

Laboratory Disinfectants

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Background Information

Decontamination is any activity that reduces the microbial contamination of materials or surfaces to prevent inadvertent infection. The appropriateness of a decontamination procedure depends on your goal. Do you wish to disinfect or sterilize? Will you be using the disinfectant on hard surfaces, in a biosafety cabinet, on instruments, or on waste? Disinfection refers to the elimination of virtually all pathogenic organisms on inanimate objects and surfaces thereby reducing the level of microbial contamination to an acceptably safe level. Sterilization refers to the destruction of all microbial life, including bacterial endospores. For example, surgical instruments must be sterile but this level of microbial killing is unnecessary for environmental surfaces such as floors and walls. When choosing a disinfectant one should consider the organism, the item to be disinfected, and the cost and ease of use of the disinfectant.

The following disinfectants can be ordered through UK Stores and are effective against a wide range of infectious agents. Approximate contact times are given for each disinfectant. Links to the MSDS files for each disinfectant are provided. Disinfectant solutions should be made and stored according to manufacturer directions. Remember that a clean surface is more effectively decontaminated than a soiled surface, disinfectants are not necessarily detergents. However, some disinfectants also include a detergent or surfactant.

Vindicator+ is a quaternary ammonium disinfectant that is extremely cost-effective and has good broad spectrum disinfecting strength. A dilution of 0.1-2% and contact time of 10 minutes are recommended. Vindicator+ provides effective disinfection for HIV, HBV, Adenovirus, many animal viruses, and others.

Vindicator is available at the UK Supply Center (Item #307680)

<https://auxweb.ad.uky.edu/UKSupplyCenter/>

<https://www.hillyard.com/images/ProductData/HIL00168.pdf>

<http://www.hillyard.com/Images/MSDS/MSDSHIL00168.pdf>

Lysol I.C. is another quaternary ammonium disinfectant that can be purchased through Fisher Scientific. A dilution of 1:256 and contact time of 10 minutes are recommended. Lysol I.C. is a highly-concentrated hospital approved disinfectant that provides virucidal, fungicidal, and bactericidal protection in the presence of up to 5% organic matter.

<http://www.reckittprofessional.com/productpromain/ProductSearch.do?brandId=2&productLineId=16&searchType=PL&template=1>

Hil-Phene is a broad spectrum phenolic disinfectant typically used at a dilution of 1-5% which is also tuberculocidal. Contact time of 10 minutes is recommended. Hil-Phene provides effective disinfection for HIV and many other infectious agents.

<http://www.hillyard.com/Images/MSDS/MSDSHIL00191.pdf>

<http://www.hillyard.com/images/ProductData/HIL00191.pdf>

Hospital approved disinfectants from other suppliers are also acceptable in a laboratory situation. Consult manufacturer directions to determine efficacy against the biohazards used in your lab. These could include household bleach, quaternary ammonium compounds, and Phenolic compounds. Various disinfectants are discussed in detail below.

Chlorine (Sodium Hypochlorite)

Chlorine, a fast-acting oxidant, is a widely available and broad-spectrum chemical disinfectant. It is normally sold as household bleach, an aqueous solution of sodium hypochlorite (NaOCl), which can be diluted with water to provide various concentrations of available chlorine. Chlorine is highly alkaline and can be corrosive to metal. The disinfectant activity of chlorine is considerably reduced by organic matter (protein). Storage of stock or working solutions of bleach in open containers, particularly at high temperatures, may release chlorine gas thus weakening their disinfectant potential. **Undiluted household bleach stored at room temperature in the original container has a shelf-life of approximately one year.** Working solutions of bleach should be prepared on a daily basis. Household bleach (typically 5.25% NaOCl, check the label) should be diluted 1:10 to obtain final concentration of 0.5% NaOCl. Industrial solutions of bleach have a higher sodium hypochlorite concentration and must be diluted accordingly to obtain the correct concentration. To increase the efficacy of sodium hypochlorite solutions against spores, vinegar may be added to the solution. Combine 5 ounces of household bleach with one gallon of water and add 8 ounces of 5% distilled white cooking vinegar to the diluted bleach solution. Chlorine gas is highly toxic. Bleach must therefore be stored and used in well-ventilated areas only. Undiluted bleach must not be mixed with acids or other incompatible chemicals, such as ammonia containing compounds, to prevent the rapid release of chlorine gas. Many by-products of chlorine can be harmful to

Phenolic compounds

Phenolic compounds, a broad group of agents, were among the earliest germicides. However, more recent safety concerns restrict their use. They are active against vegetative bacteria and lipid-containing viruses and, when properly formulated, also show activity against mycobacteria. They are not active against spores and their activity against non-lipid-containing viruses is variable. Many phenolic products are used for the decontamination of environmental surfaces and some (e.g. triclosan and chloroxylenol) are among the more commonly used antiseptics. Some phenolic compounds are sensitive to and may be inactivated by water hardness and therefore must be diluted with distilled or deionized water. They may be absorbed by latex gloves and can also penetrate the skin. Phenolic compounds can be irritating to the skin and eyes and may have an associated odor.

