CLEANING AND DISINFECTING IN THE FOOD PROCESSING INDUSTRY

I. INTRODUCTION

Why Clean?

Effective cleaning of equipment in the food processing industry reduces chances for contamination of food during preparation, processing, storage and serving. The first step in the practical application of a sanitation program is to render the surface clean. This will reduce to a degree the number of microorganisms present and eliminate one essential need for life - "food". The surviving microorganisms will be left unfed, unprotected and highly susceptible to final disinfecting and sanitizing treatment. Cleaning minimizes attraction of other lower forms of life, increases life of equipment, improves employees morale and efficiency and is important for aesthetic considerations.

II. DEFINITION OF TERMS

A. Cleaning - A process which will remove soil and prevent accumulation of food residues which may decompose or support the growth of disease or nuisance causing organisms and/or the production of toxins.

B. Soil - Appropriately defined as "matter-out-of-place". For example, grease on a gear is a lubricant, but that same grease on a table top becomes "soil".

C. Sanitization (sanitizing) - Application of any effective method or substance to a clean surface for the reduction of the bacterial count of pathogens, to a safe and acceptable level and of other organisms as far as is practicable. Such treatment shall not adversely affect the equipment, the product, or the health of the consumer and shall be acceptable to the health authority.

D. Disinfecting- The primary purpose of disinfecting (the killing of microorganisms) is to control disease, and prevent the spoiling of food. Cleaning alone is effective in removing some bacteria food supplies and waste products. Cleaning alone, however, is not adequate to reduce the bacteria population to an acceptable low level. This fact was established many years ago in hospitals, dairies, bottling plants, canneries, and other food processing industries. As soon as the cleaning process is completed, the bacteria continue to build up at a rapid rate. Disinfecting, on the other hand, at the same frequency of application, reduces the bacteria count to an extremely low level and their multiplication is markedly reduced.

III. WATER

The primary constituent of all food processing plant cleaners is water. Basic water requirements common to all food processing operations are that it must be free from disease producing organisms, toxic metal ions, and objectionable odours and tastes. Pure water presents no problems, but no food processing establishment has an ideal water supply. Therefore, the cleaning compounds must be tailored to the individual water supply and type of operation.

Water impurities effecting cleaning.

A. Suspended matter must be kept to a minimum to avoid deposits on clean equipment surfaces. Suspended matter can be removed only by treatment

B. Soluble iron and manganese salts - concentrations above 0.3 ppm will cause coloured deposits on equipment surfaces. Soluble iron and manganese can be removed only by treatment.

C. Water Hardness

Water hardness due to salts of calcium and magnesium present a major problem in the use of cleaners by reducing effectiveness and by forming surface deposits. Water hardness can be reduced or eliminated by passing the water trough a softener.

<u>Types of Hardness</u>

1. Carbonate hardness (formerly called temporary hardness) is due to calcium and magnesium carbonates and bicarbonates and can be removed by heating.

2. Non-carbonate hardness (formerly called permanent hardness) is due to calcium sulphate, calcium chloride, magnesium sulphate, and magnesium chloride, which cannot be removed by heating.

IV. FUNDAMENTALS OF CLEANING

The components of commercial cleaning compounds modify the nature of water so that it may efficiently penetrate, dislodge, and carry away surface contamination (soil). Although energy is put into the system (generally, in the form of heat and applied force), cleaning compounds decrease the external energy requirements by increasing the internal potential energy of the water.

The components required for adequate cleaning of food plant equipment generally are rather complex mixtures of chemicals combined to achieve a specific purpose. Before the basic characteristics of cleaning compounds can be considered, the fundamental phenomenon involved in the cleaning process needs to be reviewed. In this respect, it is helpful to consider cleaning in terms of a series of four (4) steps.

1. Bringing the cleaning solution into intimate contact with the soil to be removed by means of good wetting and penetrating properties.

2. Displacement of the solids and liquid soils from the surface to be cleaned by saponifying the fat, peptizing the proteins, and dissolving the minerals.

