TREATMENT TECHNOLOGIES: AUTOCLAVING, INCINERATION, CHEMICAL DISINFECTION

EFFECTIVE METHODS FOR STERILIZATION AND DECONTAMINATION

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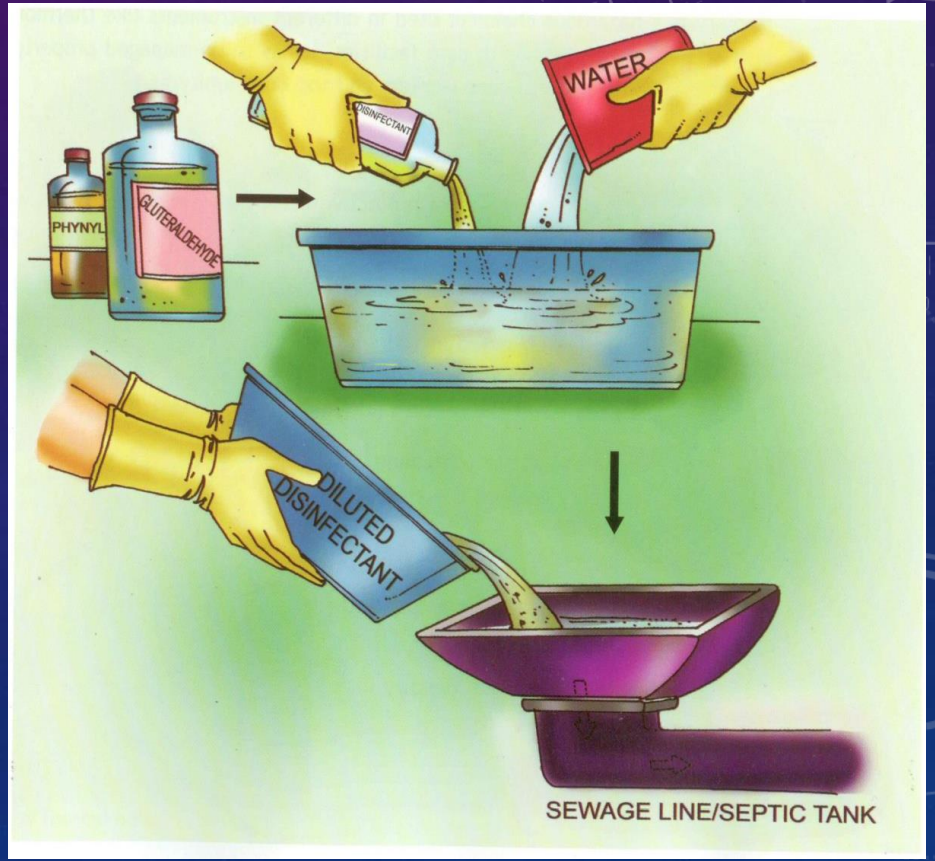
TECHNOLOGY OPTIONS FOR ‘TREATMENT’

There are mainly five technology options available for the treatment of bio-medical waste. They can be grouped as follows.

- Chemical processes
- Thermal processes
- Mechanical processes
- Irradiation processes
- Biological processes

CHEMICAL PROCESSES

- These processes use chemicals that act as disinfectants.
- Sodium hypochlorite, dissolved chlorine dioxide, peracetic acid, hydrogen peroxide, dry inorganic chemical and ozone are examples of such chemicals.
- Most chemical processes are water-intensive and require neutralising agents.



THERMAL PROCESSES

- These processes utilize heat to disinfect.
- Depending on the temperature they operate, it is been grouped into two categories, which are
  - Low-heat systems and
  - High-heat systems

LOW-HEAT SYSTEMS

- Low-heat systems (operates between 93 -177oC) use steam, hot water, or electromagnetic radiation to heat and decontaminate the waste. Autoclave & Microwave are low heat systems.
  - **Autoclaving** is a low heat thermal process and it uses steam for disinfection of waste. Autoclaves are of two types depending on the method they use for removal of air pockets. They are gravity flow autoclave and vacuum autoclave.
  - **Microwaving** is a process which disinfects the waste by moist heat and steam generated by microwave energy.

Autoclave

Microwave

HIGH-HEAT SYSTEMS

- High-heat systems employ combustion and high temperature plasma to decontaminate and destroy the waste.
- Incinerator & Hydroclaving are high heat systems.

MECHANICAL PROCESSES

- These processes are used to change the physical form or characteristics of the waste either to facilitate waste handling or to process the waste in conjunction with other treatment steps. The two primary mechanical processes are
- Compaction - used to reduce the volume of the waste
- Shredding - used to destroy plastic and paper waste to prevent their reuse. Only the disinfected waste can be used in a shredder.

IRRADIATION PROCESSES

- In these processes, wastes are exposed to ultraviolet or ionizing radiation in an enclosed chamber.
- These systems require post shredding to render the waste unrecognizable.

BIOLOGICAL PROCESSES

- Biological enzymes are used for treating medical waste.
- It is claimed that biological reactions will not only decontaminate the waste but also cause the destruction of all the organic constituents so that only plastics, glass, and other inert will remain in the residues.

POINTS TO CONSIDER IN PROCESSING THE WASTE

- **Incineration**
  - Incinerators should be suitably designed to achieve the emission limits.
  - Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.
  - Toxic metals in the incineration ash shall be limited within the regulatory quantities.
  - Only low sulphur fuel like diesel shall be used as fuel in the incinerator.

