Medical Waste Treatment Technologies

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Health Care Without Harm

Who is Health Care Without Harm?

An International network focussing on two fundamental rights:

- Right to healthcare
- Right to a healthy environment

Health Care Without Harm

Health Care Without Harm

- Issues
  - Medical waste
  - Mercury
  - PVC
  - Climate and health
  - Food
  - Green buildings
  - Pharmaceuticals
  - Nurses
  - Safer materials
- Offices in
  - USA
  - Europe
  - Latin America
  - South East Asia
- Key partners in
  - South Africa
  - India
  - Tanzania
  - Mexico
- Members in 53 countries

Global mercury phase-out

- HCWH and WHO partnering to eliminate mercury from healthcare
- Part of UN Environment Programme's Mercury Products Partnership.
- www.mercuryfreehealthcare.org

GLOBAL HEALTHCARE WASTE PROJECT

- HCWH and WHO are principal cooperating agencies
- 8-country project to reduce impacts from medical waste – esp dioxins and mercury
- Model hospitals in Argentina, India, Latvia, Lebanon, the Philippines, Senegal and Vietnam
- Technology development in Tanzania

Incineration

No longer a preferred treatment technology in many places

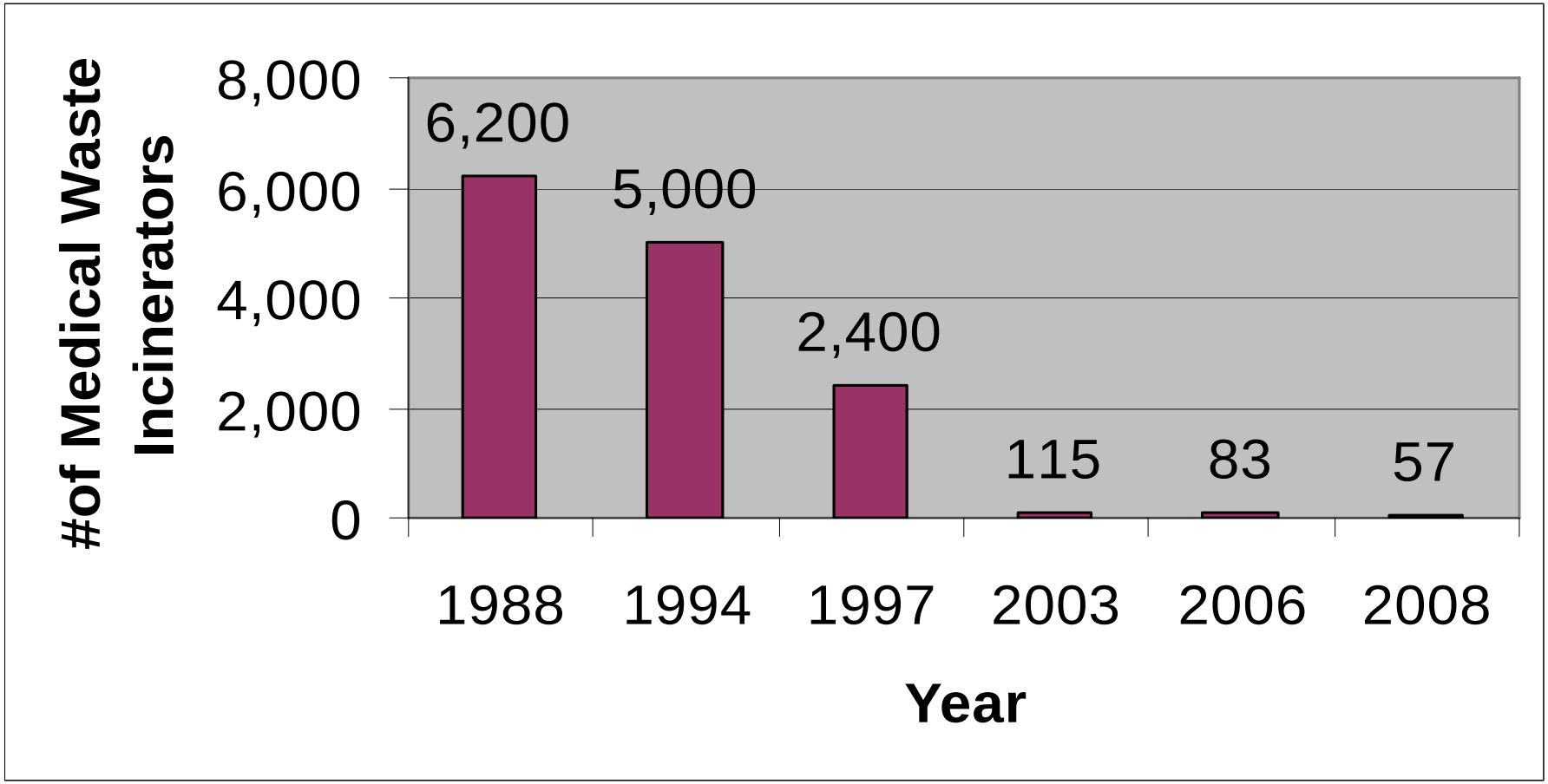
Meeting modern emission standards costs millions of dollars