3. Dispersion of the soil in the solution by dispersion, deflocculation or emulsification.

4. Preventing re-deposition of the dispersed soil back onto the clean surface by providing good rinsing properties.

<u>NATURE OF THE SOIL</u>

Cleaning compound composition, concentration, and cleaning method are dependent upon the type of soil on the surface to be cleaned. Soils from food will vary as a function of the composition of the food and processing conditions. Food constituents are markedly different in their solubility characteristics and in their susceptibility to cleaning as shown below:

COMPONENT ON SURFACE	SOLUBILITY CHARACTERISTICS	EASE OF REMOVAL	CHANGES INDUCED BY HEATING SOILED SURFACE
Sugar	Water soluble	Easy	Caramelization, more difficult to clean
Fat	Water insoluble, alkali soluble	Difficult	Polymerization
Protein	Water insoluble, alkali soluble, slightly in acid	Very difficult	Denaturation, much more difficult to clean
Salts Monovalent	Water soluble, acid soluble	Easy	None
Polyvalent (i.e $CaPO_4$)	Water insoluble, acid soluble	Difficult	Interactions with other constituents, more difficult to clean

SURFACES INVOLVED

The surface of the material must be considered in cleaning compound selection for materials such as stainless steel, aluminum, marble, wood, plastic and painted surfaces. In these cases, the compatibility of the material with the cleaning compounds must be considered.

V. DEFINITION OF FUNCTIONS PERFORMED BY CLEANING AGENTS

The components of cleaning compounds are combined in such a manner as to complete the following functions:

A. Deflocculation or Dispersion - The action in which groups or clumps of particles are broken up into individual particles and spread out suspended in the solution.

B. Dissolving - The reaction which produces water soluble materials from water insoluble soil.

C. Emulsification - A process where fats are broken up into tiny globules and are suspended in the cleaning solution.

D. Penetration - The action of liquids entering porous materials through cracks, pin holes, or small channels.

E. Peptization - Physical formation of colloidal solutions from partially soluble materials.

F. Saponification - Action of alkali on fats resulting in the formation of soap.

G. Suspension - The action in which insoluble particles are held in solution and not allowed to settle out onto the utensils.

H. Rinsability - The action which will break the surface tension of the water in the solution and permit the utensil to drain dry.

I. Water softening

1. Precipitation - Softens water by precipitating out the hardness.

2. Sequestration - The action of an inorganic compound attaching itself to the water hardness particles and inactivates them so they will not combine with other material in the water and precipitate out.

3. Chelation - The same as sequestration except that an organic compound is used.

J. Wetting - Action of water in contacting all soil, helps to reduce surface tension, (wetting agents usually do a good job of emulsification).

K. Synergism - A chemical used as a builder with a soap or detergent, which results in a detergency which is greater than the total detergency of the chemical and the soap if they were used independently.

The chemicals used as cleaning compounds can be grouped into classes as follows:

CLASS OF COMPOUND	MAJOR FUNCTIONS
Basic Alkalis	Soil displacement/emulsifying, saponifying and peptizing
Complex phosphates	Soil displacement by emulsifying and peptizing; dispersion of soil; water softening, prevention of soil depositions
Surfactants	Wetting and penetrating soils; dispersion of soils and prevention of soil redepositions
Chelating	Water softening; mineral deposit control; soil displacement by peptizing; prevention of redepositions
Acids	Mineral deposit control; water softening

The relative effectiveness of various cleaning compound components in meeting all of the various functions are found in the Table below:

Properties of Detergents Degrees of Activity

Extreme = 4 High = 3 Medium = 2 Low = 1 None = 0

	STRONG ALKALIS	MILD ALKALIS	POLY-PHOSPHATE	MILD ACIDS	STRONG ACIDS	SURFAC-TANTS
Chelating	0	1	4	0	0	0
Saponifying	4	3	3	3	3	1
Wetting	1	2	1	1	0	4
Peptizing	4	3	1	2	3	0
Emulsifying	1	2	2	0	0	4
Dispersion	2	3	1	3	0	3
Rinsing	3	3	2	1	0	4
Corrosion	4	2	0	2	4	0

