7 CLEANING AND SANITIZING OPERATIONS

Hepatitis A Outbreak Takes Toll on Bar Patrons

Seventeen people contracted Hepatitis A virus from food they consumed at a local bar. Of the 17 cases, at least 2 were hospitalized; none died.

Investigators from the local health department discovered a number of problems with the food-handling techniques and personal hygiene practices used by employees at the bar. Of particular concern was a lack of handwashing prior to food preparation; the transfer of salad materials by bare hands from a bulk container onto serving plates rather than using proper utensils such as tongs; rinsing hands in the third compartment of the 3-compartment sink rather than washing at handwashing stations where soap was available; employees frequently did not wash their hands when they returned from break; plates were stacked when transporting them from the cook line to customers; wait staff bussed soiled glasses with their fingers inside the glasses and did not wash their hands afterwards. Interviews with the staff at the bar revealed that at least 11 employees have worked recently while ill with diarrhea and/or vomiting.

Learning Objectives

After reading this chapter you should be able to:

- Recognize the difference between cleaning and sanitizing
- Identify the different processes that can be used to clean and sanitize equipment and utensils in a food establishment
- Identify the primary steps involved in manually and mechanically cleaning and sanitizing equipment and utensils
- Describe the factors that affect cleaning efficiency
- Identify the procedures used to clean environmental areas in a food establishment.

Essential Terms

- Cleaning agent
- Clean-in-place (CIP)
- Detergent
- In-place sanitizing solution
- Sanitize
- Sanitizer
  - Chlorine
  - Iodophor
  - Quaternary Ammonium Compounds
- Selectivity
- Soap

Principles of Cleaning and Sanitizing

Cleaning and sanitizing are important activities in a food safety program. Cleaning and sanitizing are two distinct processes used for very different purposes. **Cleaning is the *physical removal of soil and food residues* from surfaces of equipment and utensils. Sanitizing** (sometimes called sanitization) **is the treatment of a surface that has been previously cleaned to reduce the number of disease-causing microorganisms to safe levels** (Figure 7.1). The equipment and supplies used for cleaning are different from those used for sanitizing.

Effective cleaning consists of four separate events:

1. A detergent or other type of cleaner is brought into contact with the soil.
2. The soil is loosened from the surface being cleaned.
3. The loosened soil is dispersed in the wash water.
4. The dispersed soil is rinsed away along with the detergent to prevent it from being redeposited onto the clean surface.

Removal of Food Particles

Scrape and flush large food particles from equipment and utensils before the items are placed in a cleaning solution (Figure 7.2). Spray the equipment and utensils with warm water. Avoid using very hot water or steam because they tend to "bake" food particles on the surface of equipment and utensils and that makes cleaning more difficult.

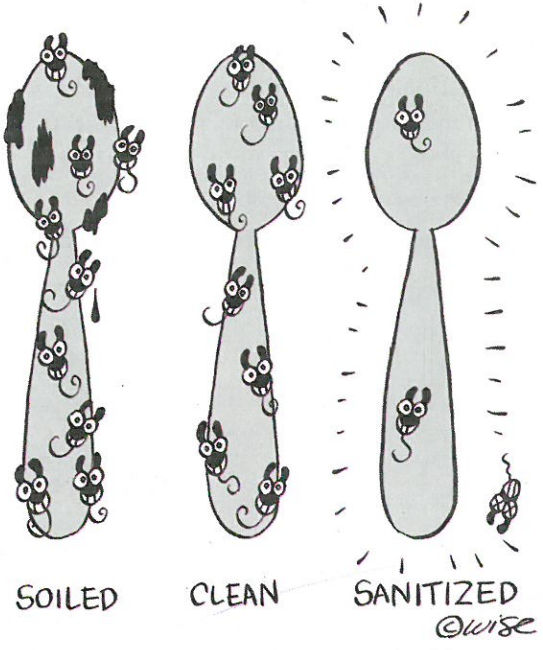

Figure 7.1 Cleaning and Sanitizing

Application of Cleaning Agents

A cleaning agent is a chemical compound formulated to remove soil and dirt. There are many methods of applying cleaning agents and solutions to the surfaces of equipment. **Cleaning agents** typically include an acid or alkaline detergent and may include degreasers, abrasive materials, or a sanitizer. Effectiveness and the economy of the method generally dictate its use.

Soaking

Small equipment, equipment parts, and utensils may be immersed in cleaning solutions in a sink. By soaking equipment or utensils for a few minutes before scrubbing, you will increase the effectiveness of manual and mechanical dishwashing.

Spray Methods

Spray cleaning solutions on equipment surfaces can use either fixed or portable spray units that use hot water or steam. These methods are

extensively used in meat departments of grocery stores and in food processing plants.

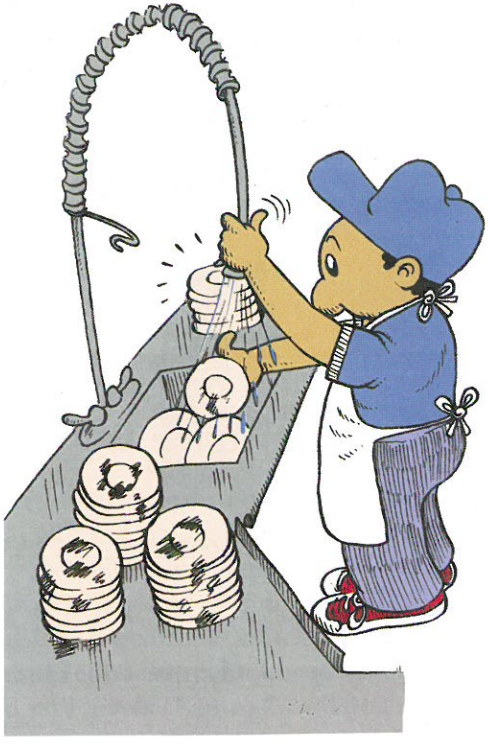

Figure 7.2 Pre-Flushing Makes Washing Easier

Clean-in-Place (CIP) Systems

The **clean-in-place** method is an automated cleaning system generally used in conjunction with permanent-welded pipeline systems. The strength and velocity of the cleaning solution moving through the pipes are chiefly responsible for soil removal in clean-in-place operations.

