# Reference Guide for Selecting Appropriate Decontamination Agents for Laboratories Using Biohazardous Material

***Introduction:***

Laboratory research, health clinic activities, and academic instruction may involve the use of, or exposure to, a wide variety of biological material including molds, fungi, bacteria, and viruses. In all cases the health and safety of workers is paramount. In many cases, especially grant funded research, quality control and quality assurance are important with respect to the validity and integrity of research results. For these reason the selection of an appropriate agent for purposes of decontaminating work areas such as biological safety cabinets after routine use, as well as in cleaning spills of biohazardous material is important. Visits to many laboratories indicate that in many instances, the use of dilute chlorine liquid is the default choice for most decontamination activity. However, the relatively rapid breakdown of most commercially available chlorinated liquids and the fact that many infectious agents may not be inactivated by exposure to such a preparation, indicate a need for laboratories to view their selection of a decontamination agent with a higher level of specificity with respect to the material targeted for inactivation.

This guide is designed for reference and use by laboratories to assist in the selection of appropriate decontamination agents. Though a broad number of agents will be listed, in some cases the use of that agent may be discouraged due to other risks or hazards associated with that specific agent.

Laboratories are encouraged to review this list and the "roster" of biological agents utilized within their research areas. Hopefully, this list will allow for more informed choices of decontamination agents and consequently lead to enhanced quality control and reduced risk to personnel.

***ADVISORY:***

The following decontamination/sterilizing agents are covered:

- Phenolic Compounds
- Quarternary Ammonium Compounds
- Iodophors
- Alcohols
- Aldehydes
- Chlorine Compounds
- Mercurials
- Ultraviolet Light

Each of these compounds has advantages and disadvantages. Some have special concerns related to health and safety and may pose significant risk to the user if proper attention is not paid to storage conditions, restrictions on use, inhalation hazards, and flammability. Always consult the SDS literature or contact EH&S prior to using any chemical.

## Phenolic Compounds: *ex. CiDecon, Amyl Phenol, Pine-Sol, Lysol*

| Recommended For: | Benefits and advantages | Limitations | Negative Factors | Safety Concerns |
|---|---|---|---|---|
| **Inactivating vegetative bacteria, including *Mycobacterium tuberculosis.* And- Fungi and lipid containing viruses at a concentration of 0.5 to 2.0%.**<br><br>**Germicidal against Gram-negative and Gram-positive organisms and *tubercle bacilli.*** | **Generally stable in storage for prolonged periods.**<br><br>**Less adversely affected by organic matter than other germicides.**<br><br>**Effective over a relatively large pH range** | **Less effective against spores and non-lipid containing viruses.**<br><br>**Limited sporicidal activity.** | **Low solubility in water unless combined with detergent.**<br><br>**Prolonged contact will deteriorate rubber.** | **Can cause skin and eye irritation.**<br><br>**Not to be used on food surfaces.**<br><br>**Containers should be dated and checked periodically for effectiveness or expiration dates.** |

## Quarternary Ammonium Compounds: *ex. Benzalkonium Chloride, Di-Quat, Parvosol*

| Recommended For: | Benefits and Advantages | Limitations | Negative Factors | Safety Concerns |
|---|---|---|---|---|
| **Acceptable as general use disinfectants to control vegetative bacteria and non-lipid containing viruses.**<br><br>**Effective against Gram-positive organisms.**<br><br>**Bacteriostatic in high dilutions.**<br><br>**Some compounds may be active against lipophilic viruses.** | **Stable in prolonged storage.**<br><br>**Effective as deodorizer.**<br><br>**Effective at temperatures up to 212 degrees F.**<br><br>**Neutralized by soap and anionic detergents.**<br><br>**Has built in detergent properties.** | **Not effective against bacterial spores or Mycobacteria at usual concentration of 1:750.**<br><br>**Ineffective against *tubercle bacilli*, spores and lipid containing viruses.**<br><br>**More effective in alkaline that acidic solutions.**<br><br>**Effectiveness is reduced in presence of organic material.** | **Do not allow mixture with chlorinated liquids** | **Common use dilution is usually non-irritating to skin, but prolonged exposure to eyes and skin should be avoided.**<br><br>**Use eye protection, gloves, lab coats when preparing or using these compounds.**<br><br>**Date the container, monitor for effectiveness, check expiration dates.** |

