CLEANING AND SANITIZING

This section is presented primarily for information. The only information the BETC participant will be responsible for is to know the sanitization standards for chemical and hot water sanitizing as found in the Rules for Food Establishment Sanitation.

CLEANING AND SANITIZING

I. CLEANING

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

Listed below are the five basic types of cleaning compounds and their major functions:

1. Basic Alkalis - Soften the water (by precipitation of the hardness ions), and saponify fats (the chemical reaction between an alkali and a fat in which soap is produced).
2. Complex Phosphates - Emulsify fats and oils, disperse and suspend oils, peptize proteins, soften water by sequestering, and provide rinsability characteristics without being corrosive.
3 Surfactant - (Wetting Agents) Emulsify fats, disperse fats, provide wetting properties, form suds, and provide rinsability characteristics without being corrosive.
4. Chelating - (Organic compounds) Soften the water by sequestering, prevent mineral deposits, and peptize proteins without being corrosive.
5. Acids - Good at mineral deposit control; and soften the water.

When considering a good cleaner the following properties should be considered:

1. Quick and complete solubility.
2. Good wetting or penetrating action.
3. Dissolving action of food solids.
4. Emulsifying action on fat.
5. Deflocculating, dispersing, or suspending action.
6. Good rinsing properties.
7. Complete water softening power.
8. Noncorrosive on metal surfaces.
9. Germicidal action.
10. Economical to use.

The factors that affect cleaning efficiency are:

1. Selecting the right cleaner for the job.
2. Increasing the temperature of the cleaning solution so that the strength of the bond between the soil and surface is decreased, the viscosity is decreased, and the solubility of the soluble materials and the chemical reaction rate is increased.
3. Increasing the turbulence "elbow grease".
4. Increasing the time the cleaner has contact with the surface needing cleaned.
5. Increasing the concentration. Concentration is the least effective variable to change in cleaning.

The cleaning operation:

1. Prewash - the removal of gross food particles before applying the cleaning solution. 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.

2. Washing - the application of the cleaning compound. There are many methods of subjecting the surface of equipment to cleaning compounds and solutions. Effectiveness and the economy of the method generally dictates its use.

   A. Soaking - immersion in a cleaning solution . The cleaning solution should be hot (125 degrees Fahrenheit) and the equipment permitted to soak for 15 - 30 minutes before manually or mechanically scrubbed.

   B. Spray method - spraying cleaning solution on the surface. This method uses a fixed or portable spraying unit with either hot water or steam.

   C. Clean-in-place systems (C.I.P.) - is an automated cleaning system generally used in conjunction with permanent-welded pipeline systems. Fluid turbulence in the pipeline is considered to be the major source of energy required for soil removal.

   D. Foaming - utilizes a concentrated blend of surfactant developed to be added to highly concentrated solution of either alkaline or acid cleaners. It produces a stable, copious foam when applied with a foam generator. The foam clings to the surface to be cleaned, which increases contact time of the liquid with the soil, and prevents rapid drying and runoff of the liquid cleaner, thereby improving cleaning.

   E. Jelling - utilizes a concentrated powdered-jelling 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 jelled acid or alkaline detergent is sprayed on the surface to be cleaned. The jelled cleaner will hold a thin film on the surface for 10 minutes or longer to attack the soil. Soil and gel are removed with a pressure warm water rinse.

F. Abrasive cleaning - abrasive type powders and pastes are used for removing difficult soil. Complete rinsing is necessary and care should be taken to avoid scratching stainless steel surfaces. Scouring pads should not be used on food-contact surfaces because small metal pieces from the pads may serve as focal points for corrosion or may be picked up in the food.

3. Rinsing - the removal of all traces of the cleaning solution with clean potable water.

4. Sanitization - a process either by using heat or a chemical concentration that will reduce the bacterial count, including pathogens to a safe level on utensils and equipment after cleaning.

II. SANITIZING

The primary reason for the application of effective sanitizing procedures is to destroy those disease organisms which may be present on equipment or utensils after cleaning, and thus prevent the transfer of such organisms to the ultimate consumer. In addition, sanitizing procedures may prevent spoilage of foods or prevent the interference of microorganisms in various industrial processes which depend on pure cultures.

There are two generally accepted methods of providing for the final sanitization of a utensil after effective removal of soil, heat and chemical.

1. Heat

A. Hot water - an effective, non-selective sanitization method for food-contact surfaces; however, spores may remain alive even after an hour of boiling temperatures. The microbicidal action is thought to be the coagulation of some protein molecules in the cell. The use of hot water has several advantages in that it is readily available, inexpensive and nontoxic. Sanitizing can be accomplished by either pumping the water through assembled equipment or immersing equipment into the water. When pumping it through equipment, the temperature should be maintained to at least 171˚F. (77˚C) for at least 5 minutes as checked at the outlet end of the equipment. When immersing equipment, the water should be maintained at a temperature of a least 171˚F. (77˚C) or above for 30 seconds.