ACID TYPE CLEANERS

Acid type cleaners have been used in the food processing industry for milkstone removal and also, as part of the cleaning process on equipment. Such equipment as brew/broth tanks, ingrediators, and yeast tanks can now be cleaned most effectively by a two-phase circulation system, using an acid type cleaner as one phase. Mineral deposits on equipment are nearly impossible to remove with alkaline cleaners, and to varying degrees, an alkaline cleaner may even contribute to a mineral deposit. Consequently, some means of removing such mineral deposits must be employed. A wide choice of acid type cleaners is available. They are blends of organic acids, inorganic acids, or acid salts, usually, with the addition of wetting agents. To be effective, an acid type detergent should produce a pH of 2.5 or lower in the final use solution. It should work well in hard as well as soft water and show a minimum of corrosion on metals. The following lists tabulate the general characteristics of the acids.

CHARACTERISTICS OF INORGANIC ACIDS (MINERAL ACIDS)

1. Strong.
2. Corrosive; dangerous to metals, unless inhibited.
3. Low pH; due to high degree of ionization.
4. Irritating to skin.
5. High concentrations dangerous to handle.
6. Injurious to clothing.
7. Under certain conditions, some inorganic acids will precipitate some soluble salts.

EXAMPLES OF INORGANIC ACIDS

Muriatic acid
Sulphuric acid
Nitric acid
Phosphoric acid
Sulphamic acid
Hydrofluoric acid

CHARACTERISTICS OF ORGANIC ACIDS

1. Generally, are natural acids.
2. Mild; non-volatile; stable; less corrosive
3. Less harmful to hands in use dilutions than inorganic acids
4. Can be combined with wetting agents
5. Acid reactions tend to prevent and remove deposits of calcium and magnesium salts derived from either milk or water.

EXAMPLES OF ORGANIC ACIDS

Acetic acid
Lactic acid
Glycolic acid
Citric acid
Tartaric acid
Formic acid

ACIDS WITH THE CHARACTERISTICS OF ORGANIC AND INORGANIC PROPERTIES

This class of acids is in general the organic phosphonic acids. They combine the advantages of polyphosphates, chelating agents and acids. They are used mainly at high temperature where stability is a problem.

EXAMPLES OF ORGANIC PHOSPHONIC ACIDS

Amino trimethylene phosphonic acid
1-Hydroxy ethylidene-1,1-diphosphonic acid
2-Phosphonebutane-1,2,4-tricarboxylic acid
Hydroxy phosphonic acid

CLEANING COMPOUNDS/APPLICATION

To achieve a consistently acceptable cleaning situation in a food operation, it is necessary to give consideration to the following:

1. Selection of the cleaning compound for the job.

2. Determination of the concentration needed to economically accomplish the desired cleaning.

3. Selection of external energy factors to facilitate cleaning. Example: Time and temperature.

4. Method of application of the cleaning compound.

CLEANING COMPOUND/SELECTION

Cleaning compound selection depends upon a number of inter-related factors, which include:

1 The type and amount of soil on the surface.

2 The nature of the surface to be cleaned.

3 The physical nature of the cleaning compound. (Liquid or powder).

4 The method of cleaning available.

5 The quality of water available.

6 Cost.

7 Service.

As previously discussed, the composition of the cleaning compound and concentration required will depend upon the nature and amount of soil on the surface. In some instances, the amount of soil on the surface is controlled by more frequent cleaning of the equipment.

The surface of the material must be considered in cleaning compound selection for material such as aluminum, painted surfaces, and plastic materials. In these cases, the compatibility of the material with the cleaning compound is most important.

The physical state of the cleaning compound (solid or liquid) influences the convenience of cleaning operations and can have an effect on cost. Liquid materials are frequently more hazardous to handle, but lend themselves to better and more uniform concentration control via automatic feed devices. Powdered materials are more frequently over-used and, where feasible, pre-weighing of standard amounts of powdered detergents can improve cleaning efficiencies and reduce waste.

