University of Rochester
Disinfectants for Biohazardous Materials Guidelines

Purpose:

The purpose of these guidelines is to provide guidance for choosing chemical disinfectants suitable for laboratory equipment and environmental surfaces which have come in contact with biohazardous materials.

Scope:

These guidelines apply to all university staff and students handling biohazardous materials.

Guidelines:

Disinfection is the process of eliminating nearly all recognized pathogenic organisms on inanimate objects and surfaces thereby reducing the microbial contamination to an acceptably safe level. Disinfection ranges from sterility at one extreme to a minimal reduction in the number of microbial contaminants at the other.

Chemical disinfectants are used in situations where steam sterilization is not feasible. Chemical disinfectants fall into the following categories: acids / alkalis, alcohols, chlorides, formaldehyde, glutaraldehyde, iodine, mercurical, phenolics, and quaternaries.

No single chemical disinfectant or disinfecting method will be practical or effective for all situations. Therefore the following questions should be considered when choosing a disinfectant:

1. What is the target microorganism?
2. What is the degree of inactivation required (sterility vs. high-level vs. intermediate level vs. low level)?
3. Is the disinfectant effective against the target organism?
4. Is the disinfectant compatible with the surface being disinfected?
5. Does the disinfectant present a risk to human or research animals in the area?
6. Will there be a residue or odor?
7. What is the shelf-life of the working solution and concentration?
8. What is the cost of the product?
9. Is the product registered with the Environmental Protection Agency and approved for use in New York State by the Departmental of Environmental Conservation?

When using any disinfectant:

1. Follow package instructions for dilution, contact time, and shelf life information for each specific product. Disinfectant concentrate with an expired shelf-life must be disposed of through the Hazardous Waste Management Unit. http://www.facilities.rochester.edu/cu/hazmat1.php?div=hw
2. Disinfectants requiring pre-dilution (refer to package instructions) should be treated as hazardous chemicals during mixing. Appropriate personal protective equipment must be worn when preparing the dilution, i.e. lab coat, gloves, and safety goggles.
3. If multiple options for appropriate disinfectants are available, always select the option with the lowest toxicity possible.
4. Organic matter inactivates some disinfectants. If this is the case, a second application of disinfectant will be necessary after all visible contamination has been removed to assure effective decontamination.

University of Rochester
Disinfectants for Biohazardous Materials Guidelines

Descending Order of Resistance to Germicidal Chemicals
(Adapted from Appendix B Table 1 of CDC/NIH 5th Edition "Biosafety in Microbiological and Biomedical Laboratories" http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5_appendixB.pdf)

Bacterial Spores
Bacillus subtilis, Clostridium sporogenes

▼

Mycobacteria
Mycobacterium tuberculosis var. *bovis*, Nontuberculous mycobacteria

▼

Nonlipid or Small Viruses
Poliovirus, Coxsackievirus, Rhinovirus

▼

Fungi
Trichophyton spp., *Cryptococcus* spp., *Candida* spp.

▼

Vegetative Bacteria
Pseudomonas aeruginosa, Staphylococcus aureus, *Salmonella choleraesuis*, Enterococci

▼

Lipid or Medium-size Viruses
Herpes simplex virus, CMV, Respiratory syncytial virus, HBV, HCV, HIV, Hantavirus, Ebola virus

Note: There are exceptions to this list. *Pseudomonas* spp are sensitive to high-level disinfectants, but if they grow in water and form biofilms on surfaces, the protected cells can approach the resistance of bacterial spores to the same disinfectant.

University of Rochester
Disinfectants for Biohazardous Materials Guidelines

Activity Levels of Select Liquid Germicides[a]
(Adapted from Appendix B Table 2 of CDC/NIH 5th Edition "Biosafety in Microbiological and Biomedical Laboratories" http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5_appendixB.pdf)