Abrasive Cleaning

Abrasive type powders and pastes are used to remove soil that is firmly attached to a surface. Always rinse these cleaners completely and avoid scratching the surface of equipment and utensils. Abrasive type cleaners are not recommended for use on stainless steel surfaces. Never use metal or abrasive scouring pads on food-contact surfaces because small metal pieces from the pads may promote corrosion or may be picked up in food to become a physical hazard.

Rinsing

Immediately after cleaning, thoroughly rinse all equipment surfaces with hot, potable water to remove the cleaning solution. This very important rinse step is necessary because the product or detergent used for washing can interfere with the germ-killing power of the sanitizer.

Factors Affecting Cleaning Efficiency

Many factors affect the efficiency of a cleaning process in terms of how well and how easily soil is removed. Among the most important factors are:

- Type of soil to be removed
- Water quality
- The detergent or cleaner to be used
- Water temperature
- Water velocity or force
- Time detergent remains in contact with the surface
- The concentration of cleaner.

Each of these factors is important for effective cleaning and can be modified to meet the needs of a particular type of problem or set of conditions.

(1) Type of Soil to Be Removed

Soil may consist of:

- Food deposits (proteins and carbohydrates)
- Mineral deposits (salts)
- Microorganisms (bacteria, viruses, yeasts, and molds)
- Fats and oils
- Dirt and debris.

When you know the type and condition of the soil you are working with, it is easier to determine the physical and chemical methods best suited to remove that soil effectively and economically.

(2) Water Quality

Water is the primary component of cleaning materials used in food establishments. **The water supply serving food establishments must be safe to drink (potable). Most establishments get their water from a**

public supply. Establishments that have a private well should have it inspected at least once a year and water samples tested at least once a year to ensure the bacteriological safety of the supply. Water must be free from harmful microorganisms, chemicals, and other substances that can cause disease. While the water supply must be safe to drink, it may contain substances that affect hardness, taste, and odors. Therefore, adjust cleaning agents to fit the characteristics of your water supply and type of operation.

"Hard" water is caused by dissolved salts of calcium, magnesium, and iron. Water hardness reduces the effectiveness of detergents and leaves "lime" scale deposits on the surface of equipment. The degree of water hardness varies considerably from place to place. For effective cleaning, hard water requires softening. If the water is not softened, the cleaner must contain a sequestering (softening) agent that inactivates the iron and manganese without settling them out.

If there is an interruption in the water supply to a food establishment, the facility should cease operations or serve only pre-prepared food using single-use disposable utensils.

Detergents and Cleaners to Be Used

A **detergent** is defined as a cleaning or purifying agent: a solvent. The origin of the word is from the Latin, *detergeo*, meaning "to wipe away." Water acts as a detergent when soils are readily soluble. However, we can improve the cleansing action of water by adding soap, alkaline detergents, acid detergents, degreasers, abrasive cleaners, detergent sanitizers, or other cleaning agents to it.

Soaps

Bar **soaps** are cleaning agents made by chemical reaction of alkali on fats or fatty acids. Soaps are only used as cleaners in food establishments in a limited way. In soft water, they are effective for washing hands. However, most soaps do not dissolve in cold water and are not compatible with some sanitizers. In hard water, soaps form troublesome precipitates and films that lose their cleaning power and break down into fatty acids. Bar soaps have largely been replaced by synthetic detergents in today's food establishments.

Alkaline Detergents

An alkali is the principal detergent ingredient of most cleaners. Alkalis combine with fats to form soaps, and with proteins to form soluble compounds easily removed by water. Some alkalis are good buffers which enhance detergency. However, in varying degrees, alkalis corrode aluminum, galvanized metal, and tin.

Sodium hydroxide (caustic soda or lye) is the strongest and cheapest of strong alkalis. It has high detergency but is also highly corrosive for nearly all surfaces, including skin. It rinses with difficulty. Wetting agents improve rinsing and wetting while inhibiting corrosion.

Mild alkalis have moderate dissolving power and are much less corrosive than strong alkalis. Some skin contact with mild alkalis is possible. Sodium carbonate competes with sodium hydroxide as the cheapest of the alkalis. Sodium carbonate is safer and less corrosive and therefore is a common ingredient in cleaners.

Alkaline detergents are good general-purpose cleaners that are commonly used to clean equipment, utensils, floors, walls, and ceilings in food establishments.

Acid Detergents

Acid cleaners dissolve mineral deposits, such as calcium and magnesium precipitates, from equipment surfaces. Acid detergents are frequently used to remove food and hard water deposits from the surfaces of equipment and utensils.

The acids may be categorized into 2 groups: inorganic and organic. The inorganic acids, also called mineral or strong acids, include hydrochloric (HCl), sulfuric (H_2SO_4), nitric (HNO_3) and phosphoric (H_3PO_4) acids. The strong acids are extremely corrosive to metals and are used only in special cases. Cleaners to remove milk films often contain nitric acid, and those to remove hard water films often contain phosphoric acid. The organic acids are the active ingredients of a wide variety of acid cleaners. The organic acids are not as corrosive to metals and are less irritating to the skin.

Degreasers

Degreasers are specialty products that remove grease and greasy or oily soil. Surfactants, their basic ingredients, penetrate and break up grease and oil. Degreasers are designed more for hard surfaces than for fabrics. They may be used for pre-treatment or as the sole cleaning agent, but their use should always be followed by rinsing.

Abrasives

Abrasives, when mixed with a detergent, are useful for jobs that require scrubbing, scouring, or polishing. Such naturally occurring mineral abrasives as pumice, quartz, and sand are ground into small particle size and supply scouring and polishing action to cleansers, hand soaps, and soap pads.

Abrasives should be used with care since they can cause scratches on metal surfaces, including stainless steel. In addition, the particles of the cleaner, along with metal particles scraped from equipment, may also contaminate food.

Detergent Sanitizers

As the name would suggest, detergent sanitizers are compounds that contain both a detergent and a sanitizer. These products effectively clean and **sanitize** a food-contact surface, provided a 2-step process is used. That is, the detergent sanitizer must be applied to a food-contact surface 2 times. The first time to clean the surface and a second time to sanitize it. Food-contact surfaces should be thoroughly rinsed to remove chemical residues that may remain on the surface after the cleaning and sanitizing process.