When cleaning is done by hand, it is evident that strong acids and alkalies cannot be used, because skin is never as inert as the surface being cleaned. Therefore, detergent strength is generally reduced and greater alliance is made of external energy. Generally, superior results can be achieved by use of circulation cleaning, either in or out of place. In circulation techniques, optimum concentrations of cleaning compounds can be more readily utilized.

Water quality cannot be over-emphasized in cleaning operations. If the water is heavily loaded with scale-forming minerals (calcium, magnesium, iron, or sulphate), the cleaning compound must be adjusted to eliminate the depositing minerals, or the water must be treated to reduce the mineral content. The efficiency of post-cleaning rinses is related directly to water quality. Mineral salts in rinse water will precipitate more readily from alkaline solutions than from acid. Therefore, the conditioning of rinse water with acid (pH 6.5 or less) will minimize the deposition of mineral salts on clean equipment surfaces.

In the final analysis, the true test in cleaning compound selection is a measure of its effectiveness in actual application, dealing with the problems at hand. Emphasis is placed on the need to make sure that every surface to be tested is "technically clean" before evaluating a cleaning compound.

VI. FACTORS AFFECTING CLEANING EFFICIENCY

The proper selection of the cleaner to do the job, concentration of cleaner, time in contact with surface, force or velocity, and temperature, are all important to have good cleaning. Each of the above can be varied independently to adjust a cleaning operation to a particular problem or plant operating practice. These factors will vary from hand cleaning to circulation cleaning and will depend upon the type and condition of soil to be removed.

Functions of various factors are:

A. The cleaning compound.

B. Temperature: Increasing temperature: (a) decreases the strength of bond between soil and surface, (b) decreases viscosity, (c) increases solubility of soluble materials, and (d) increases chemical reaction rate.

C. Velocity or force: In hand cleaning force is applied by "elbow grease," whereas fluid flow is used to apply cleaning force in CIP systems. Increased turbulence provides more effective removal of film from surfaces. However, efficiency is less affected by turbulence as the physical-chemical effectiveness of the detergent increases. CIP cleaning velocities of 1.5 metres per second (5 ft./second) are recommended to ensure adequate turbulence.

D. Time: All other factors remaining constant, cleaning efficiency can be increased by utilizing longer times.

E. Concentration: Increase in concentration increases the reaction rate. It is the least effective variable to change in cleaning. (time, temperature and velocity are other variables).

CLEANING CYCLE

The ideal cleaning cycle consists of the following steps:

1 Pre-rinse.

2 Application of detergent solution.

3 Post rinse.

4 Periodic acid rinse or cleaning.

5 Application of disinfecting or sanitizing solution.

6 Final potable water rinse, if required.

Sometimes, the sequence needs to be reversed, that is, acid cleaning followed by alkaline cleaning.

These operations are essential in all cleaning procedures, regardless of the method utilized. However, there are those cases in which the cleaning and disinfecting/sanitizing steps are consolidated by means of a cleaner/disinfectant/sani-tizer, in order to provide faster and more economical cleaning. Pre-rinsing is important to minimize the soil load in the cleaning system and can effectively remove up to 90% of the soluble material. The cleaning operation loosens and removes the soil and a post rinse then is required to prevent re-deposition of the soil upon the clean surface. The disinfecting or sanitizing step and the type of disinfectant or sanitiser to be used will be mentioned later.

Depending upon the type of soil to be removed, temperature selection for the pre-rinse, detergent solution, and post rinse is most critical. Usually, tempered water 38 - 45 degrees C. (100-115 degrees F.) is used for both pre- and post rinsing, and 50 - 75 degrees C. (120-170 degrees F.) for the alkaline detergent solution.

VII. CLEANING METHODS

A. Removal of Gross Food Particles

Loose material should be removed before the application of cleaning solutions. This may be accomplished by flushing the equipment surface with cold or warm water under moderate pressure. Very hot water or steam should not be used because it may make cleaning more difficult.

B. Application of Cleaning Compounds

There are many methods of subjecting the surfaces of equipment to cleaning compounds and solutions. Effectiveness and the economy of the method generally dictates its use.