Procedure / Product	Aqueous Concentration	Activity Level
Sterilization		
glutaraldehyde	variable	
hydrogen peroxide	6 – 30%	
formaldehyde	6 – 8%	
chlorine dioxide	variable	
peracetic acid		
Disinfection		
glutaraldehyde	variable	high to intermediate
ortho-phthalaldehyde	0.5%	high
hydrogen peroxide	3 – 6%	high to intermediate
formaldehyde [b]	1 – 8%	high to low
chlorine dioxide	variable	high
peracetic acid	variable	high
chlorine compounds [c]	500 to 5000 ml/L free/available chlorine	intermediate
alcohols (ethyl, isopropyl) [d]	70%	intermediate
iodophor compounds [e]	30 – 50 mg/L free iodine up to 10,000 mg/L available iodine 0.1 – 0.2%	intermediate to low
quaternary ammonium compounds		low

[a] This list of chemical germicides centers on generic formulations. A large number of commercial products based on these generic components can be considered for use. Users should ensure that commercial formulations are registered with EPA or by the FDA.

[b] Because of the ongoing controversy of the role of formaldehyde as a potential occupational carcinogen, the use of formaldehyde is limited to certain specific circumstances under carefully controlled conditions (e.g., for the disinfection of certain hemodialysis equipment). There are no FDA cleared liquid chemical sterilant/disinfectants that contain formaldehyde.

[c] Generic disinfectants containing chlorine are available in liquid or solid form (e.g., sodium or calcium hypochlorite). Common household bleach is an excellent and inexpensive source of sodium hypochlorite.

University of Rochester
Disinfectants for Biohazardous Materials Guidelines

Concentrations between 500 and 1000 mg/L chlorine are appropriate for the vast majority of uses requiring an intermediate level of germicidal activity; higher concentrations are extremely corrosive as well as irritating to personnel, and their use should be limited to situations where there is an excessive amount of organic material or unusually high concentrations of microorganisms (e.g., spills of cultured material in the laboratory).

[d] The effectiveness of alcohols as intermediate level germicides is limited because they evaporate rapidly, resulting in short contact times, and also lack the ability to penetrate residual organic material. They are rapidly tuberculocidal, bactericidal and fungicidal, but may vary in spectrum of virucidal activity (see text).

[e] Only those iodophors registered with EPA as hard-surface disinfectants should be used, closely following the manufacturer's instructions regarding proper dilution and product stability. Antiseptic iodophors are not suitable to disinfect devices, environmental surfaces, or medical instruments.

Disinfectant Compound Classes, their Target Organisms, and Basic Considerations

Compound Class	Target Organisms	Other Considerations
Quaternary Ammonium Compounds	• Many microorganisms, more with limited efficacy • NOT active against spores	• Inactivated by organic and inorganic matter (affected by water hardness) • Toxic by absorption or ingestion • Low order / irritant
Phenolic Compounds	• Most microorganisms • NOT active against spores	• More resistance to inactivation by organic matter • Toxic by absorption or ingestion • Skin or eye irritant
Chlorine Compounds (hypochlorite solutions)	• Most microorganisms • Somewhat active against spores	• Inactivated by organic matter • Concentrated solutions or gaseous chlorine is corrosive • Toxic by absorption or ingestion • Skin and eye irritant • **Undiluted household bleach stored at room temperature in the original container has a shelf-life of approximately 6 months.**
Iodophor Compounds	• Most microorganisms • NOT active against spores	• Inactivated by organic matter • Can be corrosive depending on specific product • Toxic by absorption or ingestion • Skin and eye irritant

University of Rochester
Disinfectants for Biohazardous Materials Guidelines

Glutaraldehydes	• Most microorganisms • Somewhat active against spores	• Toxic by absorption or ingestion • Skin, eye and respiratory irritant • **Not recommended for routine use** • **Low human exposure limit** • Use with adequate ventilation
Alcohols	• Highly effective bactericide, tuberculocide, fungicide. • Viricidal activity is varied • NOT active against spores	• **Evaporates rapidly resulting in too short a contact time, 10 minutes or more is necessary.** • **Lacks ability to penetrate residual organic material.** • **Not EPA registered** • **Vapors from evaporating ethanol build up rapidly in biosafety cabinet and may result in an explosion.**

Always refer to the MSDS of a specific product to obtain hazard and safety information for the product.

Administration:

It is the responsibility of laboratory supervision to ensure an effective disinfection protocol is in place in their laboratory and that their staff are aware of the risks posed by the disinfectants

Product suggestions may be obtained from Environmental Health and Safety.