Water Temperature

Heat-stable detergents work best when the water temperature of the solution is between 130°F (54°C) and 160°F (71°C). The temperature of the wash water needs to be hot enough to effectively remove soil, but it should not be so hot that the soil will be "baked" onto the food-contact surface. Increased wash water temperatures help decrease the strength of the bonds that hold soil to the surface being cleaned.

Some detergents are designed specifically for cold water. Check the manufacturer's directions to determine the appropriate temperatures. A good rule of thumb is to apply cold-water detergents at tap-water temperature.

Velocity or Force

In manual cleaning procedures, force is applied by "elbow grease." For mechanical and clean-in-place systems, the velocity and force of the cleaning solution help remove soil and film from food-contact surfaces. The importance of velocity and force on cleaning decreases as the effectiveness of the detergent increases. In other words, less "elbow grease" will be required when the detergent is formulated to effectively remove soil from the surfaces of equipment and utensils.

Amount of Time the Detergent or Cleaner Remains in Contact with the Surface

Cleaning efficiency is increased by use of longer contact times. The amount of scrubbing necessary to remove soil can be decreased by "soaking" items in detergents or cleaners before cleaning.

Concentration of the Detergent or Cleaner

Increasing the strength of a detergent increases the reaction rate and magnifies its cleaning power. However, there is an upper limit beyond which higher concentrations neither increase nor decrease efficiency. Always follow the manufacturer's recommendations for detergent concentration. Using too much detergent is a waste of money.

Cleaning Frequency

Under normal circumstances, food-contact surfaces and equipment used to prepare and serve potentially hazardous foods must be cleaned throughout the day to prevent the growth of microorganisms on those surfaces. The *FDA Food Code* requires food-contact surfaces of equipment and utensils that are used with potentially hazardous foods to be cleaned at least every 4 hours. Some additional guidelines for cleaning food-contact surfaces include:

- Before each use with a different type of raw animal food such as beef, fish, lamb, pork, or poultry

  [This requirement does not apply to situations where a food-contact surface or utensil is in contact with a series of different raw animal foods each requiring a higher cooking temperature. For example, equipment or utensils would not have to be cleaned when preparing raw fish followed by cutting raw poultry on the same cutting board. The final cooking temperature for poultry is 165°F (74°C) and is higher than the 145°F (63°C) final cooking temperature required for fish.]

- Each time there is a change from working with raw foods to working with ready-to-eat foods
- Between uses with raw fruits and vegetables and with potentially hazardous food
- Before using or storing a food temperature-measuring device
- At any time during the operation when contamination may have occurred.

The *FDA Food Code* allows some exceptions to the 4-hour rule for cleaning frequency. Surfaces of utensils and equipment that come into contact with potentially hazardous food may be cleaned less frequently than every four hours if:

- During storage, containers of potentially hazardous food and their contents are maintained at proper hot- and cold-holding temperatures and the containers are cleaned when they are empty

- When utensils and equipment are used to prepare potentially hazardous food in a refrigerated room or area. The room temperature and cleaning frequency prescribed in the *FDA Food Code* are listed in Figure 7.3.

Room Temperature	Cleaning Frequency
41°F (5.0°C) or less	at least once every 24 hours
41°F (5°C) - 45°F (7°C)	at least once every 20 hours
45°F (7°C) - 50°F (10°C)	at least once every 16 hours
50°F (10.0°C) - 55°F (12°C)	at least once every 10 hours

Figure 7.3 Room Temperature and Cleaning Frequency
(Source: *FDA Food Code*)

The food establishment must maintain records to demonstrate proper cleaning frequency based on the ambient temperature of the refrigerated room or area. In all instances, equipment and utensils must be cleaned at least once every 24 hours:

- Containers used in serving situations such as salad bars, delis, and cafeteria lines are maintained at proper hot- and cold-holding temperatures. The content of the container is periodically combined with additional supplies of the same food that is already heated or held at the required temperature
- Temperature-measuring devices are maintained in contact with food, such as when left in a container of deli food or in a roast, held at proper temperatures
- Equipment used for storage of packaged or unpackaged food such as a reach-in refrigerator; the equipment is cleaned at a frequency necessary to preclude accumulation of soil residues
- In-use utensils are intermittently stored in a container of water in which the water is maintained at 135°F (57°C) or more and the utensils and container are cleaned to preclude accumulation of soil residues.

Iced tea dispensers, carbonated beverage dispenser nozzles, water dispensing units, ice makers and ice bins are examples of equipment that routinely come into contact with food that is not potentially hazardous. These types of equipment must be cleaned on a routine basis to prevent the development of slime, mold, or soil residues that

may contribute to an accumulation of microorganisms. The *FDA Food Code* recommends surfaces of utensils and equipment contacting food that is not potentially hazardous be cleaned:

- At any time when contamination may have occurred
- At least every 24 hours for iced tea dispensers and consumer self-service utensils such as tongs, scoops, or ladles
- Before restocking consumer self-service equipment and utensils such as condiment dispensers and display containers.

Whenever possible, follow the manufacturer's guidelines for regular cleaning and sanitizing of the food-contact surfaces of equipment and utensils. If the manufacturer does not provide cleaning instructions, the person in charge should develop a cleaning regimen that will effectively remove soil, mold, and other contaminants from equipment and utensils.

Sanitizing Principles

Heat and chemicals are the 2 types of sanitizers most commonly used in food establishments. Sanitizers **destroy disease-causing organisms which may be present on equipment and utensils even after cleaning.** Sanitization is not sterilization, because some bacterial spores and a few highly resistant vegetative cells generally survive.

In all instances, a food-contact surface must be cleaned and then thoroughly rinsed to remove loosened soil and detergent residues that tend to inhibit the sanitizer's action.

Heat Sanitizing

Heat has several advantages over chemical sanitizing agents because it:

- Can penetrate small cracks and crevices
- Is noncorrosive to metal surfaces
- Is nonselective to microbial groups
- Leaves no residue
- Is easily measurable.