1. Soaking - Small equipment or fittings or valves may be immersed in cleaning solutions in a sink while larger vessels such as vats and tanks may be partially filled with a pre-dissolved cleaning solution. The cleaning solution should be hot 50 degrees C. (125 degrees F.) and the equipment permitted to soak for 15-30 minutes before manually or mechanically scrubbed. One relatively recent approach is the ultrasonic cleaning tanks in which equipment is immersed in a cleaning solution and cleaned by the scrubbing action of microscopic bubbles caused by high frequency vibrations (20,000-40,000 cycles per second).

2. Spray methods - Cleaning solutions may be sprayed on equipment surfaces by use of either fixed or portable spraying units using either hot water or steam. These methods are extensively used in the food industry.

3. Clean-in-Place systems - This method is an automated cleaning system generally used in conjunction with permanent welded pipeline systems. In C.I.P. cleaning, fluid turbulence in pipelines is considered to be the major source of energy required for soil removal.

4. Clean-out-of-place (COP) system - Many small parts can be washed most effectively in a recirculating parts washer (sometimes called COP-cleaned out of place). These units are similar to sanitary pipe washers in that a sanitary tank is generally utilized in combination with a recirculating pump and distribution headers that provide considerable agitation of the cleaning solution. In some cases the parts washer may also serve as the recirculating unit for CIP cleaning operations.

5. Foaming - This method utilizes a concentrated blend of surfactants developed to be added to highly concentrated solutions of either alkaline or acid cleaners. It will produce a stable, copious foam when applied with a foam generator. The foam clings to the surface to be cleaned, increases contact time of the liquid with the soil and prevents rapid drying and runoff of the liquid cleaner, thereby improving cleaning.

6. Gelling - This method utilizes a concentrated powdered gelling agent which is dissolved in hot water to form a viscous gel. The desired cleaning product is dissolved in the hot gel and the resulting gelled acid or alkaline detergent is sprayed on the surface to be cleaned. The gelled cleaner will hold a thin film on the surface for 30 minutes or longer to attack the soil. Soil and gel are removed with a pressure warm water rinse.

7. High-Pressure Cleaning - Hydraulic cleaning systems are frequently utilized for cleaning the exterior parts of equipment, floors and some building surfaces. High pressure cleaning is based on atomization of the cleaning compound through a high pressure spray nozzle. Steam injection systems and pressure-fed tanks generally operate with nozzle pressures between 60-175 psi, whereas air and motor-driven high pressure pumps may develop nozzle pressures from 300-1200 psi. Cleaning effectiveness is dependent largely upon the force of the cleaning solution against the surface, which is controlled by the nozzle design.

DISINFECTING AND SANITIZING

I INTRODUCTION

Why disinfect or sanitize?

The primary reason for the application of effective sanitizing procedures is to reduce those disease organisms which may be present on equipment or utensils after cleaning to a safe level as may be judged by public health requirements, and thus prevent the transfer of such organisms to the ultimate consumer. In addition, sanitizing procedures may prevent spoilage of foods. The existence of any microbe in a food environment must be strictly controlled. The so-called harmless microbe under the proper conditions can become a nuisance. Food can become contaminated, reproduce to sufficient numbers to cause off-colours, off-odours and off-flavours. Unsightly growth often results in waste and loss of precious dollars. Many kinds of bacteria can cause slime formation on meats, poultry, fish and similar edibles.

In order to understand the terminology, let us classify microbial control.

Definitions:

<u>Sterilizer</u> - an agent that will destroy or eliminate all forms of life including all forms of vegetive bacteria, bacterial spores, fungi and viruses.

<u>Disinfectant</u> - an agent that will kill 100% of most infectious bacteria although not necessarily capable of killing **bacterial** spores.

<u>Sanitiser</u> - a substance that reduces the microbial contaminants to safe levels as determined by public health requirements

<u>Bacteriostat</u> - an agent that inhibits or prevents the reproduction of bacteria.

<u>Sanitization</u> - application of any effective method or substance to a clean surface for the destruction of pathogens, and of other organisms as far as is practicable. Such treatment shall not adversely affect the equipment, the product, or the health of the consumer and shall be acceptable to the health authority.

