Decontamination

Principal Investigators are responsible for identification and proper application of approved disinfectants for use in their respective laboratories. Part of this process includes knowledge of the disinfectants contact time required to reduce the infectious materials to acceptable levels. In most cases acceptable levels are minimization of the agent to levels below the infectious dose for healthy adults. Immuno-compromised or other individuals who are more susceptible to infections should be identified prior to allowing them to work with the agent and allowed to work in the laboratory only after consulting with the individual's physician and making the appropriate accommodations. Disinfection is different than sterilization. Sterilization processes are typically used for waste materials and will kill all living organisms.

Chemical Decontamination

Disinfection is often accomplished by using chemicals which may require additional personal protective equipment. Care should be taken when applying the disinfectant so aerosols of the agent are not generated. This can be especially important when attempting to decontaminate a spilled culture. It is prudent to try to soak an absorbent material with the chemical and gently lay the saturated towel on the spill. This method is less likely to aerosolize the agent than splashing or spraying the disinfectant directly on the spill.

Factors to consider when disinfecting:

Solid, smooth, non-porous surfaces tend to require less contact time to be effective. All activities should take place on these surfaces when ever possible.

The higher the organic material, such as blood and tissues and/or concentration of microorganisms will require more contact time and possibly a higher concentration of the disinfectant.

Cold temperatures will often reduce the effectiveness of the chemical and the metabolism of the organism. Increase contact time.

Commonly Used Liquid Disinfectants

It is important to know which disinfectant will work effectively on the organism you are using in the laboratory. Ideally you want the least concentrated solution of the chemical that can be effective with a reasonable contact time. Toxicity to personnel and corrosivity to surfaces and equipment become serious considerations when the chemical is in too high a concentration. In the case of ethanol a 70% solution is typically more effective than a more concentrated solution. Use of a disinfectant solution that is too dilute may increase required contact time beyond practical limits

Alcohols

Ethyl alcohol or isopropanol are good disinfectants for general use around the laboratory. They work best on smooth surfaces due to fast evaporation rates the contact time is limited. Alcohols are generally pretty safe to use and don't leave behind residue but are flammable so caution is needed around open flames. They are fast acting and germicidal against a wide variety of organisms but not typically effective against endospore forming bacteria. The alcohols require some water to be effective so a 70%-90% concentration dilute with water tends to be ideal for disinfection. Alcohols will safely combine with other chemicals to increase the killing ability. A mixture of 60% ethanol and 0.01N HCl (pH 4) greatly increase cidal activity against non-lipid viruses such as poliovirus and adenoviruses.

Phenol and Phenol Derivatives

Phenols and phenol based disinfectants exhibit low solubility in water and are typically used in low concentrations of 5% to 10%. Solubility in improved with the addition of a detergent and will usually increase effectiveness. Phenol compounds are inexpensive and useful disinfectant against a wide variety of vegetative bacteria including Mycobacterium, enveloped viruses, and fungi especially on surfaces. The phenol derivatives tend to stay stable after mixing and work against a wide variety of microorganisms, work well in the presence of organic materials and a wide range of pH levels. The disadvantages include the unpleasant odor, residue makes it inappropriate for food preparation areas, and phenol is toxic so one should be careful to avoid prolonged skin contact and wear appropriate personal protective equipment

Quaternary Ammonium Compounds (Quats)

Quats are effective disinfectants even in low concentrations especially for surface disinfection but can easily be inactivated by organics, salts, metals, soaps, or certain detergents. Adding phenol in appropriate concentrations will increase the effectiveness. Gram positive bacteria and enveloped viruses are most susceptible to quats but are active against many Gram negative organisms and most fungi. Endospores are typically resistant. Besides being stable and having relatively little odor the biggest advantage of quats is they can be used in food preparation areas and general cleaning due to low toxicity. Quats are common kitchen and bathroom products such as Scrubbing Bubbles and are typically considered one of the safest disinfectants in use.