Ash must be treated as hazardous waste

Small incinerators are highly polluting

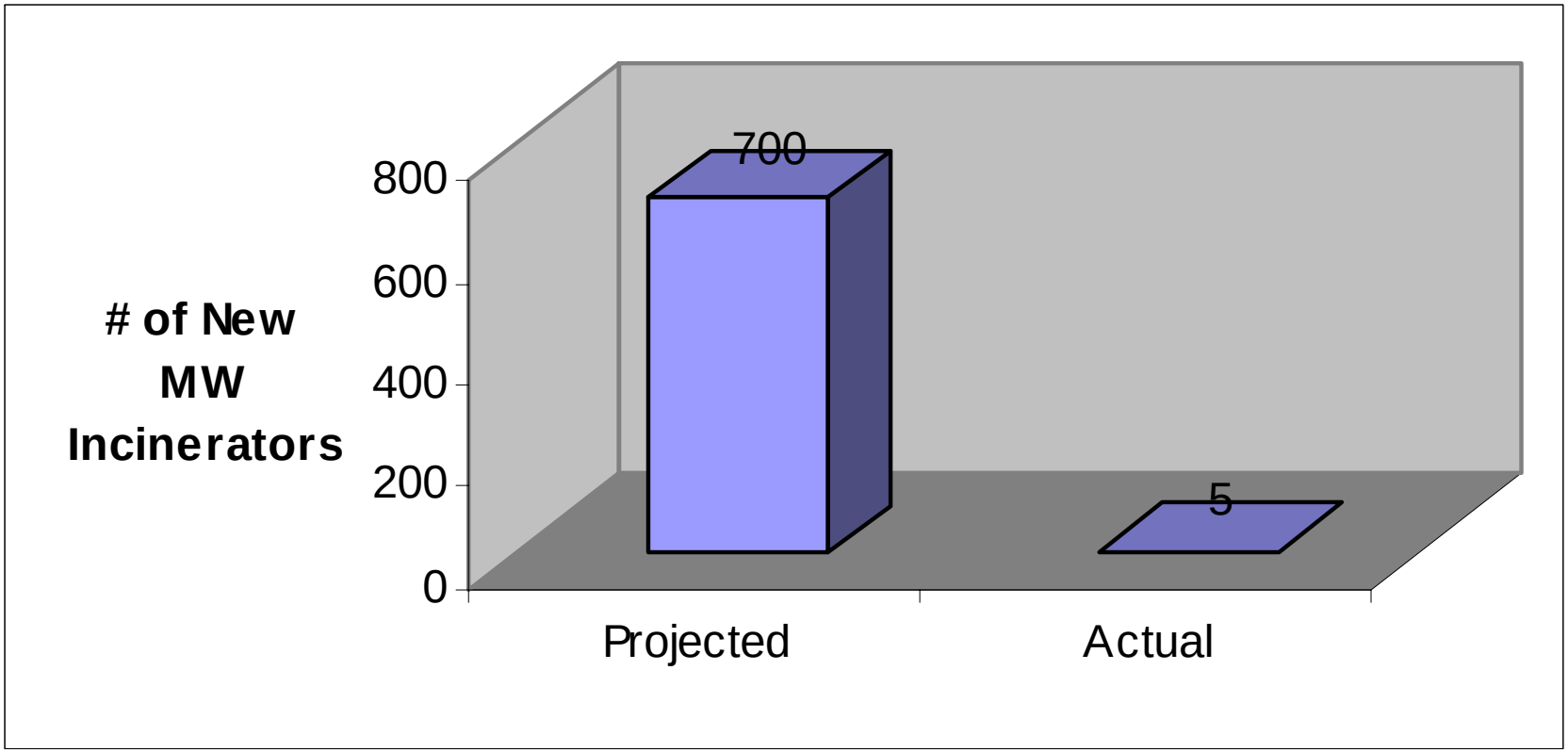
Maintenance costs can be high, breakdowns common

Decline in Medical Waste Incinerators in the U.S.



