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Special Article

Biomedical waste management: Incineration vs. environmental safety

***V Gautam, R Thapar, M Sharma**

Abstract

Public concerns about incinerator emissions, as well as the creation of federal regulations for medical waste incinerators, are causing many health care facilities to rethink their choices in medical waste treatment. As stated by Health Care Without Harm, non-incineration treatment technologies are a growing and developing field. Most medical waste is incinerated, a practice that is short-lived because of environmental considerations. The burning of solid and regulated medical waste generated by health care creates many problems. Medical waste incinerators emit toxic air pollutants and toxic ash residues that are the major source of dioxins in the environment. International Agency for Research on Cancer, an arm of WHO, acknowledged dioxins cancer causing potential and classified it as human carcinogen. Development of waste management policies, careful waste segregation and training programs, as well as attention to materials purchased, are essential in minimizing the environmental and health impacts of any technology.

Key words: *Biomedical waste, incineration, dioxin, environment, sterilizer, shredder*

Introduction

Biomedical waste (BMW) means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological, and including categories mentioned in Schedule I of BMW (Management and Handling) (second Amendment) Rules, 2000 by Ministry of Environment and Forests Notification.[1] Most medical waste is incinerated, a practice that is short-lived because of environmental considerations. The burning of solid and regulated medical waste generated by health care creates many problems. Medical waste incinerators emit toxic air pollutants and toxic ash residues that are the major source of dioxins in the environment.[2] The toxic ash residues sent to landfills for disposal have the potential to leach into groundwater. Medical waste has been identified by US Environmental Agency as the third largest known source of dioxin air emission[3] and contributor of about 10% of mercury emissions to the environment from human activities.[4] The air emissions affect the local environment and may affect communities hundreds or thousands of miles away. Dioxin is one of the most toxic chemicals known to humankind. Dioxins have been linked to cancer, immune system disorders, diabetes, birth defects and disrupted sexual development.[5] International Agency for Research on Cancer (IARC), an arm of WHO, acknowledged dioxins cancer causing potential and classified it as human carcinogen. To avoid dioxin production, no chlorinated plastic bags (and preferably no other chlorinated compounds) should be introduced into the incinerator. Red bags must not be incinerated as red colour contains cadmium, which causes toxic emissions.[6,7] If mercury-containing items are put into a red bag for infectious waste and sent to an incinerator or other waste treatment technology, mercury will contaminate the environment. Airborne mercury then enters a global distribution cycle in the environment, contaminating fish and wildlife. Mercury is a potent neurotoxin that can cross the blood–brain barrier as well as the placenta.[8]

Public concerns about incinerator emissions, as well as the creation of federal regulations for medical waste incinerators, are causing many health care facilities to rethink their choices in medical waste treatment. As stated by Health Care Without Harm, an international coalition of 470 organizations in 52 countries, non-incineration treatment technologies are a growing and developing field. Some technologies are still essentially prototypes, while others, such as autoclave technology, have been used for decades.[9]

The BMW (Management and Handling) Rules, 2000 recommend autoclaving for disposables, microbiological waste and sharps. Typical operating conditions for an autoclave are a temperature of at least 121°C at a pressure of 105 kPa for a period of at least 60 min. The second option for the temperature, etc., is that BMW can be sterilized at 132°C for 30–60 min.[10] Anatomical and pathological wastes, low-level radioactive waste, organic solvents, laboratory chemicals, and chemotherapy waste should not be treated in an autoclave.[1,2] In 2005, the California Department of Health Services

*Corresponding author (email:<r_vg@yahoo.co.uk>)
Department of Medical Microbiology (VG, MS), PGIMER, Chandigarh-160012, Department of Microbiology (RT), Swami Devi Dyal Hospital and Dental College, Barwala, Haryana, India
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(CADHS) testing was one of the first indications that medical waste autoclaves could not achieve efficacy performance claims as previously thought. Essentially, sharps container and suctions canisters could not be treated properly using traditional operational parameters. The controlling parameter, temperature is measured in the space between autoclave shell and BMW load. It is not a measure of actual temperature within the waste load. In addition, the autoclave cycle had to use multiple vacuum cycles to ensure that the steam could effectively penetrate the dense load of waste. Again, traditional autoclave practice typically uses only one vacuum step. Static autoclaves, including those with vacuum cycles, are particularly affected by this issue, and the waste will require some form of physical pre-treatment (e.g. maceration) to enable effective treatment to take place.[11] Waste is reduced by an estimated 30% of its volume, enhanced, if accompanied by mechanical shredding.[1] In a process combining shredding, direct heated steam, and high pressure to achieve complete sterilization of infectious materials, the contaminated waste is loaded into the top of the machine in which a heavy-duty shredder is mounted. Once the machine is sealed, the waste, including the containers and other large resistant material, is shredded and falls by gravity into the lower chamber. A minimal temperature of 121°C and a pressure usually of 2–5 bar (200–500 kPa) should be maintained during the total contact time of 1–4 h. Sterilized fragments are discharged from the bottom of the machine. The final treated waste is harmless and safe to dispose of as ordinary municipal waste.[2,12] In a recent study also, it has been suggested that alternatives for waste treatment rather than incineration such as a locally made autoclave integrated with a shredder should be evaluated and implemented.[13] Such equipments are available commercially and are in use for more than a decade worldwide.[5]

One thing is clear and must always be addressed before assessing any technology: "What goes in, must come out (or up)." Development of waste management policies, careful waste segregation and training programs, as well as attention to materials purchased, are essential in minimizing the environmental and health impacts of any technology.

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