Northeastern University
Environmental Health & Safety

Disinfectant Fact Sheet

Introduction

The decontamination of laboratory surfaces and equipment is critical to preventing the transmission of infectious agents to laboratory workers, the general public, and the environment. An assessment of the infectious agents present as well as surfaces and equipment to be decontaminated must be considered before selecting an appropriate decontamination technique.

Purpose

The purpose of this document is to provide general guidance for the proper disinfection of materials, equipment, and waste in the laboratory. This procedure is dependent on a number of factors, including, but not limited to:

- Nature and concentration of infectious agent present
- Amount of proteinaceous and organic matter present
- Type of surface to be disinfected
- Chemical nature of the disinfectant

Selection Criteria

When it comes to decontaminating your laboratory, it is important to know the difference between disinfection and sterilization. Disinfecting a surface uses chemicals to eliminate nearly all recognizable pathogenic organisms and is designed to make items safe to handle. Sterilizing a surface, on the other hand, uses either steam and heat (autoclaves) or chemicals to produce a 10^6 reduction in viable organism counts resulting in no detectable microbial life on the surface.

The type of decontamination to be used depends on primary factors such as the type of biohazardous agent used in the lab, the state of the agent, and the surfaces and equipment that may become contaminated with the agent.

The Spaulding classification of disinfectants includes high-level (e.g. chlorine dioxide, glutaraldehyde), intermediate-level (e.g. bleach, some phenols, ethanol) and low-level (e.g. quaternary ammonia compounds, some phenols) disinfectants. *High-level disinfectants* readily kill vegetative microorganisms and inactivate viruses but will kill spores only if given the proper contact time, which is typically between 6-8 hours. *Intermediate-level disinfectants* kill vegetative microorganisms, all fungi and lipid-containing viruses. This level of disinfectant is typically used to clean laboratory benches and for housekeeping purposes. *Low-level disinfectants* kill most vegetative bacteria, some fungi, and lipid-containing viruses, but do not eliminate mycobacteria or spores.

The following table ranks microorganisms in order of susceptibility to the various levels of disinfectants.

Prions

Resistant to conventional disinfectant and sterilization procedures including irradiation, boiling, dry heat, and chemicals

Bacteria with Spores	**Protozoa with Cysts**
Bacillus subtilis	*Giardia lamblia*
Clostridium tetani	*Cryptosporidium parvum*
Clostridium difficile	
Clostridium botulinum	

Non-Enveloped Viruses	**Mycobacteria**
Coxsackievirus	*Mycobacterium tuberculosis*
Poliovirus	*Mycobacterium avium-intracellulare*
Rhinovirus	*Mycobacterium chelonae*
Norwalk-like virus	
Hepatitis A virus	

Fungi	
Candida species	Aspergillus species
Cryptococcus species	Dermatophytes

Enveloped Viruses	**Vegetative Bacteria**
Herpes simplex	*Staphylococcus aureus*
Varicella-zoster virus	*Salmonella typhi*
Cytomegalovirus	*Pseudomonas aeruginosa*
Measles virus	Coliforms
Mumps virus	
Rubella virus	
Influenza virus	
Respiratory syncytial virus	
Hepatitis B & C viruses	
Hantavirus	
Human immunodeficiency virus (HIV)	

Shading	Disinfectant Level Needed
	Chemical Sterilant
	High-level disinfectant
	Intermediate-level disinfectant
	Low-level disinfectant

Decontamination and Cleaning

Decontamination renders an area, item or material safe to handle with the primary objective of reducing the level of microbial contamination so that infection transmission is eliminated. Concentrations and contact times vary depending on the formulation, type of microorganisms present, laboratory temperature, and the manufacturer's instructions for use. A spill control plan must be available in the laboratory and should include the approach to its application, contact time and other such parameters. Toxicity to the environment and the safety of the laboratory workers must be taken into account when using any disinfectants and only EPA approved disinfectants can be used.

Environmental surface decontamination can be safely carried out by intermediate and low-level disinfectants, with great care to follow the manufacturer's instructions closely. Disinfectants used for decontamination include bleach solutions, oxidative disinfectants such as hydrogen peroxide, as well as phenols and iodophors.
All laboratory surfaces and equipment utilized by personnel should be routinely disinfected after use in order to prevent cross-contamination including areas that may have accidentally been contaminated with gloved hands such as equipment knobs, handles and buttons.