SOURCES: **1988**: "Hospital Waste Combustion Study-Data Gathering Phase," USEPA, December 1998; **1994**: "Medical Waste Incinerators-Background Information for Proposed Standards and Guidelines: Industry Profile Report for New and Existing Facilities," USEPA, July 1994; **1997**: 40 CFR 60 in the Federal Register, Vol. 62, No. 178, September 15, 1997, page 48350; **2003**: "Status of Current HMIWI Efforts," presented by Fred L. Porter, USEPA, Medical Waste Institute, June 2003; **2006**: USEPA medical waste incinerator inventory, February 17, 2006; **2008**: Updated HMIWI Inventory Database, T. Holloway, USEPA Background Information Document, October 24, 2008.

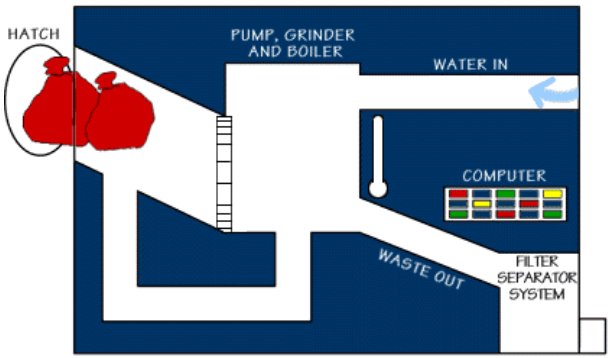
Decline in Construction of New Medical Waste Incinerators in the U.S.



EPA original projection of new medical waste incinerators (without the HMIWI rule) vs. Actual Number of new medical waste incinerators built since the HMIWI rule, as of 2008

Alternative Technology Options

- Needle Destroyers
- Autoclaves
- Advanced Steam Treatment Systems
- Microwave Units
- Dry Heat Systems
- Alkaline Hydrolysis
- Others



Non-incineration technologies

1. Low-heat thermal processes
2. Chemical processes
3. Irradiative processes
4. Biological processes

LOW-HEAT THERMAL PROCESSES

- Mostly between 93°C to about 177°C.
- Wet heat (steam) and dry heat (hot air) disinfection.

- Wet heat treatment uses steam to disinfect
- Autoclaving- the most common treatment method
- Microwave- also a steam disinfection process. Water is added to the waste. Micro-organisms are destroyed by moist heat and steam generated by microwave energy.

- Dry heat processes are less common. No water or steam is added.
- Waste is heated by conduction, natural or forced convection, and/or thermal radiation using infrared heaters.

Autoclaves of all sizes

- Autoclaves
  - Very small autoclaves

4 L pressure cooker
$25 - $50

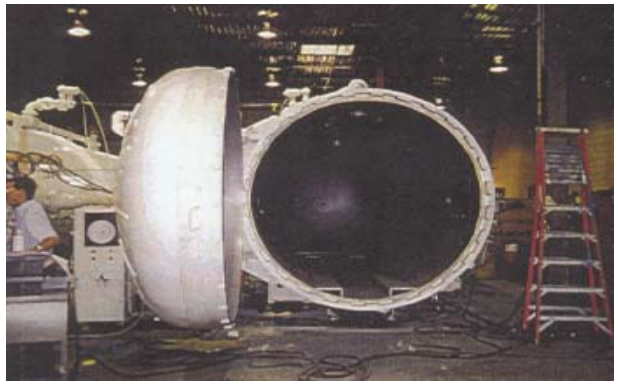
40 L sterilizer
$125-$600

  - Small to medium-size autoclaves

100 L autoclave
$1000 - $5000

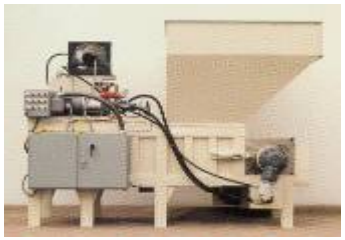
260 L waste autoclave
$25,000 - $35,000

  - Large centralized autoclaves



14,000 L waste autoclave
$200,000 - $250,000

  - Optional Shedders



$20,000 - $150,000

Advantages of autoclaves for medical waste disinfection

- Familiar technology in hospitals
- Reliable and economical
- Available in many sizes and levels of sophistication
- Can easily test them, prove they are working effectively

Rotoclave- advanced autoclave

Microwave

- Waste typically shredded then conveyed past several microwave generators to create heat and steam.
- Sizes range from doctor’s office to large hospital systems

Dry heat technology

- Small scale example:
- Desktop for small facilities
- Also melts syringes, but the residue is not recyclable.