## IODOPHORS: *ex. Betadyne, Providon, Wescodyne*

| Recommended For: | Benefits and Advantages | Limitations | Negative Factors | Safety Concerns |
|---|---|---|---|---|
| **Effective against vegetative bacteria and viruses and general use at concentrations of 70 – 150ppm.**<br><br>**"Wescodyne" brand is effective against *M. tuberculosis* when used at proper concentrations.**<br><br>**Effective against Gram-negative and Gram-positive organisms, some viruses and *tubercle bacilli.*** | **Rapid biocidal action.**<br><br>**Stable storage if kept cool and tightly covered.**<br><br>**Iodophors are relatively harmless to humans.**<br><br>**Iodophors have a built-in color indicator. If the solution is still brown or yellow it is still active.** | **Poor activity against bacterial spores.**<br><br>**Combine iodine with non-ionic detergents.**<br><br>**Effectiveness requires acidic solution.**<br><br>**Vaporizes in 120F to 125F.**<br><br>**Effectiveness is greatly reduced in hot water.**<br><br>**Effectiveness is reduced in organic matter, but not as much as hypochlorite.** | **May cause staining on some surfaces and clothing. Stains may be removed by solution of sodium thiosulfate.**<br><br>**May tarnish metals such as silver, silver plate and copper** | **Wear eye protection, gloves lab coat and closed toed shoes when preparing solution or applying commercially prepared solutions.** |

## ALCOHOLS: *ex. 70% Ethanol soln', Isopropyl Alcohol*

| Recommended For: | Benefits and Advantages | Limitations | Negative Factors | Safety Concerns |
|---|---|---|---|---|
| **In concentrations of 70%. Alcoholic solutions are good general use disinfectants.**<br><br>**Germicidal against a broad spectrum of bacterial species and many viruses.**<br><br>**Combination of 60% ethanol with 0.01N HCl (pH 4) has remarkably improved cidal action against poliovirus and adenovirus.** | **Fast Acting**<br><br>**Compatibly combines with other disinfectants such as quarternaries, phenolics and iodine to form tinctures which will extend alcohols cidal action.**<br><br>**Inexpensive** | **No activity against some bacterial spores, fungal spores or *tubercle bacilli*.** | **See "*Safety Concerns*" in column to the right.**<br><br>**Requires storage in an approved "Flammables" safety cabinet.** | **FLAMMABLE !**<br><br>**Must be used with caution and appropriate eye protection, gloves, lab coat and closed-toed shoes at a minimum.**<br><br>**Not to be used near open flame or spark.**<br><br>**Use inside a biological safety cabinet may be a safety hazard.**<br><br>**Check with EH&S for Fire Hazard Assessment.** |

## ALDEHYDES: *ex. Formaldehyde, Formalin, Gluteraldehyde, Paraformaldehyde*

| Recommended For: | Benefits and Advantages | Limitations | Negative Factors | Safety Concerns |
|---|---|---|---|---|
| **Effective against a wide spectrum of bacteria and viruses.**<br><br>**Sporicidal when used properly with 10 hour contact period.**<br><br>***Formaldehyde* solutions or *formalin* at concentrations of 8% exhibit good activity against vegetative bacteria, spores and viruses. See *Safety Concerns***** | **Can be mixed with alcohol in a solution of 8% formalin and 70% ethanol to give a very good disinfecting agent effective against vegetative bacteria, spores and viruses. Often the disinfectant of choice.** | **Use of *Gluteraldehyde* is strictly limited to the interior of ventilated hoods that have been "flow checked" and verified as having a 100 ft/minute flow rate. Requires prior approval of EH&S. and should be listed as a "*proposed disinfectant*" on any application for biological research or Recombinant DNA research.** | **Use in preparing solutions of gluteraldehyde or the use of commercially prepared gluteraldehyde solutions will require a through review of your research project and facilities and must be approved by EH&S prior to approval of research application.** | ***Formaldehyde* or *Formalin* use must be limited due to associated toxic properties. Contact EH&S prior to use.**<br><br>***Gluteraldehyde* has toxic properties and may be damaging to the eyes.**<br><br>**Contact EH&S at 3-3531 prior to use.** |