Space decontamination is a specialized activity and should be performed by specialists with proper training and protective equipment. Procedures for decontamination of large spaces such as biosafety cabinets, incubators or rooms are varied and influenced significantly by the type of etiologic agent involved, the characteristics of the structure containing the space, and the materials present in the space. Primary methods of large space or equipment decontamination involve the following disinfectants: formaldehyde, glutaraldehyde, hydrogen peroxide vapor, or chlorine dioxide gas.

Decontamination of biosafety cabinets before relocation is most commonly performed with formaldehyde gas, though hydrogen peroxide vapor and chlorine dioxide gas can also be used successfully.

Contact times of disinfectants vary depending on the type of microorganisms present as well as the air temperature in the laboratory. Toxicity to the environment and the safety of the laboratory workers must be taken into account when using disinfectants.

The attached comprehensive table at the end of the document contains relevant efficacy, application, and characteristic information for the most common disinfectants used in the laboratory.

The following table gives a brief overview of the various disinfectants used in the laboratory including the recommended use, preparation, and risks associated with each:

Disinfectant	Recommended Use	Preparation	Hazards
Mercury-free Clorox Bleach	Hard surface, liquid waste, and large space decontamination	The 5% Clorox solution should be diluted with water 1:10 (1 part bleach to 9 parts water) to obtain a final concentration of 5,000ppm available chlorine. Follow with 70% ethanol to remove any bleach residue on metal surfaces.	Eye, skin, and respiratory irritant
Virkon S	Hard surface decontamination	Prepare a solution of **0.7 oz.** of powder (or 4 tablets) per gallon of water	Eye, skin and respiratory irritant
Clidox-S	Hard surface decontamination	Follow mixing directions in Clidox-S technical information sheet	Eye, skin and possible respiratory irritant
Quatricide PV	Hard surface decontamination	Prepare a solution of **2 oz.** of the concentrate per gallon of water	Eye, skin and respiratory irritant
Quatricide PV-15	Hard surface decontamination	Prepare a solution of **½ oz.** of the concentrate per gallon of water	Eye, skin and respiratory irritant
Vindicator+	Hard surface decontamination	Prepare a solution of **½ oz.** of the concentrate per gallon of water	Eye, skin, and possible respiratory irritant
Lysol I.C.	Hard surface decontamination	Prepare a solution of **½ oz.** of the concentrate per gallon of water	Eye, skin, and possible respiratory irritant
Cetylcide-II	Hard surface decontamination	Prepare a solution of **2 oz.** of the concentrate per gallon of water	Eye, skin, and possible respiratory irritant
Roccal-D	Hard surface decontamination	Prepare a solution of **½ oz.** of the concentrate per gallon of water	Eye, skin and respiratory irritant
Hil-Phene	Hard surface and lab equipment decontamination	Prepare a solution of **1 oz.** of the concentrate per gallon of water	Eye, skin, and possible respiratory irritant
Wescodyne	Hard surface and lab equipment decontamination	Prepare a solution of **3 oz.** of the concentrate per **5 gallons** of water	Eye, skin, and possible respiratory irritant

**Disinfectants are hyperlinked to their respective product data sheets*
***See the comprehensive table at the end of the document for efficacy and characteristic information*

Summary

When choosing a disinfectant, remember the resistance hierarchy and identify potentially effective disinfectants and processes. Next, perform an assessment of the materials by identifying the type of material and the state that it is in. If you work with tissue or cell culture in media, commercial bleach is the leading choice for the decontamination of cell culture waste since its mechanism of action is proven effective against risk group 1 and 2 animal cell lines. Follow the bleach dilution guidelines provided above and wipe down all potentially contaminated surfaces for the required contact time. For animal research facilities, Virkon S is recommended as a broad-spectrum disinfectant and Clidox-S is recommended for large facility decontamination.

See the attached comprehensive table for an in-depth overview of different disinfectant types and brands associated with laboratory decontamination.

