step in the biomedical waste management and can alone ensure efficient waste management.[6]

Transportation and Storage

Trolleys and covered wheelbarrow are most commonly used for transporting the waste. Bags containing biomedical wastes should always be accompanied with the signed documents from the nurse or doctor .[6]

Final Disposal

Various techniques involved in the final disposal of the biomedical waste are as follows

Incineration Technology

This is a high temperature thermal process employing combustion of the waste under controlled condition for converting them into inert material and gases. Incinerators can be oil fired or electrically powered or a combination thereof. Broadly, three types of incinerators are used for hospital waste: multiple hearth type, rotary kiln and controlled air types. All the types can have primary and secondary combustion chambers to ensure optimal combustion. These are refractory lined. 7 The main function of incinerators are to reduce organic & combustible waste to inorganic incombustible to reduce volume & weight that cannot be reveled, reused or disposed in outer land fields[7]

Non-Incineration Technology

Non-incineration treatment includes four basic processes: thermal, chemical, irradiative, and biological. The majority of non-incineration technologies employ the thermal and chemical processes. The main purpose of the treatment technology is to decontaminate waste by destroying pathogens. Facilities should make certain that the technology could meet state criteria for disinfection. [8]

Autoclaving

The autoclave operates on the principle of the standard pressure cooker. The process involves using steam at high temperatures. The steam generated at high temperature penetrates waste material and kills all the micro organism These are also of three types: Gravity type,Pre-vacuum type and Retort type. In the first type (Gravity type), air is evacuated with the help of gravity alone. The system operates with temperature of 121 deg. C. and steam pressure of15 psi. for 60-90 minutes. Vacuum pumps are used to evacuate air from the Pre vacuum autoclave system so that the time cycle is reduced to 30-60 minutes. It operates at about 132 deg. C. Retort type autoclaves are designed much higher steam temperature and pressure. Autoclave treatment has been recommended for microbiology and biotechnology waste, waste sharps, soiled and solid wastes. This technology renders certain categories (mentioned in the rules) of bio-medical waste innocuous and unrecognizable so that the treated residue can be land filled.[8] Autoclaves can be used to process up to 90% of medical waste, and are easily scaled to meet the needs of any medical organization.[9]

Microwave Irradiation

The microwave is based on the principle of generation of high frequency waves. These waves cause the particles within the waste material to vibrate, generating heat. This heat generated from within kills all pathogens.[9]

Chemical Methods

Chemical disinfection is the preferred

Plasma Pyrolysis

Plasma pyrolysis is a state-of-the-art technology for safe disposal of medical waste. It is an environment-friendly technology, which converts organic waste into commercially useful byproducts. The intense heat generated by the plasma enables it to dispose all types of waste including municipal solid waste, biomedical waste and hazardous waste in a safe and reliable manner. Medical waste is pyrolysed into CO, H2, and hydrocarbons when it comes in contact with the plasma-arc. These gases are burned and produce a high temperature (around 1200oC).[9]

Conclusion

Biomedical waste is posing a serious threat to our environment. Proper handling and disposal of this waste is must and should be done with utmost care . Improper and inadequate segregation , collection or transportation of waste can lead to several problems to society therefore making it mandatory to use protective measures . Effective and careful management of biomedical waste is not just a legal necessity but also a social responsibility.

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