<u>Cleaner/Disinfectant/Sanitiser</u> - A product that possesses the properties of a cleaner, disinfectant and a sanitiser. It is considered to be a representation of value against bacteria of public health significance greater than that provided by an ordinary soap or detergent.

II. TYPES OF DISINFECTANTS OR SANITISERS

A. <u>Heat</u>

1. Steam
2. Hot water
3. Hot air

B. <u>Chemical</u>

1. Chlorine releasing compounds - 100 ppm available chlorine
2. Iodine complexes - known as iodophors - 30 ppm titratable iodine

3. Quaternary ammonium compounds (Quats) - 450 ppm available quat
4. Acid-anionic combination - 200 ppm available anionic
5. Synthetic phenols - 700 ppm synthetic phenols

III. RELATIVE MERITS OF CHEMICAL GERMICIDES

The generally recognized advantages and disadvantages of the most popular chemical germicides are as follows:

A. CHLORINE RELEASING COMPOUNDS

Advantages:

1. Effective against a wide variety of bacteria including spores and bacteriophages.
2. Relatively inexpensive.
3. Not affected by hard water salts.
4. Concentration easily measured by convenient field tests.

Disadvantages:

1. Corrosive to many metals - hypochlorites more corrosive than organic chlorines.
2. Irritating to the skin and mucous membranes.
3. Dissipates rapidly from solutions.
4. Effectiveness decreases with increasing pH of most chlorine solutions.
5. Activity decreases rapidly in the presence of organic matter.
6. Odour can be offensive.

B. IODOPHORS

Advantages:

1. Broad spectrum of activity.
2. Visual control by colour - forms an amber colour in solution.
3. Not affected by hard water salts.
4. Non-corrosive, non-irritating to the skin
5. Prevents film formation due to its acid nature.
6. Activity not lost as rapidly as chlorine in presence of organic matter.
7. Easily titrated by field methods.
S. Stable - long shelf life.
9. Spot-free drying.
10. Good penetrating qualities.

Disadvantages:

1. Should not be used at temperatures exceeding 50 degrees C. (120 degrees F.)
2. Very slow acting at pH 7.0 or above.
3. Can cause staining problems, particularly on certain plastic surfaces.
4. Less effective against bacterial spores and bacteriophages than chlorine.

C. QUATERNARY AMMONIUM COMPOUNDS

Advantages:

1. Non-toxic, odourless, colourless, non-corrosive, non-irritating.
2. Stable to heat and relatively stable in presence of organic matter.
3. Possess cleaning properties due to its surfactant activity.
4. Eliminates odours.
5. Forms bacteriostatic film.
6. Active against a wide variety of microorganisms.
7. Active over a wide pH range.

Disadvantages:

1. Non-compatible with soaps, anionic detergents and anionic matter in general.
2. Produce foam problems in mechanical operations.
3. Film forming.
4. Not effective against TB and certain viruses.
5. Forms bacteriostatic film.

D. ACID-ANIONIC SURFACTANTS

Advantages:

1. Non-staining.
2. No objectionable odour.
3. Removes and prevents milkstone and waterstone formation.
4. Effective against a wide spectrum of organisms.
5. Stable in concentrated and in-use dilution form.

Disadvantages:

1. Effective at acid pH only; 1.9 to 2.2 offers optimum activity.
2. Generates foam.
3. Slow activity against spore-forming organisms.

E SYNTHETIC PHENOLS

Advantages:

1. Broad spectrum of activity.
2. Effective in the presence of soils.
3. Destroys fungi, bacteria, including the tubercle bacillus, and viruses, but *not* spores.
4. Not affected by hard water.
5. Stable in concentrated and in-use dilution form.

Disadvantages:

1. Irritating to the skin and mucous membranes.
2. Odour can be offensive.
3. Film forming.

IV. LEGAL CRITERIA FOR ANTIMICROBIAL PRODUCT REGISTRATIONS IN CANADA

All compounds bearing labels describing or directing their use as disinfectants or making other antimicrobial claims, must meet all requirements of and be properly registered with either or both Agriculture Canada (PCP Act) and Health Canada (Food and Drugs Act, DIN).

