




Decontamination


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Outline

- **Decontamination:**
 - Definitions
 - Categories
 - Methods:
 - Physical
 - Chemical
 - Gases
- **Q & A**



Environmental Health & Safety 2



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Decontamination - Definitions

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



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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, vaporous 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 a 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 a decontamination method (cont'd):

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

	Microorganism	Examples
 <p>MORE RESISTANT</p>	Prions	BSE, Creutzfeldt-Jacob disease, Scrapie, CWD
	Bacterial Spores	<i>Bacillus</i> , <i>Geobacillus</i> , <i>Clostridium</i>
	Protozoan oocysts	<i>Cryptosporidium</i>
	Helminth eggs	<i>Ascaris</i> , <i>Enterobius</i>
	Mycobacteria	<i>M. tuberculosis</i>
	Small non-enveloped viruses	Poliovirus, parvoviruses, papillomaviruses
	Protozoan cysts	<i>Giardia</i> , <i>Acanthamoeba</i>
	Fungal spores	<i>Aspergillus</i> , <i>Penicillium</i>
	Gram-negative bacteria	<i>Pseudomonas</i> , <i>Providencia</i> , <i>Escherichia</i>
	Vegetative fungi and algae	<i>Aspergillus</i> , <i>Trichophyton</i> , <i>Candida</i> , <i>Chlamydomonas</i>
<p>LESS RESISTANT</p>	Vegetative helminths & protozoa	<i>Ascaris</i> , <i>Cryptosporidium</i> , <i>Giardia</i>
	Large, non-enveloped viruses	Adenovirus, rotaviruses
	Gram-positive bacteria	<i>Staphylococcus</i> , <i>Streptococcus</i> , <i>Enterococcus</i>
	Enveloped viruses	HIV, hepatitis B virus, herpes simplex virus, Ebola virus

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

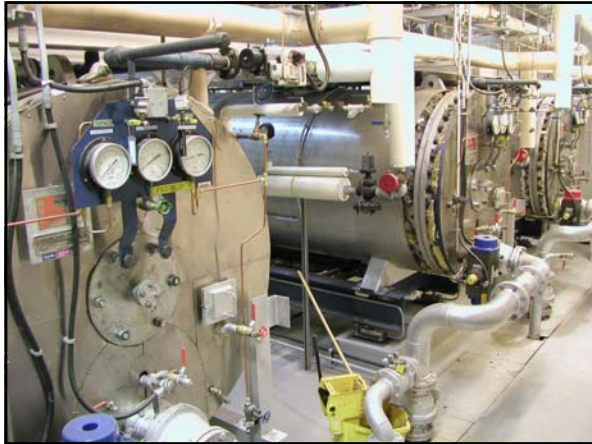
Heat:

Steam sterilization (rendering/biowaste cookers) -

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

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Decontamination - Methods

Heat:

Dry heat sterilization (oven) -

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

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Decontamination - Methods

Heat:

Incineration -

- former method of choice for anatomical biological 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



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Decontamination - Methods

Filtration:

- used for heat-sensitive material, e.g. pharmaceuticals, culture media, antibiotics
- synthetic membrane filters – 0.2 μ diameter pores
- HEPA filters remove 99.99% of 0.3 μ 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
- odorless or ideally with a pleasant odor
- 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 odor & 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

Types of chemical disinfectants:

Biocide	Concn (mg/liter)	
	Sporistatic	Sporicidal
Benzalkonium chloride	5	— ^b
Chlorhexidine	1	—
Ethanol	700	—
Sodium hypochlorite	1	100
Phenol	500	—
Hydrogen peroxide	500	50,000
Peracetic acid	10	100
Glutaraldehyde	50	10,000
Formaldehyde	500	20,000

Decontamination - Methods

Gases:

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

Decontamination

**Disinfectants DO NOT replace good
microbiological practices or good hygiene!**

Thank you!!