**A Review On Bio Medical Waste Management And Safety**

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**Abstract**

The biomedical waste produced in the course of health care activities carries a higher potential for infection and injury than any other type of waste. Inappropriate handling of biomedical waste may have serious public health consequences and a significant impact on the environment. The Medical Waste Tracking Act (MWTA), USA, of 1988 defined medical waste as any solid waste, which is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biological. In India, Ministry of Environment & Forests (MoEF) has notified Biomedical waste (Management and Handling) Rules, 1998. Healthcare Wastes in the European Waste Catalogue are principally separated on the basis of their origin, either animal or human. A relatively large number of systems which use the fundamental principles of heat, chemicals, irradiation, or combinations of these are available to treat infectious medical waste. Treatment by incineration and disposal of the resultant ash by land filling is the most widely used treatment process for managing medical waste. There is growing interest in alternative technologies for treatment of biomedical waste due to concerns of air pollution from waste incineration. Managing these wastes is a challenging task due to unpredictable variation in the load on common biomedical waste treatment facility

**Keywords:** Biomedical Waste, Waste Management, Safety, Health Care Waste, Classification, Management, Treatment, Disposal.

**Introduction**

The potential microbiological risks associated with health care waste are still unfamiliar to health workers, and the assessment requires expert advice. Public health is compromised due to lack of accountability in the handling of some hospital and veterinary wastes; specifically body fluid contaminated equipment and containers as well as microbiological materials. The most important to protect public health is a manifest system of cradle-to-grave accountability for an infectious portion of a hospital’s waste. The waste produced in the course of health-care activities carries a higher potential for infection and injury than any other type of waste. Inadequate and inappropriate handling of health-care waste may have serious public health consequences and a significant impact on the environment (Pruss et al., 1999). For proper handling of waste generated, it is equally important to predict the amount of waste generation beforehand. The main reasons for improper management of the biomedical waste are financial and technological constraints and difficulty in monitoring of scattered health care facilities. To realize a sustainable development within hospitals, it is necessary that the need to maintain a balance between effective infection control and a good ecological environment is recognized and supported by health-care workers and the hospital management (Daschner and Dettenkofer, 1997). Biomedical waste (infectious waste/ regulated medical waste) is estimated to be 15 percent or less of overall waste stream. Regulated medical waste varies considerably in composition and characteristics as shown in Table.

Table. Typical Composition and Characteristics of Infectious Waste

|  |  |
| --- | --- |
| Particulars | Percent |
| Composition: |  |
| Celluloid Material (paper & Cloth) | 50-70% |
| Plastics | 20-60% |
| Glassware | 10-20% |
| Fluids |  |
| Typical Characteristics: |  |
| Moisture | 8.5-17% by weight |
| Incombustibles | 8% by weight |
| Heating Value | 7,500 BTU/lb |

Source: HCWH, 2001.

**Classification of Biomedical Waste**

In India, MoEF, GoI (1998) has notified Bio-medical Waste (management & Handling) Rules -1998, which describes ten categories viz., Human Anatomical Waste; Animal Waste; Microbiology & Biotechnology Waste; Waste Sharps; Discarded Medicines and Cytotoxic Drugs; Solid Waste; Liquid Waste; Incineration Ash and Chemical Waste. Many regulatory definitions of regulated medical waste are based on ten broad categories defined in a 1986 EPA guide on infectious waste management. The ten categories are: Cultures and Stocks; Anatomical Wastes (or Human Pathological Wastes); Human Blood, Blood Products, and Other Bodily Fluids; Sharps; Animal Wastes; Isolation Wastes; Contaminated Medical Equipment; Surgery Wastes; Laboratory Wastes; and Dialysis Wastes (HCWH, 2001).

**Technology Options for Biomedical Waste Treatment**

The environmental regulations actually mandate the treatment of infectious medical waste on a daily basis if it is stored at room temperature. A number of treatment methods are available. The final choice of suitable treatment method is made carefully, on the basis of various factors, many of which depend on local conditions including the amount and composition of waste generated, available space, regulatory approval, public acceptance, cost, etc.

**Incineration Technology**

Incinerators designed especially for treatment of health-care waste should operate at temperatures between 900 and 1200˚C (Pruss et al., 1999). Liberti et al., (1996) reported in their second paper in a two-part series more detailed data on the physicochemical characteristics of normal (NHW) and infectious (IHW) hospital waste determined experimentally in a large sanitary district that includes four hospitals, public and private, with 164 sanitary departments, 40 analytical laboratories and 2500 rehabilitation beds, near the town of Bari (Suthern Italy). In all cases, IHW was shown to be classified Sustainable Solid Waste Management as “non-toxic” deserving 950˚C rather than 1200˚C incineration temperature according to Italian Legislation.