CHEMICAL PROCESSES

- Disinfectants eg dissolved chlorine dioxide, bleach (sodium hypochlorite), peracetic acid, or dry inorganic chemicals.
- Chemical mixture often proprietary/secret.
- Usually often involve shredding, grinding, or mixing.
- May go through a dewatering section to remove and recycle the disinfectant.
- One developing technology uses ozone to treat medical waste and others utilise catalytic oxidation.
- Specific deactivation/neutralisation reactions used for individual chemicals

Encapsulation

- Encapsulation is a chemical process that solidifies sharps, blood, or other body fluids within a solid matrix prior to disposal.

- Even concrete can be used to dispose of small quantities of pharmaceutical waste in remote areas

Tissue digestors

- Use high temperature sodium hydroxide to break down tissues and chemicals
- Destroys prions, EU approved for carcass disposal
- Creates a caustic slurry rich in fatty acids and amino acids
- Bones are friable
- Sizes from 5kg to thousands of kg

IRRADIATIVE PROCESSES

Involve electron beams, Cobalt-60, or UV irradiation.

Need shielding to prevent occupational exposures.

Electron beam irradiation uses high-energy electrons to destroy micro-organisms in the waste by though chemical dissociation and rupture of cell walls.

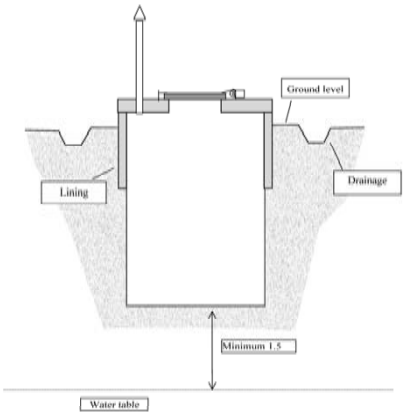
Germicidal ultraviolet radiation (UV-C) has been used as a supplement to other treatment technologies.

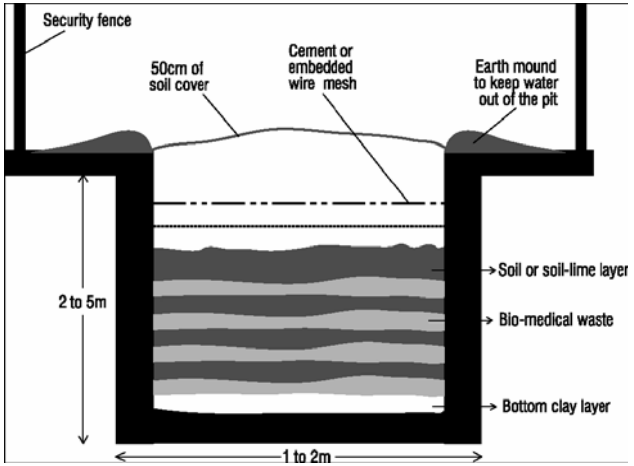
Irradiation does not alter the waste physically and would probably require a grinder or shredder to render the waste unrecognisable.

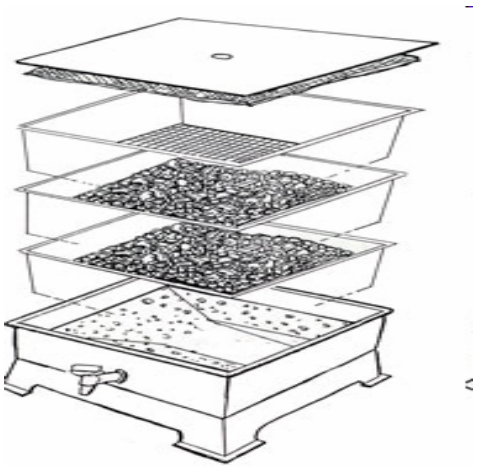
BIOLOGICAL PROCESSES

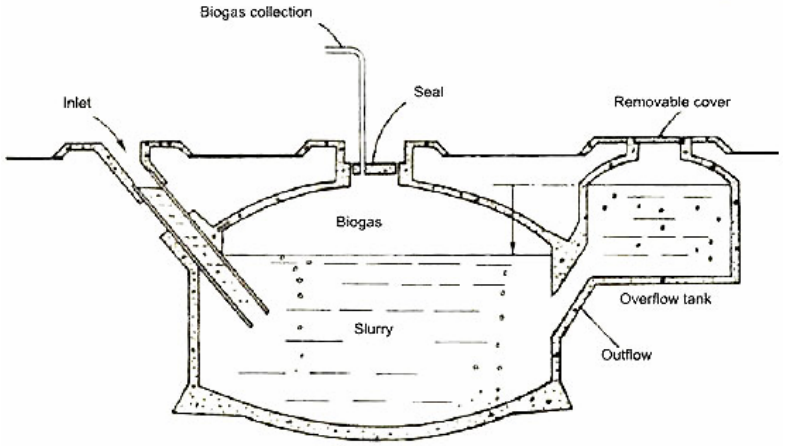
- Technologies employ enzymes to destroy organic matter. Few non-incineration technologies have been based on biological processes.
- Natural biological processes can also be used, particularly for rural areas and small health centres