In general there are two main agencies that regulate general purpose disinfectants. The first question a manufacturer needs to answer is, where do they intend to market their product. Disinfectants for use in Hospitals, Medical Facilities and Food Processing operations fall under the Food and Drugs Act. Disinfectants used in all other areas (Schools, Office buildings etc.) fall under the Pest Control Products Act. Manufacturers may register products for use in one or the other only, or both types of areas (dual registration). Label claims and registration process will be contingent on the answer to the "marketing question" above.

When a disinfectant or sanitizer is approved by Health Canada and is issued a DIN number, the product has to be listed by the Food Inspection Directorate of Agriculture Canada. Only when a disinfectant or sanitizer is listed in the “Reference Listing of Accepted Construction Materials, Packaging Materials and Non-food Chemical Products” may a germicide be used in food processing plants. This listing is necessary not only for disinfectant and sanitizers, but for ALL chemical products, packaging, coatings, etc. when the product is used in food processing industries or may come into contact with food.

V. FACTORS AFFECTING THE BACTERICIDAL EFFECTIVENESS OF CHEMICAL GERMICIDES

1. Concentration - minimum concentration required for effective disinfecting or sanitizing.
2. pH - actual pH of germicidal solution depends on the type of germicide
3. Temperature - in general warm 38 - 45 degrees C. (100-115 degrees F.) or hot 50 - 75 degrees C. (120-170 degrees F.) Water is preferred
4. Time of exposure - a minimum time is needed for complete disinfection
5. Cleanliness of equipment - some germicides are more affected by soils than others
6. Water hardness - in hard water a different germicide is sometimes needed than in soft water
7. Incompatible agents - most germicide are incompatible with each other or are in compatible with soaps or other additives

VI. APPLICATION OF GERMICIDES

1. Circulation (C.I.P.)
2. Submersion (soaking)
3. Manual application
4. Fogging
5. Spraying

VII. MICROBIOLOGICAL DETERMINATIONS

1. Rinse solution method
2. RODAC Plates (replicate organism detecting and counting)
3. Swab contact method

VIII. GLOSSARY

CLEANING/MICROBIOLOGY/SANITATION

DEFINITION OF TERMS

AEROBE	Oxygen-requiring organism.
AGAR	Dried extract of a red alga used as a solidifying agent in microbiological media.
ANAEROBE	Organism that requires the absence of oxygen to grow.
ANTI-MICROBIAL	Any physical or chemical agent that destroys or inhibits the growth of microorganisms.
ANTISEPTIC	Refers to the action of a substance on living tissue.
AUTOCLAVE	An apparatus which uses steam under pressure for sterilization.
BACTERIA	One celled microorganisms belonging to the Kingdom Protista.
BACTERICIDAL	Capable of killing bacteria but not necessarily bacterial spores.
BACTERIOSTATIC	Preventing or inhibiting the growth of bacteria.
BINARY FISSION	The division of a bacterium into two equal parts-the usual means of bacterial reproduction.
BUDDING	A form of reproduction in some yeasts and molds involving the formation of a small protrusion from a mother cell. The protrusion (bud) gradually increases in size and separates, forming another cell.
CHELATION	The same as sequestration except that an organic compound is used.
CLEANING	A process which will remove soil and prevent accumulation of food residues which may decompose or support the growth of disease or nuisance causing organisms and/or the production of toxins.
COLONY	A mass of cells visible to the naked eye, usually on an agar plate and resulting from reproduction of a single bacterial cell.
COCCUS	A spherical (round) bacterium.
COLIFORMS	A group of Gram-negative rods often associated with fecal pollution.
CULTURE	Growth of microorganisms in an artificial medium containing nutrients.
DEFLOCCULATION	The action in which groups of clumps or particles are broken up into individual particles and spread out suspended in the solution.
DISINFECTANT	A product capable of killing 100% of most infectious bacteria but not necessarily capable of killing bacterial spores.