Heat destroys vegetative bacteria cells by disrupting some of the protein molecules in the cells. Moist heat is much more efficient in killing microorganisms than dry heat. Heat sanitization is used in both manual and mechanical warewashing operations.

Heat sanitizing in manual warewashing operations involves immersing cleaned equipment and utensils for at least 30 seconds in hot water that is maintained at 171°F (77°C) or above. A properly calibrated thermometer must be kept on hand to routinely check the temperature of the sanitizing water. Use dish baskets or racks to lower equipment and utensils into the sanitizing water. This allows employees to cover the items completely with the hot water without being scalded. Use extreme care with this process. Enforce procedures that protect the safety of the employees involved in manual dishwashing operations.

Sanitizing with hot water can also be performed in mechanical warewashing equipment. The *FDA Food Code* requires a temperature of not less that 180°F (82°C) for the hot water sanitizing rinse in mechanical warewashers. However, in single-tank, stationary-rack, and single-temperature machines, the final rinse temperature must be at least 165°F (74°C). The temperature of the hot water sanitizing rinse in a mechanical warewashing machine must not be more than 194°F (90°C) at any time.

The equipment shown in Figure 7.4 is an example of a low pressure, high temperature steam/vapor cleaning system. One of the most attractive features of this machine is the low amount of water it uses while cleaning. With the aid of this equipment it is possible to clean food-contact surfaces of equipment without the use of chemicals. When steam in a flow cabinet is used, it should be sufficient to achieve 171°F (77°C) for at least 15 minutes or 200°F (94°C) for at least 5 minutes.

Figure 7.4 Steam Cleaning Machine

(Reprinted with Permission of Food Safety Academy, Skokie, IL, and Hi-Tech Cleaning Systems)

When using heat for sanitization, it is the temperature at the utensil surface that is most important to ensure proper destruction of microorganisms. The temperature at the utensil surface can be measured by using irreversible heat-sensitive labels or tapes that are attached directly to equipment and utensils by a self-adhesive. The silver labels will turn black when the required sanitization temperature is reached. An example of a T-Stick is presented in Figure 7.5.

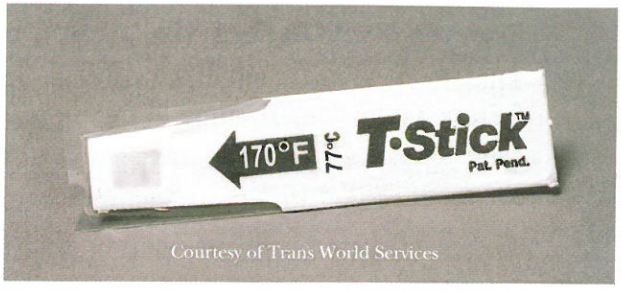

Figure 7.5 A T-Stick Can Be Used to Measure the Sanitizing Temperature in Dishwashing Machines

Another commonly used device for measuring the temperature of hot water sanitizers is the "maximum registering" or "holding" thermometer. This type of thermometer will continue to hold the highest temperature measured until shaken down like a medical thermometer. An example of a maximum registering thermometer is presented in Figure 7.6. These instruments are becoming less popular because they contain mercury which can be a contaminant of food and the general environment.

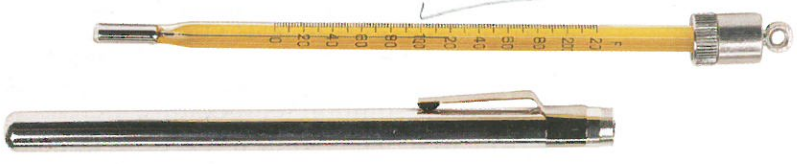

Figure 7.6 Maximum Registering Thermometer
(Courtesy of Cooper Instrument Corporation)

Chemical Sanitizing

To chemically sanitize, one either immerses an object in a sanitizing solution or by swabbing, brushing, or pressure spraying a sanitizing solution directly on the surface to be sanitized.

The effectiveness of a chemical sanitizer weakens as bacteria and other microorganisms are destroyed. Also, water from the wash and rinse stages of the warewashing process will dilute the sanitizer. Keep a chemical test kit or test strips on hand to permit personnel to routinely check the strength of the sanitizing solution. Replace the sanitizing solution in the sink whenever it is contaminated or if the concentration falls below the minimum recommended by the chemical manufacturer.

Factors that Affect the Action of Chemical Sanitizers

The effectiveness of chemical sanitizers is affected by many different factors. Following are some of the most important factors to consider.

- **Contact of sanitizer**—in order for a chemical to react with microorganisms, it must achieve intimate contact.
- **Selectivity of sanitizer**—certain sanitizers are nonselective in their ability to destroy microorganisms, whereas others exhibit a degree of selectivity. Chlorine is relatively nonselective. However, both iodophors and quaternary compounds have a selectivity which may limit their application.
- **Concentration of sanitizer**—in general, increasing the concentration of a chemical sanitizer proportionately increases the rate of microbial destruction. But there are certain limitations. The increased activity only extends to a certain maximum and then levels off so that any further increase in concentration has no advantage. In rare instances, the activity actually decreases with increased concentration. Concentration limits have been set for each type of sanitizer. *More is not always better, and high concentrations of sanitizers can be toxic.* Always follow the manufacturer's label use instructions to ensure peak effectiveness of chemical sanitizers.
- **Temperature of solution**—all of the common sanitizers increase in activity as the solution temperature increases. This is partly based on the principle that chemical reactions in general are speeded up by raising the temperature. The recommended range of water temperatures for chemical sanitizing solutions is between 75°F (24°C) and 120°F (49°C). Water temperatures above 120°F (49°C) should be avoided when using chlorine and iodine. At high temperatures, the potency of these sanitizers is lost by its evaporation into the atmosphere.
- **pH of solution**—water hardness can affect the pH of water which exerts a significant influence on most sanitizers. Quaternary compounds react differently to changing pH, depending on the type of organism being destroyed. Chlorine and iodophors

generally decrease in effectiveness with an increase in pH. Most soaps and detergents are alkaline with a pH between 10 and 12. That is why the soap or detergent must be rinsed off before a surface is sanitized.