Quaternary ammonium compounds

Many types of quaternary ammonium compounds are used as mixtures and often in combination with other germicides, such as alcohols, or detergents. They have good activity against some vegetative bacteria and lipid-containing viruses. The germicidal activity of certain types of quaternary ammonium compounds is considerably reduced by organic matter, water hardness, and anionic detergents. Care is therefore needed in selecting agents for pre-cleaning when quaternary ammonium compounds are to be used for disinfection. Potentially harmful

bacteria can grow in quaternary ammonium compound solutions. Quaternary ammonium compounds, properly diluted, have low odor and are not irritating.

Alcohols

Ethanol (ethyl alcohol, C₂H₅OH) and 2-propanol (isopropyl alcohol, (CH₃)₂CHOH) have similar disinfectant properties. They are active against vegetative bacteria, fungi, and lipid-containing viruses but not against spores. Their action on non-lipid-containing viruses is variable. For highest effectiveness they should be used at concentrations of approximately 70% (v/v) in water: higher or lower concentrations may not be as germicidal. A major advantage of aqueous solutions of alcohols is that they do not leave any residue on treated items. Mixtures with other agents are more effective than alcohol alone, for example 70% (v/v) alcohol with 100 g/L formaldehyde and alcohol containing 2 g/L available chlorine. A 70% (v/v) aqueous solution of ethanol can be used to soak small pieces of surgical instruments. A contact time of ten minutes or more is necessary. Ethanol should never be used to disinfect hands since ethanol can dry the skin. Alcohol-based hand-rubs, alcohol mixed with emollients, are recommended for the decontamination of lightly soiled hands in situations where proper hand-washing is inconvenient or not possible. However, it must be remembered that ethanol is ineffective against spores, HBV, Mycobacterium tuberculosis (TB) and may not kill all types of non-lipid-containing viruses. Alcohols are volatile and flammable and must not be used near open flames. Do not use 70% ethanol to clean a Class II, Type A recirculating biosafety cabinet. The vapors from ethanol are flammable and the lower explosive limit (LEL) for ethanol is easily attained. Working solutions should be stored in proper containers to avoid the evaporation of alcohols. Alcohols may harden rubber and dissolve certain types of glue. Proper inventory and storage of ethanol in the laboratory is very important to avoid its use for purposes other than disinfection. Bottles with alcohol-containing solutions must be clearly labeled to avoid autoclaving.

Iodine and Iodophors

The action of these disinfectants is similar to that of chlorine, although they may be slightly less inhibited by organic matter. Iodine can stain fabrics and environmental surfaces and is generally unsuitable for use as a disinfectant. On the other hand, iodophors and tinctures of iodine are good antiseptics. Povidone-iodine is a reliable and safe surgical scrub and preoperative skin antiseptic. Antiseptics based on iodine are generally unsuitable for use on medical/dental devices. Iodine should not be used on aluminum or copper. Iodine can be toxic. Organic iodine-based products must be stored at 4–10°C to avoid the growth of potentially harmful bacteria in them.

Common Liquid Disinfectants		Usage Requirements		Active Against (positive effect +, no effect -, variable effect *)						
Category	Example	Dilution	Contact Time (mins)	Vegetative Bacteria	Bacterial Spores	Lipoviruses	Non-lipid viruses	HIV	HBV	Tb
Quaternary Ammonium Compounds	Vindicator+	0.1-2%	10-30	+	+	+	-	+	-	-
	Lysol I.C.	1-2.5%	10	+	+	+	-	+	-	+
Phenolics	Hil-Phene	1-5%	10-30	+	-	+	*	+	*	+
Chlorine	Clorox	5-10%	10-30	+	+	+	+	+	+	+
Iodophors	Wescodyne	0.5-10%	10-30	+	-	+	+	+	+	+
Ethyl Alcohol		70-85%	10-30	+	-	*	*	+	*	-
Isopropyl Alcohol		70-85%	10-30	+	-	*	*	+	*	-
Formaldehyde	Sterac	0.2-8%	10-30	+	+	+	+	+	+	+
Glutaraldehyde	Cidex	2%	10-30	+	+	+	+	+	+	+

References:

World Health Organization Laboratory Biosafety Manual,
<http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf>

EPA Approved Disinfectants Website,
<http://www.epa.gov/oppad001/chemregindex.htm>

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