Use of Chlorine Compounds as Disinfectants

SafetyNet #: 68

Application
Chlorine, commonly in the form of hypochlorites, is a broad spectrum and inexpensive disinfectant that is active against most microorganisms, including bacterial spores. Potential applications for chlorine in the laboratory and vivarium as a disinfectant are:

- Work surfaces
- Contaminated glassware
- Surface decontamination of fixed or portable equipment and cages
- Liquids treated for discard
- As foot bath prior and/or post vivarium entry

Use In The Laboratory
Many active chlorine compounds are available at various strengths; however, the most widely used for chemical disinfection is sodium hypochlorite. Household or laundry bleach is a solution of 5.25% or 52,500 ppm of sodium hypochlorite. Note that a 10% or 1:10 dilution of bleach will result in a 0.525% or 5250 ppm solution of chlorine.

The Center for Disease Control (CDC) recommends 500 ppm (1:100 dilution of household bleach) to 5000 ppm (1:10 dilution of bleach), depending on the amount of organic material present, to inactivate Human Immunodeficiency Virus. The strength of chlorine to be used for disinfection must be clearly indicated when described in the Biological Agent Use Authorization and/or training documentation such as standard operating procedures.

Stability Of Chlorine Solutions
Chlorine solutions will gradually lose strength, so fresh solutions must be prepared frequently. Diluted solutions should be replaced after 24 hours. The chlorine solution should have the following characteristics for maximum stability:

- Low chlorine concentration
- Absence or low content of catalysts such as nickel or copper
- High alkalinity
- Low temperature
Absence of organic materials
- Shielded from ultraviolet light by storage in the dark in closed containers

Factors Affecting Chlorine Biocidal Activity
The following characteristics will affect the biocidal activity of chlorine solutions:
- Chlorine is more effective at a lower pH.
- An increase in temperature produces an increase in bactericidal activity.
- A fourfold increase of chlorine will result in a 50% reduction in killing time and a twofold increase in a 30% reduction.
- Organic material will consume available chlorine. If the organic material contains proteins, the reaction with chlorine will form chloramines that will have some antibacterial activity. Loss due to organic materials is more significant if minute amounts of chlorine are used. Footbaths are frequently contaminated with organic material and may require more frequent changing than the 24 hours previously stated.
- Hardness of the water does not have a slowing effect on the antibacterial action of sodium hypochlorite.
- Addition of ammonia and nitrogen compounds will slow the bactericidal action of chlorine.

Other Available Chlorine Compounds
Other active chlorine compounds that are available are liquid chlorine, chlorine dioxide, inorganic chloramines, organic chloramines, and halazone.

Characteristics and Hazards
Chlorine combines with protein and rapidly decreases in concentration in its presence. It is also inactivated to some extent by natural non-protein material and plastics and is not compatible with cationic detergents. It is a strong oxidizing agent that is corrosive to metals. Chlorine should not be used on the metal parts of centrifuges and other machines that are subject to stress when in use. Do not autoclave chlorine solutions or materials treated with them, as the residual chlorine can vaporize resulting in an inhalation hazard. Chlorine should not be used in combination with ammonia, acetylene, butadiene, butane, methane, propane (or other) petroleum gases, hydrogen, sodium carbide, benzene, finely divided metals, or turpentine.

Chlorine is toxic and may cause irritation to the eyes, skin, and lungs. For additional hazard information, see the Safety Data Sheet for sodium hypochlorite, aqueous solution. Wear safety goggles, rubber gloves, aprons, or other protective clothing when handling undiluted solutions.

Note: The US EPA and Cal EPA have defined disinfectants (antimicrobials) as pesticides. All EPA-registered antimicrobials must be used according to California worker safety regulations. This includes bleaches such as Clorox and Purex and other commonly used chlorine cleaner/disinfectants.

Information
For additional information regarding California worker safety regulations or for assistance and additional information, contact EH&S or refer to EH&S SafetyNet #85 [1] "Antimicrobials are
Pesticides”.

Additional Information and Links

- Chlorine Chemistry Council [2]
- Cleaning and Disinfecting [3]

Contact

Biological Safety Office
biosafety@ucdavis.edu 530-752-1493
FAX: 530-752-4527

More information

Related content

1. Antimicrobials are Pesticides

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