- **Time of exposure**—allow sufficient time for chemical reactions to destroy the microorganism. The amount of exposure time depends on the preceding factors as well as the size of the microbial populations and their susceptibility to the sanitizer.

There is a wide variety of chemicals whose properties destroy or inhibit the growth of microorganisms. However, many of these chemicals are not suitable for use on food-contact surfaces because they may corrode, stain, or leave a film on the surface. Others may be toxic or too expensive for practical use. Therefore, the chemical sanitizing agents discussed in this section will be limited to those agents commonly used in food establishments. If a chemical sanitizer other than chlorine, iodine, or a quaternary ammonium compound is used, it must be applied in accordance with the manufacturer's use direction included in the labeling.

Chlorine

Chlorine is a chemical component of hypochlorites. These compounds are commonly used as chemical sanitizers in retail food establishments. Hypochlorites offer many advantages as sanitizers. The chief advantages they offer are that they:

- Control a wide range of microorganisms through germicidal action
- Deodorize and sanitize
- Are nontoxic to humans when used at recommended concentrations
- Are colorless and nonstaining
- Are easy to handle
- Are economical to use.

Hypochlorites are available as powders or liquids. Calcium hypochlorite is generally available in powder form and contains 70% available chlorine. Sodium hypochlorite, more commonly called household bleach, comes in a liquid form and contains between 2% and 6% available chlorine. Industrial strength hypochlorites usually contain between 10% and 18% available chlorine. Hypochlorites release hypochlorous acid in solution. It is the hypochlorous acid that provides chlorine's germ-killing power.

The germicidal effectiveness of chlorine-based sanitizers depends, in part, on water temperature and pH of the solution. The *FDA Food Code* requires food-contact surfaces to be exposed to a 50 parts per million (ppm) chlorine sanitizer for at least 7 seconds when the chlorine solution has a pH of 10 or less and a water temperature of 100°F (38°C) or a pH of 8 or less and a water temperature of at least 75°F (24°C). Equipment and utensils will also be properly sanitized when exposed to 25 ppm chlorine and water temperature of 120°F (49°C) or 100 ppm chlorine and water temperature of 55°F (13°C) for 10 seconds. Equipment and utensils must be placed in the sanitizer long enough to effectively reduce the number of germs that remain on the surface after the cleaning. State and local food codes may require equipment and utensils to be immersed in chlorine sanitizers for longer periods of time. Consult the food regulatory agency in your area to determine the sanitizing requirements for your operation.

The effectiveness of hypochlorites is reduced by even small amounts of food soils and other types of organic matter. Therefore, a fresh water rinse must be provided to remove detergent and soils from equipment and utensils before immersing them in the sanitizing solution. A chlorine test kit or strips must be provided to measure the concentration of the chlorine sanitizer at least once per hour. The sanitizer solutions must be replaced whenever it becomes contaminated or the concentration falls below the required strength.

Iodine

Iodine is chemically related to chlorine and has long been used to kill germs. The iodine-containing sanitizers commonly used in retail food establishments are called **iodophors**. Iodophors are effective against a wide range of bacteria, small viruses, and fungi. They are especially effective for killing disease-causing bacteria that are found on human hands. Iodophors kill more quickly than either chlorine or the quaternary ammonium compounds.

Iodophors function best in water that is acidic and at temperatures between 75°F (24°C) and 120°F (49°C). Iodophors must be applied at 12.5 parts per million when immersion sanitizing and at 25 parts per million in swab and spray applications. Food-contact surfaces must be exposed to an iodophor for at least 30 seconds to ensure proper disinfection.

Iodophors are less influenced by organic matter than are hypochlorites. However, they are more expensive to use, and they will discolor and stain some surfaces such as silver, silverplate, and copper. Iodophors are also slippery and harder to handle than hypochlorites.

Quaternary Ammonium Compounds (quats)

Quaternary ammonium compounds (quats) are ammonia salts that are used as chemical sanitizers in retail food establishments. Quats are effective sanitizers, but they do not destroy the wide variety of germs that chlorine and iodophore sanitizers do. The *FDA Food Code* recommends using quats at 200 parts per million (ppm) for immersion sanitizing of food-contact surfaces. Quats are noncorrosive and nonirritating to skin and have no taste or odor when used in the proper dilution. Quats are more heat stable than either hypochlorites and iodophors. Therefore, they work well at all temperatures above 75°F (24°C). They are effective in a wide pH range (although they are most effective in slightly alkaline water). The recommended contact time for quats is at least 30 seconds.

Quats should be used only in water with 500 ppm hardness or less, or in water having a hardness no greater than specified by the manufacturer's label.

At concentrations above 200 ppm, quats can leave a residue on the surface of an item. This is undesirable for food-contact surfaces. It is generally recommended that quats not be used at concentrations above 200 ppm. Always follow the manufacturer's directions for proper uses and concentration of quats. You may also consult with the retail food regulatory agency in your jurisdiction about the uses of these and other chemical sanitizers.

A summary of the advantages and disadvantages of the chemical sanitizers used most frequently in retail food establishments is presented in Figure 7.7

SANITIZER	ADVANTAGES	DISADVANTAGES
Chlorine compounds	Economical cost Kills many types of microbes Good for most sanitizing applications	Corrosive to equipment Can irritate human skin and hands
Iodophors	Less corrosive to equipment Less irritating to skin Good for killing germs on hands	Moderate cost Can stain equipment
Quats	Stable at high temperature Stable for a longer contact time Good for in-place sanitizers	Very expensive not wide range of MO

Figure 7.7 Advantages and Disadvantages of Selected Chemical Sanitizers

Mechanical Dishwashing

The mechanical dishwashing machine has been used in food establishments for many years to clean and sanitize multiple-use equipment and utensils. A dishwashing machine is designed to clean and sanitize large quantities of equipment and utensils that will fit into the machine and that have no electrical parts. When properly operated and maintained, machine dishwashing is more reliable than manual dishwashing for removing soil and bacteria from equipment and utensils.