Halogens (Chlorine)

Chlorine containing disinfectant solutions are desirable for disinfection due to their broad spectrum activity. Sodium hypochlorite is the active ingredient in household bleach and will yield approximately 5% chlorine. Typical dilutions of household bleach for common disinfection are 1/10 or 1/100 for common disinfection. A 1/100 dilution would yield a solution with 500 ppm available chlorine which is very effective against most vegetative

fungi, bacteria viruses. Higher concentrations at increased contact times can be considered sterilants as they demonstrate sporicidal activity. Rapid sporicidal action can be obtained at about 2500ppm. With higher concentrations the corrosivity characteristics of chlorine (especially hypochlorite) often become an issue and can damage equipment and surfaces. Soaking solutions with approximately 2000 ppm are commonly used to decontaminate equipment. A one percent hypochlorite solution is recommended for destruction of the Hepatitis B antigen

Wear appropriate PPE when handling high concentrations of chlorine as it is a strong oxidizer and can quickly damage eyes, skin and mucous membranes. Organics can significantly reduce the effectiveness. Chlorine activity will decline at a fairly rapid rate over time and it is generally recommended to mix fresh solutions at least weekly. Household bleach can be used for up to a year if stored in the dark in a closed container. Fresh (daily) solutions should be used for spills or when using high concentrations of infectious materials.

Halogens (Iodine)

Iodine has similar properties to chlorine. Iodophors (organically bound iodine) are recommended disinfectants. They are most often used as antiseptics and in surgical soaps and are relatively nontoxic to humans. Although these show poor activity against bacterial spores, they are recommended for general use (70 to 150 ppm total iodine). They are effective against vegetative bacteria, fungi and viruses.

- Combine iodine with non-ionic detergent.
- Rapid biocidal action.
- Effective against Gram positive and Gram negative organisms, and tubercle bacilli.
- Most effective in acid solutions.
- Vaporized at 120°F to 125°F so they should not be used in hot water.
- Effectiveness reduced by organic matter (but not as much as with hypochlorites).
- Stable in storage if kept cool and tightly covered.
- Iodophors are relatively harmless to man.
- Iodophors have a built-in indicator. If the solution is brown or yellow, it is still active.
- Iodophors can be readily inactivated and iodophor stains can be readily removed with solutions of sodium thiosulfate.
- Tarnish silver, silverplate, and copper.

For optimal cidal activity, dilute with warm, acidic water. Resulting solutions are less stable but have a higher biocidal activity.

Formalin

Formalin is 37% solution of formaldehyde in water. Dilution of formalin to 5% results in an effective disinfectant. Formaldehyde is a human carcinogen and creates respiratory problems at low levels of concentration.

> Formaldehyde Solutions At a concentration of 8% formaldehyde exhibits good activity against vegetative bacteria, spores, and viruses.
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> FormaldehydeAlcohol Solutions of 8% formaldehyde in 70% alcohol are considered very good for disinfection purposes because of their effectiveness against vegetative bacteria, fungi, spores and viruses. For many applications, this is the disinfectant of choice.

Activated Gluteraldehyde Two percent solutions exhibit good activity against vegetative bacteria, spores, and viruses. Its use, however, must be limited and controlled because of its toxic properties and the damage to eyes. Limited stability after activation (for alkaline gluteraldehyde).

Vapors and Gases

A variety of vapors and gases possess germicidal properties. The most commonly used are formaldehyde and ethylene oxide. Applied in closed systems under controlled conditions (e.g., humidity) these gases achieve sterility.

Formaldehyde gas is primarily used in the decontamination of spaces or biological containment equipment like biological safety cabinets. Formaldehyde is a toxic substance and a suspected human carcinogen. Considerable caution must be exercised in handling, storing, and using formaldehyde.

Ethylene oxide is used in gas sterilizers under controlled conditions. Ethylene oxide is also a human carcinogen and monitoring is necessary during its use.

Radiation

Gamma and X-ray are two principal types of ionizing radiation used in sterilization. Their application is mainly centered on the sterilization of prepackaged medical devices.

Ultraviolet (UV) radiation is a practical method for inactivating viruses, mycoplasma, bacteria and fungi. UV radiation is successfully used in the destruction of airborne microorganisms. UV light sterilizing capabilities are limited on surfaces because of its lack of penetrating power.