Rural / low tech biological technologies









MECHANICAL PROCESSES

Shredding, grinding, hammermill processing, mixing, agitation, liquidsolid separation, conveying (using augers, rams, or conveyor belts), and compaction all supplement other treatment processes.

Main purposes:

Renders the waste unrecognisable

Destroy needles and syringes

In thermal- or chemical-based processes, shredders etc mixers can improve the rate of heat transfer or expose more surfaces to chemical disinfectants.

Mechanical processes often need a lot of maintenance

Needle cutters and burners

- Mechanical or electrical
- Prevent NSI during waste disposal
- The best models prevent syringe reuse

Effluent decontamination systems

- Use temperatures over 100C for over an hour to kill pathogens.
- Heating can be provided by steam, electricity, gas, or a combination
- Heat exchangers increase efficiency
- Continuous or batch systems available
- Some batch systems can include a tissue digestion stage to destroy organics as well
- Conventional ETPs, reed bed systems also effective where space is available

Technology selection factors

- Regulatory acceptance
- Throughput capacity
- Types of waste treated
- Microbial inactivation efficacy
- Environmental emissions and waste residues
- Space requirements
- Utility and other installation requirements
- Waste reduction
- Occupational safety and health

Noise

Odour

Automation

Reliability

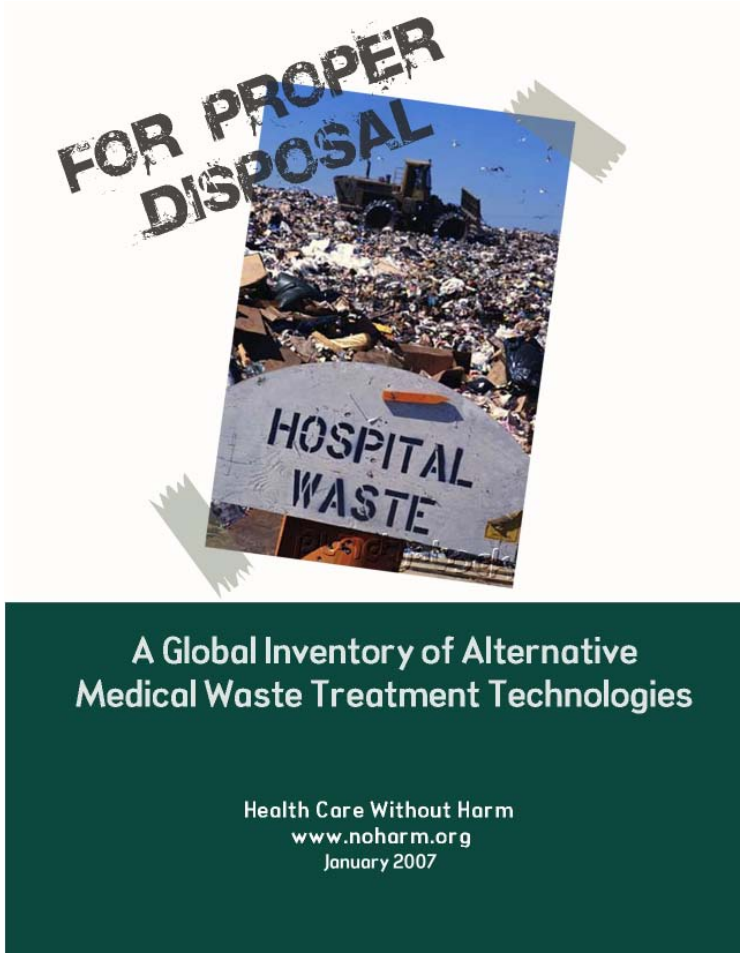
Level of commercialisation

Background of the technology manufacturer or vendor

Community and staff acceptance

Cost

Technology supplier inventory



- 130 suppliers in 13 countries
- New version in preparation- around 300 suppliers

- More information at

  www.noharm.org

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Thank you

More information from

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