Mechanical Dishwashing Process

The mechanical dishwashing process employs 8 separate steps to wash and sanitize equipment and utensils. A summary of the mechanical process follows. You must:

1. Pre-scrape and pre-flush soiled equipment and pre-soak utensils to remove visible soil.
2. Rack equipment and utensils so that wash and rinse waters will spray evenly on all surfaces and the equipment will freely drain.
3. Wash equipment and utensils in a detergent solution that satisfies the temperature requirements prescribed in Figure 7.8.
4. Rinse equipment and utensils in clean water at a temperature consistent with the type of dishwashing machine being used.
5. Rinse equipment and utensils in a fresh hot water sanitizing rinse between 180°F (82°C) and 194°F (90°C), except for a single-tank, stationary-rack, or single-temperature machine, where the final rinse may not be less than 165°F (74°C). The recommended final rinse temperature for low-temperature chemical sanitizing dishwashing machines is 120°F (49°C) or less.
6. Air-dry equipment and utensils.
7. Store clean and sanitary items in a clean, dry area where they are protected from contamination.
8. Clean and maintain the machine to keep it in proper working condition.

The majority of commercial spray-type dishwashing machines on the market today will work efficiently. The major problems with this type of equipment are operational and require ongoing supervision and surveillance. Selection of a particular machine for a given food establishment requires knowledge of the demands to be placed on the machine. This includes the type of utensils to be washed and the quantity of equipment and utensils to be processed during peak periods.

Provide sufficient counter or table space for the accumulation of soiled equipment and utensils and keep them separate from items that are clean and sanitary. Scrape food debris into a garbage disposal or garbage can. Freshly deposited soil is the material that remains on equipment and utensils after meal preparation or a meal itself. This is the easiest type of soil to remove because washing usually occurs while the soil is still moist.

Dried deposits of soil result when dirty dishes and utensils stand for a long period of time or are exposed to high temperatures. This allows fresh soft soil to dry, harden, and form a crusty deposit that is hard to remove. Dried soil frequently requires pre-soaking to soften and loosen it from the surface.

Once items are pre-flushed and pre-scraped, position them in a rack or on a conveyor so that wash and rinse water and the sanitizer will spray evenly on all surfaces. Glasses and small equipment are racked with their bottom side up. Dishes are racked on their edge and eating utensils are placed in baskets with the mouth piece up. After the utensils are washed, rinsed, and sanitized, invert them into another basket with the handles up and repeat the warewashing process.

The temperature of the wash water (and power rinse if applicable) is extremely important in providing effective sanitizing of equipment and utensils. Minimum wash and rinse water temperatures are provided in Figure 7.8. Equipment and utensils should be exposed to the wash water for at least 40 seconds.

Type of Machine	Wash Temperature	Rinse Temperature
Single-tank, stationary-rack, single-temperature machine	165°F (74°C)	165°F (74°C)
Single-tank, conveyor, dual temperature machine	160°F (71°C)	180°F (82°C)
Single-tank, stationary-rack, dual temperature machine	150°F (66°C)	180°F (82°C)
Multi-tank, conveyor, multi-temperature machine	150°F (66°C)	160°F (71°C) to 180°F (82°C)
Chemical sanitizing machine	120°F (49°C)	120°F (49°C)

Figure 7.8 Minimum Wash and Rinse Temperatures of Mechanical Dishwashing Machines
(Source: *FDA Food Code*)

Some machines provide a power rinse which removes soil and detergent residues. The final rinse is designed to sanitize at a temperature of not less than 165°F (74°C) for at least 30 seconds in single-tank, stationary-rack, single-temperature machines. Sanitizing in all other machines requires a final rinse temperature between 180°F (82°C) and 194°F (90°C) for at least 30 seconds. The flow pressure of the hot water sanitizing rinse must be between 15 and 25 pounds per square inch (psi) to ensure the water makes good contact with the surface of the items being sanitized.

Wash and power rinse water temperatures less than those prescribed in the FDA Food Code will not effectively sanitize equipment and utensils even when the final rinse (sanitizing) temperature is properly maintained. This is because effective sanitizing of dishes is the result of the cumulative temperature effects of wash, power rinse, and final rinse waters. Dish machine operators must be careful not to contaminate cleaned and sanitized equipment and utensils by touching them with soiled hands.

Cleaned and sanitized equipment and utensils *must be air-dried* before storage (Figure 7.9). Soiled, multi-use cloth towels can recontaminate cleaned and sanitized equipment and utensils. The *FDA Food Code* prohibits cloth drying of equipment and utensils, with the exception that air-dried utensils can be "polished" with cloths that are clean and dry.

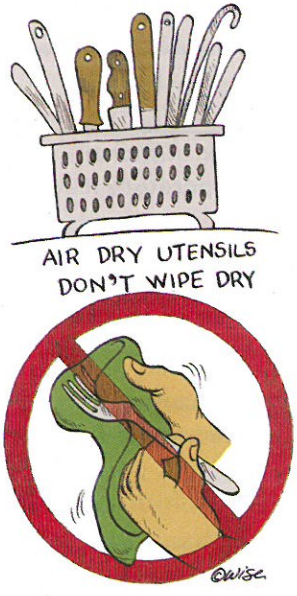

Figure 7.9 Air-Dry Utensils

Cleaned and sanitized equipment and utensils must be stored in such a way as to protect them from contamination (Figure 7.10). Cabinets and carts used to store cleaned and sanitized equipment and utensils may not be located in locker rooms and toilet rooms and under sewer lines that are not shielded to catch drips, leaking water lines, open stairwells, or under other sources of contamination.

Figure 7.10 Clean Tray Storage

Manual Dishwashing

Manual warewashing is typically performed in a sink that has at least 3 compartments (Figure 7.11). The first compartment is used for washing, the second for rinsing, and the third compartment is used for sanitizing. Each compartment must be large enough to accommodate immersion of the largest equipment and utensils used in your food establishment. If equipment or utensils are too large for the warewashing sink, they must be cleaned and sanitized using a mechanical dishwashing machine or alternative manual warewashing equipment, such as high-pressure detergent sprayers, low- or line-pressure spray detergent foamers, or other task-specific cleaning equipment.The manual warewashing sink must be equipped with sloped drain boards or dish tables of adequate size to store soiled items prior to washing, and clean items after they have been sanitized. Hot

and cold potable water must be supplied to each compartment of the sink, and the sink should be cleaned and sanitized prior to use.

