

Decontamination

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Outline

- Definitions
- Methods
 - Physical
 - Chemical
 - Gases



Decontamination - Definitions

“A procedure or process that renders an area, device or equipment safe to be in, to handle or to use.”



Decontamination - Definitions

Sanitization:

- microbial population reduced to levels considered safe by public health standards
- objects usually cleaned as well as partially disinfected

e.g. sanitizers used to clean restaurant utensils



Decontamination - Definitions

Disinfection:

- killing, inhibition or removal of microorganisms that may cause disease
- usually chemical agents
- does not necessarily sterilize objects (some spores & microorganisms remain)



Decontamination - Definitions

Sterilization:

- use of a physical or chemical procedure to destroy all microbial life, including large numbers of highly resistant bacterial spores



Decontamination - Categories

Categories of decontamination in the microbiology lab:

- surface decontamination
- waste decontamination
- space decontamination



Decontamination - Categories

Surface decontamination:

- daily clean-up of work area
- daily decontamination of any spills
- liquid disinfectants most commonly used



Decontamination - Categories

Waste decontamination:

- to protect workers who handle lab waste away from the lab
- to protect the environment
- autoclaving
- liquid disinfectants



Decontamination - Categories

Space decontamination:

- large areas of hidden surfaces
- requires use of fumigants such as formaldehyde, vapourized hydrogen peroxide (VHP) or chlorine dioxide
- impacts on facility design parameters



Decontamination - Methods

Decontamination can be achieved by:

- physical methods (heat, filtration, radiation)
- chemical disinfectants
- gases



Decontamination - Methods

Selection of decontamination method:

- type of organism/number
- amount of organic material present
- its risk group or containment level classification
- the reason for the decontamination
- degree of microbial killing required



Decontamination - Methods

Selection of decontamination method (cont'd):

- the nature of item/surface to be treated
- type & concentration of disinfectant
- time/temperature of exposure
- safety



Decontamination - Methods

Physical agents:

- heat
- filtration
- radiation (UV & gamma)



Decontamination - Methods

Heat:

- moist – steam (autoclaves, renderer)
- dry – convection oven
- incineration



Decontamination - Methods

Heat:

Steam sterilization (autoclaves) -

- ensure proper functioning of autoclave
- load test to be carried out to determine standard load times/temps.
- vessels should be loosely capped or plugged



Decontamination - Methods

Heat:

Steam sterilization (autoclaves) (cont'd) -

- verification via biological indicators (*Geobacillus stearothermophilus* spores)
- thermocouples
- chemical indicators





Decontamination - Methods

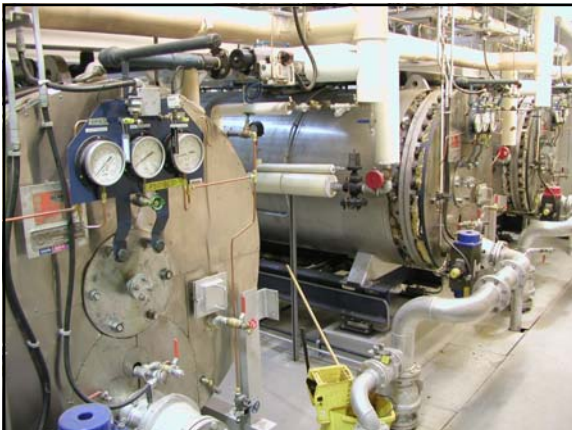
Heat:

Steam sterilization (renderer/biowaste cookers) -

- used for solid waste or liquid effluent
- secondary waste treatment method for CL3 (Ag) & CL4 labs
- parameters set out by commissioning with *G. stearothermophilus* spores







Decontamination - Methods

Heat:

Dry heat sterilization (oven) -

- denaturation of proteins: 160 - 170°C/2-4h
- used for impervious non-organic materials (glass)



Decontamination - Methods

Heat:

Incineration -



- former method of choice for anatomical biomedical waste
- waste should be initially treated at the containment barrier then packaged before removing off-site
- provincial or territorial authorities should be consulted regarding operations & emissions



Decontamination - Methods

Filtration:

- used for heat-sensitive material, e.g. pharmaceuticals, culture media, antibiotics
- synthetic membrane filters – 0.2µm diameter pores
- HEPA filters remove 99.99% of 0.3µm particles from the air



Decontamination - Methods

Radiation:

- **UV lamps** of limited use – do not penetrate glass, dirt, films, water & other substances very effectively; difficult to maintain
- **Gamma radiation** used for cold sterilization of antibiotics, sutures, pathogens coming out of containment labs, etc.



Decontamination - Methods

Chemical:

Used for:

- decontamination of surfaces & equipment that cannot be autoclaved
- clean-up of infectious spills, rooms & animal cubicles



Decontamination - Methods

Factors influencing the effectiveness of chemical disinfection:

- number of microorganisms present
- type of population of microorganisms
- concentration & nature of disinfectant
- length of treatment
- environmental factors



Decontamination - Methods

Microorganisms differ in their resistance to chemical disinfection:

- **High Resistance:** spore forming organisms
- **Moderate Resistance:** protozoan cysts, Hepatitis B, poliovirus, *M. tuberculosis*, *S. aureus*, *Pseudomonas*
- **Least Resistance:** most bacteria, yeasts



Decontamination - Methods

Chemical disinfectants should be:

- effective against a wide variety of infectious agents at high dilution & in presence of organic matter
- toxic for the infectious agent but not toxic to people
- non-corrosive for common materials



Decontamination - Methods

Chemical disinfectants should be (cont'd):

- stable upon storage
- odourless or ideally with a pleasant odour
- soluble in water & fats for penetration into pathogens & easy penetration on surfaces
- inexpensive



Decontamination - Methods

Types of chemical disinfectants:

- phenolics
- alcohols
- halogens
- quaternary ammonium compounds
- aldehydes
- gases



Decontamination - Methods

Phenolics:

- first widely used disinfectant – used today
- active against tuberculosis; effective in presence of organic material
- remains active on surfaces long after application
- disagreeable odour & can cause skin irritation & allergies

e.g. Lysol



Decontamination - Methods

Alcohols:

- most widely used today
- kills bacteria, fungi & some lipid-containing viruses but not spores
- ethanol & isopropanol most popular (70% concentration)



Decontamination - Methods

Halogens:

- **Iodine** can be used as a skin disinfectant & in lab (e.g. Wescodyne)
- **Bromine** used instead of chlorine in hot tubs
- **Chlorine** (sodium hypochlorite) kills live bacteria & fungi, not spores [

[use 1/10 dilution of 5% Javex
(100ml Javex / litre of water)]



Decontamination - Methods

Quaternary Ammonium Compounds:

- actual detergents, not soaps
- cationic detergents kill most bacteria but not *M. tuberculosis* or spores
- stable, non-toxic but inactivated by hard water

e.g. MicroChem Plus



Decontamination - Methods

Aldehydes:

- active against spores; used as a chemical sterilant
- **formaldehyde** widely used to sterilize lab spaces & BSCs
- 2% **glutaraldehyde** (e.g. Cidex); much less irritating than formaldehyde
- used to disinfect hospital & lab equipment



Decontamination - Methods

Gases:

- **ethylene oxide** kills both living bacteria & spores
- penetrates packing material
- **vapourized hydrogen peroxide (VHP)** used to decontaminate BSCs & sealed containment labs
- **chlorine dioxide gas**



Decontamination

Disinfectants DO NOT replace good microbiological practices or good hygiene!