## CHLORINE COMPOUNDS: *ex. Sodium Hypochlorite* (Bleach)

| Recommended For: | Benefits and Advantages | Limitations | Negative Factors | Safety Concerns |
|---|---|---|---|---|
| **Recommended for certain disinfecting procedures such as cleanup of blood or body fluid spills when household bleach liquid is diluted 1:10 with tap water.**<br><br>**A 1:10 dilution of bleach has a biocidal effect for *M. tuberculosis, S. Aureus,* other vegetative bacteria and for HIV and HBV after 10-20 minutes.**<br><br>**For bacterial spores and mycobacteria concentrations of 1:5 dilution is required.** | **Inexpensive.**<br><br>**Preparations/dilutions are easy to prepare.**<br><br>**Good general disinfectant of surfaces and liquid biohazardous wastes at 1:10 dilution and 10-20 minute contact time.**<br><br>**Undiluted bleach has been use for surface disinfection after contamination by Creutzfeldt-Jacob Disease (CJD); however, 1.0N NaOH is the current disinfectant for CJD recommended by the NIH.** | **Must be prepared in fresh batch "as needed" due to rapid decay rate.**<br><br>**A 1:5 dilution of chlorine bleach stored at room temperature in a closed plastic container will deteriorate to a 1:100 dilution at one month.**<br><br>**Solutions are neutralized rapidly in presence of organic matter.** | **Potential for excessive waste of raw bleach ingredients if not monitored and stored appropriately.**<br><br>**Always label chlorine disinfectant preparations with the preparation date and concentration and monitor closely, prepare fresh batches frequently as need.**<br><br>**"Expired" dating on disinfectants is an inspection item by EH&S and regulatory agency representatives.**<br><br>**Multiple preparations at different concentrations may be required.** | **Must not be mixed with ammonia.**<br><br>**Avoid breathing vapor at high concentrations.**<br><br>**May irritate eyes.**<br><br>**Use in well ventilated areas with proper eye protection, gloves, lab coat and closed toed shoes.** |

## MERCURIALS

**Although activity is good against viruses, these compounds are specifically recommended against by EH&S due to associated toxic properties. Contact EH&S before any activities using these compounds as disinfectants. On all applications for research and in registering your projects with the Biosafety Office, mercurials should be listed as "proposed decontaminants".**

## ULTRAVIOLET LIGHT DECONTAMINATION

**Under certain conditions of radiation intensity, exposure time, temperature and humidity, UV Light at approximately 254 nanometers will cause eventual death of microorganisms. The radiation at this wavelength causes the formation of thymine-thymine dimmers and other effects on the cellular DNA and RNA. Nucleic acids containing thymine dimmers do not replicate properly and the result is usually lethal mutations. UV light is most effective against actively growing bacteria. Low pressure mercury vapor lamps usually supplied with biological safety cabinets emit germicidal radiation at a wavelength of 254 nanometers for about nine months. After this time the lamp will not produce enough germicidal radiation to effectively kill bacteria, even though it appears to function properly. These lamps should be tested semi-annually and replaced when they emit 70% or less of the rated initial output. UV lamps installed in biological safety cabinets must be replaced when the 254nm UV irradiation intensity on the work tray surface of the cabinet is less than 40 microwatts per square centimeter. These lamps should be cleaned frequently to remove any dust accumulation. Cleaning should be performed when the lamp is "off" by wiping with a soft alcohol moistened pad. Please note that biological safety cabinets listed by the National Sanitation Foundation (NSF) after 1992 may not have lamps installed because there is no longer a NSF secondary test standard for UV lamps.**

**In general, UV radiation is used to reduce exogenous contaminants and/or pathogenic microorganisms on exposed surfaces and in air.**

**CONTACT THE BIOSAFETY OFFICE AT: 3-6359, IF YOU HAVE ANY QUESTIONS OR CONCERNS REGARDING THE INFORMATION IN THIS PUBLICATION.**