Equipment and utensils are washed in the first compartment with warm water and an effective cleaning agent. Washing removes visible food particles and grease. The correct amount of detergent, based on the quantity of water used in the compartment, should always be used. The temperature of the wash solution must be maintained at not less than 110°F (43°C) unless a different temperature is specified by the manufacturer of the cleaning agent.

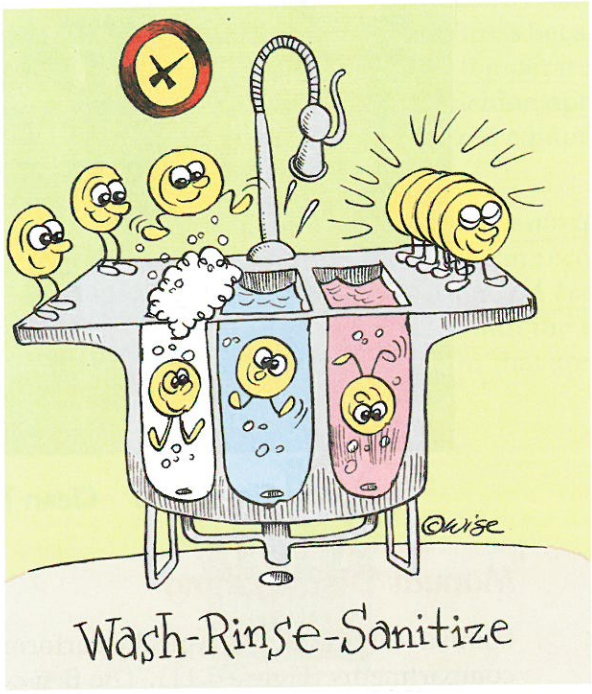

Figure 7.11 Manual Dishwashing

A cloth, nylon brush, or other approved cleaning device should be used to loosen and remove soil.

Equipment and utensils are rinsed in clean, warm water in the second compartment. Rinsing removes cleaning agents, soap film, remaining food particles, and abrasives that may interfere with the sanitizer agent. For best results, the rinse water must be kept clean and the temperature should be at least 120°F (49°C).

Items are sanitized in the third compartment by submerging them in hot water or a chemical sanitizer solution. **When hot water is used as a**

sanitizer, the temperature of the water must be maintained at 171°F (77°C) or above at all times. Items must be immersed in the hot water for at least 30 seconds. Chemical sanitizers are frequently preferred in food establishments because they do not require large amounts of hot water, which saves energy. The *FDA Food Code* recommends that items being chemically sanitized be submerged in the sanitizer solution for at least 10 seconds for a chlorine compound and 30 seconds for other chemical sanitizers. Most state and local food codes require immersion in all chemical sanitizers for at least 60 seconds. You should consult the regulatory authority in your jurisdiction to find out what rules apply in your area. **The recommended range of water temperatures for most chemical sanitizing solutions is between 75°F (24°C) and 120°F (49°C). Except for quats, water temperatures above 120°F (49°C) must be avoided because at high temperatures the potency of the sanitizer is lost by evaporation into the air.** Soil and other deposits can shield bacteria from chemical sanitizing solutions. Therefore, always make certain that all surfaces are properly cleaned before they are sanitized.

As with mechanical warewashing, items that have been manually cleaned and sanitized must be air-dried before they are put into storage. Avoid wiping cleaned and sanitized equipment and utensils with cloths or towels because this can recontaminate the sanitized surfaces. If drying agents are used in conjunction with sanitization they must contain components that are Generally Recognized As Safe (GRAS) for use in food, GRAS for the intended purpose, or have been approved for use as a drying agent under the relevant provisions contained in Title 21 of the Code of Federal Regulations.

Cleaned and sanitized equipment and utensils must be stored in such a way as to protect them from contamination. Cabinets and carts used to store cleaned and sanitized equipment and utensils may not be located in locker rooms and toilet rooms and under sewer lines that are not shielded to catch drips, leaking water lines, open stairwells, or under other sources of contamination.

The effectiveness of the manual warewashing process depends to a great degree on the condition of the wash, rinse, and sanitizing water. When the cleaning agent disappears in the first compartment, the wash solution should be completely drained and replaced with fresh detergent. When detergent builds up in the second compartment, the fresh water rinse should be drained and replaced with clean, fresh water. When the sanitizer in the third compartment is depleted, it should be drained completely and a new solution made. The concentration of a chemical sanitizer solution must be tested periodically with a chemical test kit or strips to make sure that it

remains at the strength required by the regulatory agency in your jurisdiction. These strips provide a color comparison to indicate the strength of the sanitizer (see Figure 7.12). Obtain test strips from the manufacturer of your sanitizer.

Figure 7.12 Measuring the Concentration of Sanitizers Using Test Strips

Cleaning Fixed Equipment

Some equipment such as floor model mixers, slicers, and grinders cannot be cleaned and sanitized using either mechanical or conventional manual warewashing processes (Figure 7.13). This equipment should be disassembled to expose food-contact surfaces to cleaning and sanitizing agents The basic steps for cleaning fixed equipment are:

1. To avoid electrocution and other injury, always disconnect power to the equipment before disassembling it for cleaning.
2. Equipment must be disassembled as necessary to allow access of the detergent solution to all parts.
3. Use a plastic scraper to clean equipment parts and remove food debris that has accumulated under and around the equipment. Scrape all debris into the trash.
4. Carry the parts that have been removed from the equipment to the manual warewashing sink where they will be washed, rinsed, and sanitized.

5. Wash the remaining parts of the equipment using a clean cloth, brush, or scouring pad and warm, soapy water. Clean from top to bottom.
6. Rinse thoroughly with fresh water and a clean cloth.
7. Swab or spray a chemical sanitizing solution, mixed to the manufacturer's recommendations, onto all food-contact surfaces.
8. Allow all parts to drain and air-dry.
9. Reassemble the equipment.

Figure 7.13 Meat Grinder
(Courtesy of Hobart Corp.)

10. Resanitize any food-contact surface that might have been contaminated due to handling when the equipment was being reassembled.