For more information regarding disinfecting agents or procedures, contact EHS at ehs@neu.edu or (617)-373-2769

References

Biosafety in Microbiological and Biomedical Laboratories. Centers for Disease Control and Prevention/National Insitutues of Health, 5th Ed. U.S. Department of Health and Human Services. Washington, DC: 2009

Block, S. Disinfection, Sterilization, and Preservation, 4th Ed. Philadelphia: Lea and Febiger, 1991

McDonnell, G. Antisepsis, Disinfection, and Sterilization: Types, Action and Resistance. Washington, DC: ASM Press, 2007

New Hampshire Department of Education. EPA Registered Hard Surface Disinfectants Comparison Chart. http://education.nh.gov/instruction/school_health/documents/disinfectants.pdf

U.S. Department of Health, Education, and Welfare. NIH Laboratory Safety Monograph: A Supplement to the NIH Guidelines for Recombinant DNA Research. National Institutes of Health, 1978.

	Practical Requirements				Inactivation Efficacy					Potential Application				Characteristics			
Disinfectants	Optimal Dilution	Activity Level	Optimal Contact time	Shelf Life (Dilute/open)	Bactericidal	Virucidal	Fungicidal	Sporicidal	Tuberculocidal	Skin Disinfectant	Hard Surfaces	Stainless Steel	Liquid Waste Disposal	Leaves Residue	Inactivated by organic matter	Recommended for animal laboratories	Other
Quaternary Ammonia Compounds																	
Quatricide PV	1:64 (750 ppm)	Low	10m		+	+	+			+	+	+			+		Parvoviricidal
Quatricide PV-15	1:256 (660 ppm)	Low	10m		+	+	+			+	+	+			+		
Quatricide TB	N/A (2,100 ppm)	Intermediate	10m		+	+	+		+	+	+	+			+		
Vindicator+	0.1-2.0%	Low	10-30m	1 month	+	+	+				+	+			+		
Lysol I.C. Liquid	1:256 (660 ppm)	Low	10m	2 years	+	+	+				+	+	+		+		
Lysol I.C. Spray	N/A (1,000 ppm)	Low	10m	2 years	+	+	+	+	+		+	+			+		
MadaCide-FD	N/A (3,080 ppm)	Low	6m		+	+	+	+	+		+	+			+		
Cetylcide-II	1:64 (740 ppm)	Low	10m	64d (dil/cl) 1d (dil/op)	+	+	+	+			+	+			+		
Roccal-D	1:256 (920 ppm)	Low	10m		+	+	+	+			+	+		+	+		
Chlorine Compounds																	
Mercury-Free Clorox Germicidal Bleach	1:10 (5,000 ppm)	Low	10-30m	1d	+	+	+	+			+		+		+		Corrodes metal
Virkon S	1:200 (0.5%)	Low	10m	7d	+	+	+				+	+				+	
Clidox-S	1:18:1	Low	5m		+	+	+				+	+				+	Dilution format is Base:Water:Activator
Clidox-S	1:3:1 (sporicidal)	Low	5h		+	+	+	+			+	+				+	
Phenolic Compounds																	
Hil-Phene	0.5-3.0%	Low	10-30m		+	+	+		+								
Iodophors																	
Wescodyne	30-50mg/L free iodine	Intermediate	10-30m	years	+	+	+	+	+	+	+		+		+		Poor residual activity
Betadine	30-50mg/L free iodine	Intermediate	10-30m	years	+	+	+	+		+	+				+		
Iodine	30-50mg/L free iodine	Intermediate	10-30m	years	+	+	+	+		+					+		
Gas																	
Paraformaldehyde	0.3 g/ft^3	High	4 hours		+	+	+	+			+	+		+	+		80% rel. humidity; large space/BSC decon.
Glutaraldehyde	15 - 20 mg/m^3	High	1 hour		+	+	+	+			+	+		+			Heat-sensitive equipment decon.
Chlorine Dioxide	10 mg/L	High	1-2 hours		+	+	+	+	+								Large space/BSC decon.
Vapor-plasma																	
Hydrogen Peroxide	2.4 mg/L	High	1 hour		+	+	+				+	+					Small space/BSC decon.
Alcohols	**NOT ACCEPTABLE AS A PRIMARY DISINFECTANT. Must** be used in conjunction with an iodophore or chlorine compound.																
Ethyl and Isopropyl	70% (700,000 ppm)	Intermediate	10-30m							+					+		Use as residue cleanup only