

University Occupational Health and Safety Guidance Notes

SELECTION AND USE OF DISINFECTANTS

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1. PURPOSE

Safe and effective decontamination of work surfaces, equipment, consumables and liquid waste is important in managing the risks associated with work involving infectious biological agents. Disinfection is not as effective or as easily monitored for efficacy as steam sterilisation in destroying biological agents but may be used for decontaminating equipment, reusable items and for the treatment of liquid wastes which may not be suitable for autoclaving.

This document provides information on the selection and use of appropriate disinfectants. It should be used in conjunction with the Occupational Health and Safety Standard for Biological Safety.

2. SCOPE

This document applies to all staff, post graduate students and visitors (for example visiting academics) who are required to make use of disinfectants for the purpose of decontamination within the scope of activities using biological material.

3. APPLICATION OF COSHH TO THE USE OF DISINFECTANTS

Under the requirements of the COSHH regulations, a risk assessment must be made for the safe handling of disinfectants. Most disinfectants are toxic and some are also corrosive. The COSHH risk assessment must state the controls and personal safety measures to be taken when handling concentrated and working dilutions of disinfectant. Safety data sheets can be obtained from manufacturers. It should be noted when carrying out a COSHH assessment that some disinfectants release hazardous gases when mixed with other chemicals or with organic materials, or upon autoclaving. Different disinfectants must not be mixed together, used in combination, or autoclaved unless the possibility of the formation of toxic products has been properly assessed.

4. CHOOSING AN APPROPRIATE DISINFECTANT

Chemical disinfectants reduce the number of viable micro-organisms to a level below which infectivity is destroyed and the disinfected object rendered safe to handle. Reduction in titre should be at least 10^5 . In some cases it may be necessary to test the efficacy of the disinfectant in house.

Disinfection is not an alternative to sterilisation, but chemical disinfection may, where appropriate, be followed by autoclave treatment or by incineration.

The following factors should be considered when selecting an appropriate disinfectant:

4.1 The micro-organism

Disinfectants vary both in the spectrum of micro-organisms inactivated (Table 1) and in specific activity for different micro-organisms. Disinfectant manufacturers can provide details of the activity of their product for particular micro-organisms and recommend appropriate dilutions. When the type(s) of micro-organism present in a sample(s) is not known a wide-spectrum disinfectant must be used.

4.2 The circumstances under which the disinfectant will be used

The optimal concentration of disinfectant will vary depending on whether it is used under "dirty" or "clean" conditions. The efficacy of a disinfectant against viruses may be altered if the virus is intracellular. The presence of other chemicals or organic materials in liquid wastes or on the surface to be decontaminated can inhibit disinfection activity. Disinfectant activity may also be affected by temperature, pH, or even by the "hardness" of the water used to dilute the product. Further advice on appropriate dilutions of disinfectants for use under particular conditions should be available from manufacturers.

4.3 The nature of the surfaces or equipment to be disinfected

Disinfectants containing electrolytes, strong acids, alkalis, or hypochlorites can chemically attack stainless steel and other metals resulting in corrosion or pitting of surfaces. Disinfectants containing organic solvents may similarly affect the integrity of plastic surfaces.

In contrast to these unwanted effects, some disinfectants have a surface-active (detergent) component which allows for simultaneous cleaning and disinfection of contaminated surfaces. Such disinfectants are especially useful in decontamination where blood or other body fluids have been spilt. Manufacturers will provide advice on the suitability of using their product on particular surface materials.

5. USE OF DISINFECTANTS

5.1 Stability of working dilutions

Once diluted, the activity of disinfectants decays with time. Even 'stock' concentrated hypochlorite will lose half the available chlorine in three months, with decay much more rapid in more dilute solutions. Some products (e.g. Virkon) contain a coloured indicator to show effective disinfection capacity. Manufacturers will recommend an active-life for their products in concentrated form and when diluted to working strength. If the disinfectant does not contain a colour indicator the expiry date should be clearly marked on the container when the working strength solution is prepared.

5.2 Concentration and contact time

Disinfectants must remain in contact with the micro-organism at a specific concentration for the appropriate length of time to be effective. The contact time between the disinfectant and the contaminated material can be critical. Disinfectants must remain in contact with micro-organisms for a period of time sufficient to achieve disinfection. Manufacturers should recommend appropriate combinations of disinfectant concentrations and contact times for various applications.

5.3 Validation

Where little or no relevant efficacy data is available (e.g. when working with high titres or with significant quantities of organic material), the effectiveness of disinfectants for use with specific biological agents should be determined experimentally to identify the optimal combination of disinfectant concentration and contact time. Thereafter, standards should be established for local use to enable the performance of the disinfectant to be critically assessed, especially when changes in working practices, new micro-organisms or new materials are proposed.

5.4 Wet discard jars

Containers of working strength disinfectant must be placed at, or close to, each work-station where waste is generated. Items placed in discard containers should be completely immersed in the disinfectant, and care taken to ensure that air bubbles do not prevent contact with surfaces to be disinfected. If liquid waste is to be decanted to a discard jar the amount of concentrated disinfectant in the jar must allow for dilution to the final working strength.

Discard jars must not be allowed to become reservoirs for infection, they should be washed thoroughly and if possible autoclaved before refilling.

5.5 Decontamination of Working Surfaces

Benches and other working surfaces should be cleaned with disinfectant at the end of each working day as a matter of routine. Work surfaces that are contaminated with blood or other body fluids must immediately be treated with disinfectant. Control measures to avoid the hazard to health posed by the disinfectant must be taken during disinfection procedures.