Large equipment such as preparation tables and band saws can be cleaned by using a foam or spray method. In this process, detergents and degreasers, fresh water rinse, and a chemical sanitizer are applied using foam or spray guns. The hoses, feed lines, and nozzles that make up the foam or spray unit should be in good condition and attached properly.

The bucket method is often used to clean equipment that could be damaged by pressure spraying or immersion in the manual warewashing sink. This system employs separate buckets for washing, rinsing, and sanitizing. Three buckets are required when sanitizing with a clean cloth and sanitizer solution. Only 2 buckets (1 for wash and another for rinse) are required if the sanitizer is sprayed on the equipment from a spray bottle.

The clean-in-place (CIP) method is used for equipment that is designed to be cleaned and/or sanitized by circulating chemical solutions through the equipment. An example of this type of equipment is a soft-serve ice cream or yogurt machine (Figure 7.14). The basic steps in the clean-in-place method are:

1. Empty food product and waste from the equipment.
2. Disconnect the power to the equipment.
3. Disassemble if parts are removable and cleanable in the manual warewashing sink.
4. Clean and sanitize the removable parts using the three-compartment warewashing sink and process.
5. Clean and sanitize the main unit by circulating wash, rinse, and sanitizing solutions through it. Combination detergent sanitizers can also be used on equipment that is designed for CIP cleaning.
6. Reassemble parts that were removed from the main unit.
7. Resanitize by circulating a manufacturer approved sanitizing solution through the equipment.

The cleaning frequency for kitchen equipment depends on the location and product processed. In most operations, the equipment should be cleaned at least once every 4 hours or between uses with different types of food products. Always check the manufacturer's instructions for recommended cleaning frequency and procedures.

Figure 7.14 Soft-Serve Ice Cream Machine
(Courtesy of SaniServ)

Many food operations use wiping cloths to clean up spills. Wiping cloths should be stored in an **in-place sanitizing solution** in order to reduce microbial growth on the wiping cloths between uses (Figure 7.15). The in-place sanitizing solution can contain chlorine, iodine, or quarternary ammonia compounds. Quarternary ammonia compounds are preferred because they are capable of killing germs for a longer period of time. Wiping cloths must be changed regularly, and they must be used for no other reason except for removing spills. Cloths used for wiping floors, raw food preparation areas, and equipment must be kept separate. The *FDA Food Code* requires wiping cloths to be laundered daily.

Working containers of sanitizing solutions for storage of in-use wiping cloths may be placed above the floor and used in a manner to prevent contamination of food, equipment, utensils, linens, single-service or single-use articles.

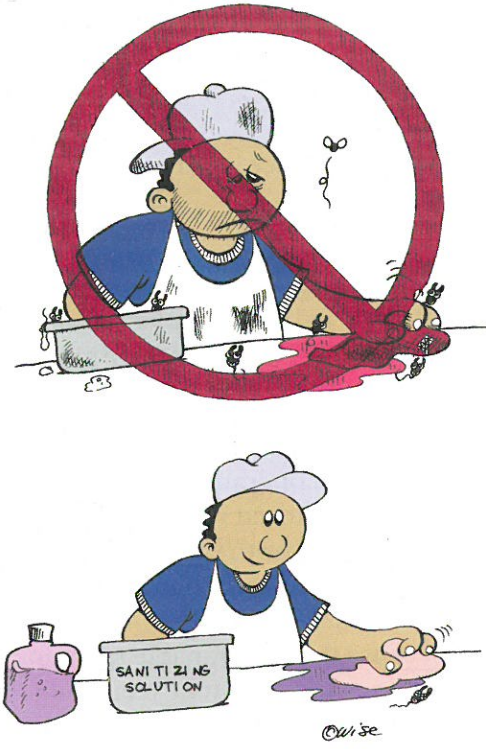

Figure 7.15 Store and Use Wiping Cloths Properly

Many food establishments use a variety of single-service items. These are typically paper or plastic dishes, cups, and eating utensils that are used one time and then discarded. Single-use items must be stored and dispensed to protect them from contamination from customers and the surrounding environment. Dishes and cups should be stored in boxes or cabinets or upside down and away from overhead plumbing lines to protect them from contamination. Eating utensils should be either wrapped in plastic or stored in an approved dispensing container with the handles up. This will prevent the eating part of the utensil, the one that comes into contact with your customer's mouth, from becoming contaminated.

Cleaning Environmental Areas

Food debris or dirt on floors, walls, ceilings, floor drains, and other non food-contact surfaces may provide a suitable environment for the growth of microorganisms which employees may accidentally transfer to food. These surfaces must be cleaned regularly to minimize

contamination, odors, and pest infestations. A regular cleaning schedule should be established and followed to maintain the facility in a clean and sanitary condition. The manager or supervisor should create a master cleaning schedule that will list the following items:

- The specific equipment and facilities to be cleaned
- The processes and supplies needed to clean the equipment and facilities
- The prescribed time when the equipment and facilities should be cleaned
- The name of the employee who has been assigned to do the cleaning.

Major cleaning should be done during periods when the least amount of food will be exposed to contamination and service will not be interrupted. The best time is normally when the establishment is closed. Workers should minimize general purpose cleaning when foods are being prepared and served. This requirement does not apply to cleaning that is necessary to remove spills or debris due to accidents.

There should be a separate sink to fill and empty mop buckets, to rinse and clean mops, and to clean brushes and sponges. Handwashing, food preparation, and warewashing sinks must never be used for cleaning mops and brushes. A "janitor's" sink or floor drain should be provided to dispose of waste water produced by cleaning activities.

Ceilings

Ceilings should be checked regularly to make certain they are not contaminating food production areas. Ceilings, lights, fans, and covers can be cleaned using either a wet or dry cleaning technique. When wet-cleaning ceilings and fixtures, it is best to use a bucket method to keep water away from lights, fans, and other electrical devices. Whenever possible, disconnect power before cleaning fixtures.

Walls

Some parts of the walls in a food production area, such as those around a sink or food production equipment, should be considered food-contact surfaces. These areas should be washed, rinsed, and sanitized whenever the other food-contact surfaces in the area are cleaned. Other wall areas are considered non food-contact surfaces and do not need to be cleaned as often.