

HETI Horizons

Medical Waste Treatment Technologies – An Update *Part 1: Currently Available Technologies*

This is the first of a two-part update summary of technologies used for treating “infectious” waste generated at healthcare facilities, research and clinical laboratories, biotechnology/pharmaceutical laboratories, and the like. Part 1 reviews what are considered currently viable technologies. Part 2 will provide recommendations for evaluating, selecting and implementing the best, most cost-effective system for a facility-specific application.

Starting Point – Properly Describe and Define the Waste

Evaluation, decision-making and the implementation of any facility-specific waste management, treatment and disposal program should always begin with the establishment of a clear, precise description and characterization of the waste stream, along with a compositional breakdown of its main constituents. Failure to do so could result in any number of problems – ranging from management difficulties to the procurement of an inadequate, noncompliant, or overly costly waste treatment system.



It is also important that proper, clear terminology be used to describe or define the waste as opposed to vague, generic terms – such as “medical waste” – which provide no useful information about the waste itself. There are at least a dozen terms often used when referring to “medical waste” – including “infectious waste”, “contaminated waste”, and “clinical waste”. But such terms have different meanings and are subject to varying interpretations.

Use of the term “infectious waste” is a prime example where clarification is recommended; simply because only a small fraction of medical waste is actually infectious. Technically, infectious waste comprises disposed items that have been contaminated by a pathogenic microorganism or pathogens (such as bacteria, viruses, or fungi) capable of causing an infectious disease in healthy humans. The primary source for such contamination is contact with blood or body fluids from medical procedures. However, since it’s problematic to know with certainty whether any such contacted fluids actually contain viable pathogens, it is standard practice for such contaminated waste to be designated as being “infectious” and collected in red-colored containers having a universal biohazard symbol. All such color-coded containers are assumed to be filled with “infectious” waste, but published data have shown that upwards of 95% of the waste is not “infectious” and poses a negligible risk of transmitting an infectious disease.

Viable Medical Waste Treatment Technologies

Terminology

Waste Processing vs. Waste Treatment



The terms “waste processing” and “waste treatment” are often used interchangeably; but they are different. Waste processing involves the application of equipment, such as shredders and compactors, to change the physical characteristics of a waste for a particular purpose; while waste treatment involves the application of processes and equipment to convert wastes having hazardous characteristics or properties to a residue that is safe for handling and disposal.

Disinfection vs. Sterilization

The terms “disinfection” and “sterilization” are also often used interchangeably, but they also have different meanings. Disinfection involves processes for eliminating harmful microorganisms from objects and surfaces to an acceptable level, while sterilization involves processes for killing all microorganisms. Only a few medical waste treatment technologies, such as high-temperature incineration, are capable of providing sterilization. But other technologies provide a sufficiently high level of disinfection (typically 99.99% or higher) to be considered acceptable in accordance with most state regulations.

Evolutionary Development

Until the early 1990s, incineration and steam autoclaving were widely considered the only proven, viable medical waste treatment technologies. But a series of national events, including fears associated with the AIDS epidemic, triggered the rapid proliferation of non-incineration treatment technologies – with more than 200 different technologies developed by the early 2000s. Within a few years virtually all of them proved unsuccessful and became no longer available. Today, the only proven, viable, medical waste treatment technologies are again incineration, steam autoclaving, and possibly pyrolysis. A few other technologies – including ozonation and microwaving – continue to be promoted; but none of them have demonstrated proven success and basically reflect failed technologies from decades ago.

Incinerator Systems & Equipment



Incineration is a high-temperature combustion process suitable for destroying virtually all types of waste. A properly designed, controlled, and operated incinerator system readily converts medical waste (and almost all other types of waste generated at healthcare facilities) to an inert, sterile, non-hazardous, unrecognizable ash residue that is safe for disposal in a sanitary landfill. Incinerator systems typically reduce the weight and volume of medical waste by upwards of 95 percent or more, and provide the opportunity to recover useful energy from the waste in the form of steam via heat recovery boilers.

The most widely used incinerator technology for disposing of medical waste is termed controlled air type incineration – because of the way air for combustion is introduced and controlled. However, regardless of incinerator type, the key to procuring a successful, reliable, compliant system involves the application or specification of widely recognized design, construction and operational criteria for the incinerator itself and all associated components (such as the waste loading system, ash removal system, burners and blowers, stack and breechings, controls and instrumentation, and air pollution control devices).

Steam Autoclave Systems & Equipment



Steam autoclaving uses pressurized, saturated steam injection within a chamber for inactivating or killing pathogenic microorganisms. It is suitable for treating or disinfecting most types of medical waste; but they are not considered acceptable for treating pathological waste, waste containing bulk quantities of fluids, or hazardous waste and chemicals. Autoclaving effectiveness or efficiency is a function of steam temperatures, the ability of the steam to contact microorganisms within loaded waste containers, and the duration of steam contact with contaminated items. Since most autoclaved waste remains recognizable and because sharps within the waste containers remain as potential puncture hazards, it is often necessary to shred the autoclaved waste to render it unrecognizable and safe for handling and off-site disposal.

Pyrolysis Treatment Technologies

Pyrolysis technologies use indirect heating sources – without the introduction of air or oxygen – to heat the waste to high temperatures. This process drives off volatile gases from the waste, but such gases need to be combusted in a fuel-fired afterburner prior to stack discharge. The solid residues after pyrolysis have high percentages of carbonaceous, recognizable items that require additional special processing such as shredding or encapsulation prior to disposal.

HETI Services

HETI has extensive expertise, experience, and full-service capabilities involving all aspects of medical waste management, treatment and disposal – including feasibility evaluations, engineering and design, permitting, construction administration, and ongoing compliance support. HETI staff have provided such services to more than 500 healthcare, university and biomedical research facilities throughout the United States and internationally.

To find out more about HETI's environmental and regulatory support services,
please contact us.

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