**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.

**Autoclaving**

Autoclaving is an efficient wet thermal disinfection process. Typically, autoclaves are used in hospitals for the sterilization of reusable medical equipment. They allow for the treatment of only limited quantities of waste and are therefore commonly used only for highly infectious waste, such as microbial cultures or sharps. Research has shown that effective inactivation of all vegetative microorganisms and most bacterial spores in a small amount of waste (about 5-8 kg) require a 60-minute cycle at 121˚C (minimum) and 1 bar (100kPa); this allows for full steam penetration of the waste material. About 99.9999% inactivation of microorganisms is achievable with autoclave sterilization (Pruss et al., 1999). Blood bank regulations and biomedical waste rules of India advocate disinfection of contaminated blood units. Incineration is not recommended due to polyvinyl chloride (PVC) content of blood bags.

**Microwave Irradiation**

Most microorganisms are destroyed by the action of microwaves of a frequency of about 2450 MHz and a wavelength of 12.24 cm. The microwaves rapidly heat the water contained within the waves and the infectious components are destroyed by heat conduction. In the USA, a routine bacteriological test using Bacillus subtilis is recommended to demonstrate a 99.99% reduction of viable spores (Pruss et al., 1999). Hoffman and Hanley (1994) assessed a clinical waste decontamination unit that used microwave-generated heat for operator safety and efficacy.

**Chemical Methods**

Chemical disinfection is most suitable for treating liquid waste such as blood, urine, stools, or hospital sewage. Several self-contained waste treatment systems, based on chemical disinfection, have been developed specifically for health care waste and are available commercially. Barek et al. (1998) have tested three chemical methods viz. oxidation with sodium hypochlorite (NaClO, 5%) hydrogen peroxide (H2O2, 30%), and Fenton reagent (FeCl2.2H2O; 0.3 g in 10 ml H2O2, 30%), for the degradation of four anticancer drugs: Amsacrine, Azathioprine, asparaginase and Thiotepa. The efficiency of the degradation was monitored by high-performance liquid chromatography. In all cases where a high degree of degradation was achieved, the residues obtained were non mutagenic.

**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 by-products. 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 Biomedical Waste Classification and Prevailing Management Strategies 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 1200˚C). The plasma pyrolysis technology has been indigenously developed at the Facilitation Centre for Industrial Plasma Technologies, Institute for Plasma Research, Gandhinagar (Nema and Ganeshprasad, 2002).

**Selection of Suitable Treatment Technology**

Certain treatment options may effectively reduce the infectious hazards of health care waste and prevent scavenging but, at the same time, give rise to other health and environmental hazards. Walker (1990) studied the current technology used to manage infectious and hazardous wastes in hospitals. Infectious waste is either incinerated or it is sterilized and landfilled (a few states permit landfilling without pretreatment). Most hospital based waste incinerators are adequate to dispose of syringe needles and body parts. Chlorinated plastics require state-of-art commercial incinerators that can remove the hydrochloric acid, dioxins, and furans from the stack gas. Chemotherapy waste is mostly gloves and gowns and if not properly sorted can represent a large volume. A potential problem is the discharge of small concentrations of formaldehyde into the sewer. Yufeng et al., (2003) reported that based on the conventional pyrolysis principle, a new apparatus has been developed for waste disposal in China. It is especially useful in China, as the waste is not sorted. The final choice of treatment system should be made carefully, on the basis of various factors, many of which depend on local conditions (Pruss et. al., 1999; HCWH, 2001).

**Conclusions**

Medical wastes should be classified according to their source, typology and risk factors associated with their handling, storage and ultimate disposal. The segregation of waste at source is the key step and reduction, reuse and recycling should be considered in proper perspectives. Construction of a Medical Waste Materials Recovery Facility (MED-MRF) will reduce the quantities of medical waste requiring landfill or incineration Incineration used to be the method of choice for most hazardous health care wastes and is still widely used. However, little is documented about the physical health of community members who live close to incinerators. The use of proper APCDs during incineration would significantly reduce the carcinogenic potencies associated with PAH emissions from HWI/MWI to the residential area. Municipal Corporations, State Governments, and the Central Government need to plan and construct centralized facilities to recycle, treat, and dispose of biomedical waste. Large-scale enterprises should be encouraged to recycle, to treat, and to dispose of wastes by means of constructing facilities, and to have extra capacities available to the for a reasonable fee. The fundamental information for selecting and designing the most efficient treatment method of hospital waste is obtained by means of waste composition analysis. The final choice of treatment system should be made carefully, on the basis of various factors, many of which depend on local conditions including the amount and composition of waste generated, available space, regulatory approval, public acceptance, and cost.

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