6.15C: Types of Disinfectants

There are multiple types of disinfectants, including but not limited to air disinfectants, alcohols, and oxidizing agents.

LEARNING OBJECTIVES

List the types of disinfectants available

KEY TAKEAWAYS

Key Points

- Air disinfectants are typically chemical substances capable of disinfecting microorganisms suspended in the air.
- Alcohols, usually ethanol or isopropanol, are sometimes used as a disinfectant, but more often as an antiseptic.
- Oxidizing agents act by oxidizing the cell membrane of microorganisms, which results in a loss of structure and leads to cell lysis and death.

Key Terms

- **disinfectants**: Disinfectants are substances that are applied to non-living objects to destroy microorganisms that are living on the objects. Disinfectants are substances that are applied to non-living objects to destroy microorganisms that are living on the objects.
- **microorganisms**: A microorganism or microbe is a microscopic organism that comprises either a single cell (unicellular), cell clusters, or multicellular relatively complex organisms.
- **antiseptic**: Any substance that inhibits the growth and reproduction of microorganisms. Generally includes only those that are used on living objects (as opposed to disinfectants) and aren’t transported by the lymphatic system to destroy bacteria in the body (as opposed to antibiotics).

Types of disinfectants include: Air disinfectants, Alcohols, Aldehydes, Oxidizing agents, Phenolics, Quaternary ammonium compounds, Silver, and Copper alloy surfaces.

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### Air Disinfectants

Air disinfectants are typically chemical substances capable of disinfecting microorganisms suspended in the air. Disinfectants are often assumed to be limited to use on surfaces, but that is not the case. In 1928, a study found that airborne microorganisms could be killed using mists of dilute bleach. An air disinfectant must be dispersed either as an aerosol or vapor at a sufficient concentration in the air to cause the number of viable infectious microorganisms to be significantly reduced.

In the 1940s and early 1950s, further studies showed inactivation of diverse bacteria, influenza virus, and *Penicillium chrysogenum* (previously *P. notatum*) mold fungus using various glycols, principally propylene glycol and triethylene glycol. In principle, these chemical substances are ideal air disinfectants because they have both high lethality to microorganisms and low mammalian toxicity.

Although glycols are effective air disinfectants in controlled laboratory environments, it is more difficult to use them effectively in real-world environments because the disinfection of air is sensitive to continuous action. Continuous action in real-world environments with outside air exchanges at door, HVAC, and window interfaces, and in the presence of materials that adsorb and remove glycols from the air, poses engineering challenges that are not critical for surface disinfection. The engineering challenges associated with creating a sufficient concentration of the glycol vapors in the air have not to date been sufficiently addressed.

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### Alcohol Disinfectants

Alcohols, usually ethanol or isopropanol, are sometimes used as a disinfectant, but more often as an antiseptic, the distinction being that alcohol tends to be used on living tissue rather than nonliving surfaces. These alcohols are non-corrosive but can be a fire hazard. They also have limited residual activity due to evaporation, which results in brief contact times unless the surface is submerged. They also have a limited activity in the presence of organic material.

Alcohols are most effective when combined with purified water to facilitate diffusion through the cell membrane; 100% alcohol typically denatures only external membrane proteins. A mixture of 70% ethanol or isopropanol diluted in water is effective against a wide spectrum of bacteria, though higher concentrations are often needed to disinfect wet surfaces. Additionally, high-concentration mixtures (such as 80% ethanol + 5% isopropanol) are required to effectively inactivate lipid-enveloped viruses (such as HIV, hepatitis B, and hepatitis C). Alcohol is only partly effective against most non-enveloped viruses (such as hepatitis A), and is not at all effective against fungal and bacterial spores.

The efficacy of alcohol is enhanced when in solution with the wetting agent dodecanoic acid (coconut soap). The synergistic effect of 29.4% ethanol with dodecanoic acid is effective against a broad spectrum of bacteria, fungi, and viruses. Further testing is being performed against *Clostridium difficile* (*C. Diff*) spores using higher concentrations of...
ethanol and dodecanoic acid, which has been indicated to be effective with a contact time of ten minutes.

Aldehydes, such as formaldehyde and glutaraldehyde, have a wide microbiocidal activity and are sporocidal and fungicidal. They are partly inactivated by organic matter and have slight residual activity. Some bacteria have developed resistance to glutaraldehyde; it has also been found that glutaraldehyde can cause asthma and other health hazards, hence ortho-phthalaldehyde is replacing glutaraldehyde.

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**Oxidizing Disinfectants**

Oxidizing agents act by oxidizing the cell membrane of microorganisms, which results in a loss of structure and leads to cell lysis and death. A large number of disinfectants operate in this way. Chlorine and oxygen are strong oxidizers, so their compounds figure heavily here.

Phenolics are active ingredients in some household disinfectants. They are also found in some mouthwashes and in disinfectant soap and handwashes.

Quaternary ammonium compounds (quats), such as benzalkonium chloride, are a large group of related compounds. Some concentrated formulations have been shown to be effective low-level disinfectants. Typically, quats do not exhibit effectiveness against difficult to kill non-enveloped viruses such as norovirus, rotavirus, or polio virus.