DISSOLVING	The reaction which produces water soluble materials from water insoluble soil.
EMULSIFICATION	A process where fats are broken up into tiny globules and are suspended in the cleaning solution.
ENZYMES	Complex molecules that speed up chemical reactions within cells.
FUNGI (MOLDS)	Members of the Protista that are microscopic plants not containing chlorophyll.
GERMICIDE	Same as bactericide.
GRAM STAIN	A differential staining procedure for classifying bacteria as Gram positive or Gram negative-classification depends on whether the bacteria retain or lose the primary stain (Crystal Violet) when exposed to a decolorizing agent.
INCUBATION	A process of maintaining conditions suitable for the growth of microorganisms.
INFECTION	A pathological condition due to the growth of microorganisms in living tissue.
INHIBITION	Preventing the growth of microorganisms without killing them.
MEDIUM	A substance used to provide nutrients for the growth of microorganisms.
MESOPHILIC	An organisms whose optimum growth temperature is in the range of 20-40°C. (68 - 140°F.).
MICRON	A unit of linear measurement approximately equal to 1/25,000 of an inch (1/1,000,000 of a meter).
MICROORGANISMS	Microscopic forms of life including bacteria, yeasts, molds, rickettsiae, viruses, protozoa, and algae.
NOSOCOMIAL INFECTION	An infection acquired during hospitalization. It is neither present nor incubating at time of admission unless related to a prior admission - may become manifest following discharge from the hospital.
PARASITE	An organism which lives on, in, or at the expense of another organism and usually causes some damage to its host.
PASTEURIZATION	The process of killing microorganisms in a product by heating at controlled temperatures without changing the natural characteristics of the treated material. There are two types: 1. Flash- at 161°F. for 15 seconds. 2. Holding process at 145° F. for 30 minutes.
PATHOGENIC	Capable of causing disease.

PENETRATION	The action of liquids entering porous materials through cracks, pin holes, or small channels.
PEPTIZATION	Physical formation of colloidal solutions from partially soluble materials.
PETRI DISH	Glass or plastic dish with cover used for growing microbiological cultures.
PLATE COUNT	A fundamental method of isolating microorganisms for quantitative determination.
PROTOPLASM	Living substance of a cell.
PSYCHROPHILIC	An organism whose optimal growth range is below 20°C. (68°F.). Some of these organisms will grow at 0°C. (32°F.).
RINSABILITY	The action which will break the surface tension of the water in the solution and permit the utensil to drain dry.
RODAC PLATE	A small plastic dish designed and used in an agar contact method of estimating the numbers of microorganisms on flat surfaces. The name stands for "Replicate Organism Detection And Counting."
SANITATION	Practical application of sanitary measures.
SANITIZER	A substance that reduces the number of bacteria to relatively safe levels as may be judged by public health requirements or governmental regulations - usually a 99.999% reduction.
SANITIZATION	Application of any effective method or substance to a clean surface for the destruction of pathogens and of other organisms as far as is practicable. Such treatment shall not adversely affect the equipment, the product, or the health of the consumer and shall be acceptable to the health authority.
SAPONIFICATION	Action of alkali on fats resulting in the formation of soap.
SEQUESTRATION	The action of an inorganic compound attaching itself to the water hardness particles and inactivates them so they will not combine with other material in the water and precipitate out.
SPORE	Bacterial - a resistant body formed by certain Gram-positive bacteria. Fungal - a unicellular reproductive body.
STERILIZATION	A process resulting in the death of all forms of life.
SUSPENSION	The action in which insoluble particles are held in solution and not allowed to settle out onto the utensils.
SWAB CONTACT TEST	A microbiological method for determining the sanitary condition of various surfaces.

THERMODURIC	An organism which is heat resistant to the point of being able to withstand normal pasteurization treatments.
THERMOPHILIC	An organism whose optimal growth temperature is above 50°C. (122°F.)
TRICHINOSIS	A disease caused by ingesting Trichinella spiralis, usually in poorly cooked pork.
WETTING	Action of water in contacting all soil, helps to reduce surface tension, (wetting agents usually do a good job of emulsification).
VIRUS	Submicroscopic infective agent.
YEAST	A one-celled fungus which generally reproduces by budding.

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