- **Autoclaving**
  - The autoclave should be dedicated for the purpose of disinfecting and treating biomedical waste.
  - When operating a gravity flow autoclave, medical waste shall be subjected to:
    - A temperature of not less than 121^{o} and pressure of about 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or
    - A temperature of not less than 135 ^{o}C and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or
    - A temperature of not less than 149 ^{o}C and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.

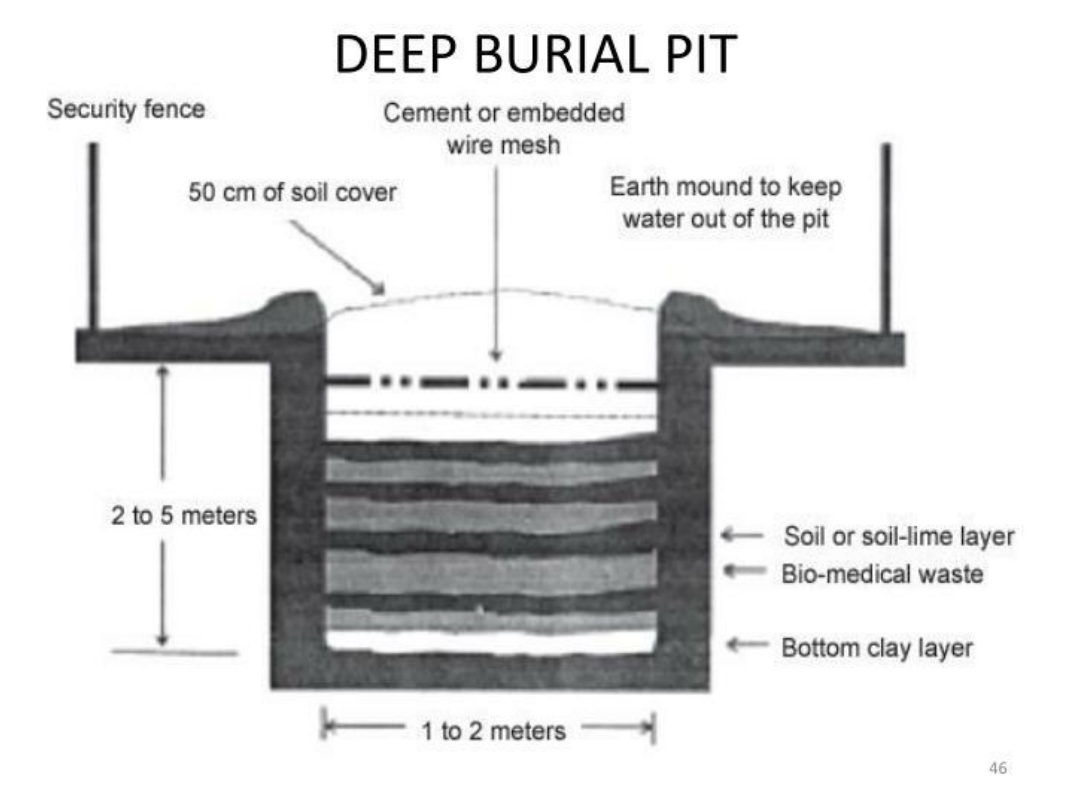
- When operating a vacuum autoclave, medical waste shall be subjected to a minimum of one per vacuum pulse to purge the autoclave of all air. The waste shall be subjected to the following :
  - A temperature of not less than 121^{o}C and a pressure of 15 psi per an autoclave residence time of not less than 45 minutes; or
  - temperature of not less than 135 ^{o}C and a pressure of 31 psi for an autoclave residence time of not less than 30 minutes; or Medical waste shall not be considered properly treated unless the time, temperature and pressure indicate stipulated limits. If for any reason, these were not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.

Microwaving

- Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal carcasses, body parts and large metal items.
- The microwave system shall comply with the efficacy tests/routine tests
- The microwave should completely and consistently kill bacteria and other pathogenic organism that is ensured by the approved biological indicator at the maximum design capacity of each microwave unit.

- **Deep Burial**
  - A pit or trench should be dug about 2 m deep. It should be half filled with waste, and then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.
  - It must be ensured that animals do not have access to burial sites.
  - Covers of galvanised iron/wire meshes may be used.
  - On each occasion, when wastes are added to the pit, a layer of 10cm of soil be added to cover the wastes.
  - Burial must be performed under close and dedicated supervision.
  - The site should be relatively impermeable and no shallow well should be close to the site.
  - The pits should be distant from habitation, and sited so as to ensure that no contamination occurs of any surface water or ground water.
  - The area should not be prone to flooding or erosion.
  - The location of the site will be authorized by the prescribed authority.
  - The institution shall maintain a record of all pits for deep burial.

DEEP BURIAL PIT



DISPOSAL OF SHARP MATERIALS

- Blades and needles waste after disinfection should be disposed in circular or rectangular pits.
- Such pits can be dug and lined with brick, masonry, or concrete rings.
- The pit should be covered with a heavy concrete slab, which is penetrated by a galvanized steel pipe projecting about 1.5 m above the slab, within internal diameter of upto 20 mm.
- When the pipe is full it can be sealed completely after another has been prepared.

MERCURY CONTROL

- Wastes containing Mercury due to breakage of thermometer and other measuring equipment need to be given attention.
- Proper attention should be given to the collection of the spilled mercury, its storage and sending of the same back to the manufacturers.
- Must take all measures to ensure that the spilled mercury does not become part of biomedical wastes
- Waste containing equal to or more than 50 ppm of mercury is a hazardous waste and the concerned generators of the wastes including the health care units are required to dispose the waste as per the norms.

Thank you