6. TYPES OF DISINFECTANT

The activities and characteristics of the common classes of disinfectant have been shown in Tables 1 and 2. Examples of commonly used disinfectants and additional comments are given below:

6.1 Phenolics (eg Hycolin, Stericol, Clearsol)

Phenol is an effective protein denaturant which, when in contact with membranes, results in lysis of the micro-organism. Some phenolic disinfectants also contain detergents that result in synergistic activity. Concentrates are stable but stability is reduced on dilution. The agent of choice for mycobacteria disinfection damages the surface of many plastics.

6.2 Chlorine containing or Generating Compounds (e.g. Hypochlorite, Chlorox, Presept)

Rapid action probably due to protein denaturation. Chlorine gas is released when mixed with strong acids and some other chemicals. Carcinogens may be produced when mixed with formaldehyde.

Common dilutions of hypochlorite for the following applications are:

- General use, 1-2,500 ppm available chlorine; Discard containers, 5-10,000 ppm available chlorine;
- Treatment of accidental spillages, 20,000 ppm available chlorine. (Disinfection of TSE infected material)

These compounds generally decompose more rapidly once diluted. In addition some commercial products contain a perfume (analogous to that added to natural gas to enable its detection by smell) which can persist beyond the active life of the solution. Organic chlorine-releasing compounds, e.g. Chloramines, have the advantage that chlorine is not liberated so readily and so exert a more prolonged disinfectant effect. Hypochlorite's (not Presept) are the only disinfectants known to inactivate the prions that are presumed to cause transmissible spongiform encephalopathys.

6.3 Alcohols (e.g. Ethanol, Propanol, Industrial Methylated Spirits)

The efficacy of alcohols as disinfectants is generally poor and highly susceptible to interference. They produce a very rapid kill of bacteria and some viruses probably by denaturation of protein, but should only be used on physically clean surfaces as alcohols have poor penetration of organic matter. Alcohols must be diluted (70% ethanol; 60% propanol) before use (100% alcohol is not an effective disinfectant). Due to their flammability alcohols require appropriate precautions during storage and in use. They should not be used in microbiological safety cabinets or on large areas.

6.4 Aldehydes (e.g. Cidex, Gluteraldehyde, Formaldehyde)

The use of formaldehyde for disinfection (and fumigation) is discouraged and an alternative should be sought. These chemicals have irritant and toxic properties and are extremely hazardous.

6.5 Surface-Active Agents (e.g. Cetrimide, Tego)

These are relatively non-toxic and non-irritant but are inactivated by organic matter and anionic detergents, e.g. soap.

6.6 Peroxygen compounds (Virkon)

Virkon has a wide range of bactericidal, virucidal, fungicidal and sporocidal activities. Representative viruses from all the major virus families are inactivated by Virkon. Working solutions of 1% w/v have low toxicity and no irritancy. In powder form it is a moderately irritant for eyes and the respiratory tract. It has a built-in colour indicator for effective disinfection capacity and contains detergent properties that combine cleaning with disinfection. Virkon is stable for seven days in solution.

There is some evidence however that Virkon can be corrosive for lower quality steel surfaces, and can attack certain plastics.

Other disinfectants (skin disinfectants, e.g. Hibiscrub, Hibitane, Betadine, pHisomed, Cidal etc., or household disinfectants, e.g. bleach) are not suitable for use as general laboratory disinfectants.

DISINFECTANT TYPE	ACTIVE AGAINST						
	Vegetative bacteria	Bacterial spores	Fungi	Enveloped viruses	Non-Enveloped viruses	Mycobacteria	TSE and prion agents
Phenolic	+	-	+	+	2	+	-
Hypochlorites	+	+	1	+	+	1	+
Alcohols	+	-	-	+	+	+	-
Aldehydes	+	+	+	+	+	+	-
Surface active agents	+	-	1	2	2	-	-
Peroxygen compounds (Virkon)	+	+	+	+	+	+	-

Table 1. Activities of some Common Classes of Disinfectants

- + Generally Effective
- Generally Ineffective
- 1. Limited activity
- 2. Depends on the virus

DISINFECTANT TYPE	INACTIVATED BY					
	Hazard Class	Organic matter	Hard water	Detergent	Corrosive to metals	Flammable
Phenolic	Toxic	-	+	1	-	-
Hypochlorites	Toxic Corrosive	+	-	1	+	-
Alcohols	Harmful Flammable	-	-	-	-	+
Aldehydes	Very Toxic Irritant	-	-	-	-	-
Surface active agents		+	+	2	-	-
Peroxygen compounds (Virkon)	Irritant (dust)	-	-	-	3	-

Table 2. Characteristics of some Common Classes of Disinfectants

1. Inactivated by cationic detergents - can alter effectiveness
2. Inactivated by anionic detergents - no alteration in effectiveness
3. Can corrode lower quality steel on prolonged contact

7. DISINFECTION AND SPILLS OF BIOLOGICAL AGENTS

Procedures for dealing with accidental spills of biological agents should always be part of the COSHH Risk Assessment. Containers of disinfectant at an appropriate concentration should be available at each work station where biological agents are handled. In the case of an accidental spillage a disinfectant that gives a rapid kill is required. Disinfectants supplied in powder or granular form (e.g. Virkon and Presept) and gelating agents that contain disinfectant are especially useful for sprinkling over spills. In contrast, liquid disinfectant added to a spill increases the surface area of the spill and may also result in splashing. This can be minimised however by covering the spill with tissues before pouring on the liquid disinfectant.

Further information: Guidance Notes on '[Dealing with spillages of biological agents](#)'.