B. Steam is an excellent agent for treating food equipment. Treatment on heavily contaminated surfaces may cake on the organic residues and prevent lethal heat to penetrate to the microorganism. Steam flow in cabinets should be maintained long enough to keep the thermometer reading above 171°F. (77°C) for at least 15 minutes or above 200°F. for at least 5 minutes. When steam is used on assembled equipment, the temperature should be maintained at 200°F. for at least 5 minutes as checked at the outlet end of the assembled equipment.

2. <u>Chemical</u>

There are a wide variety of known chemicals whose properties destroy or inhibit the growth of microorganisms. Many of these chemicals, however, are not suitable for use on food-contact surfaces because they may corrode, stain or leave a film on the surface. Others may be highly toxic or too expensive for practical use. When looking for an approved sanitizer the label must include:

1. EPA registration number.
2. States that the product may be used on food contact surfaces.
3. Does not require a potable water rinse.
4. States that the product will sanitize. If a product is a detergent/sanitizer, it must also make the claim to clean.

The most commonly used chemical sanitizers for food contact are:

1. **<u>Chlorine</u>** and its compounds combine indiscriminately with any and all protein and protoplasm. The mode of bactericidal action is thought to be the reaction of chlorine with certain oxidizable groups in vital enzyme systems.

Advantages	Disadvantages
Effective against a wide variety of microorganisms.	Organic matter causes a quick reduction in bactericidal effectiveness.
Not affected by water hardness	Effectiveness decreases as pH increases.
Non-staining.	Dissipates in hot water.
Concentration easily measured by field tests.	Corrosive.
Generally inexpensive	Irritating to skin.
Non-film forming	Short shelf life.
	Some odor.

2. **Iodophors** are soluble complexes of iodine combined usually with non-ionic surface-active agents, loosely bound.

Advantages	Disadvantages
Rapid bacterial action in acid pH range in cold or hard water.	Slow acting at pH 7.0 above, vaporizes at 120˚F.
Less affected by organic matter than chlorine.	Less effective against bacterial spores than hypochlorites.
Non-corrosive and non-irritation to skin.	May stain some plastics and porous surfaces.
Generally spot free drying.	Relatively expensive.
Stable -- long shelf life.	
Visual control (color)	

3. **Quaternary Ammonium Compounds** are compounds that are synthetic surface - action agents. The most common ones are the cationic detergents which are poor detergents but excellent germicides. In these compounds, the organic radical is the cation and the anion is usually chlorine. The mechanisms of germicidal action is not completely understood, but is associated with enzyme inhibition and leakage of cell constituents.

Advantages	Disadvantages
Non-corrosive.	Not compatible with hard water and most detergents.
Non-irritating to skin.	Forms film.
Stable to heat.	Produces foam in mechanical operations.
Forms bacteriostatic film on surface after treatment.	Selective in destruction or inhibition of various types of organisms.
Relatively stable in presence of organic matter.	Requires higher concentration for action than chlorine or iodine.
Active over a wide pH range.	Relatively expensive.
No taste or odor in use dilutions.	
Broad spectrum of activity.	
Long shelf life.	

Factors affecting the action of chemical sanitizers:

1. Contact of the sanitizer - in order for a chemical to react with microorganisms, it must achieve intimate contact.

2. Selectivity of the sanitizer - certain sanitizers are non-selective in their ability to destroy a wide variety of microorganisms while others demonstrate a degree of selectivity. Chlorine is relatively non-selective; however both iodophors and quaternary compounds have a selectivity which may limit their application.

3. Concentration of the sanitizer - in general, the more concentrated a sanitizer, the more rapid and certain its actions. Increases in concentration are usually related to exponential increases in effectiveness until a certain point when it accomplishes less noticeable effectiveness.

   A. A chlorine solution shall have a minimum temperature based on the concentration and pH of the solution as listed in the following chart;

Minimum Concentration	Minimum Temperature	
mg/L	pH 10 or less °C (°F)	pH 8 or less °C (°F)
25	49 (120)	49 (120)
50	38 (100)	24 (75)
100	13 (55)	13 (55)

   B. Iodine solution shall have a:

      1. Minimum temperature of 24°C (75°F),

      2. pH of 5.0 or less or a pH no higher than the level for which the manufacturer specifies the solution is effective, and

      3. Concentration between 12.5 mg/L and 25 mg/L.

   C. Quaternary ammonium compound solution shall;

      1. Have a minimum temperature of 24°C (75°F),

      2. Have a concentration as specified under the requirements specified in 21 CFR 178.1010 and as indicated by the manufacturer's use directions included in the labeling, and

3. Be used only in water with 500 mg/L hardness or less or in water having a hardness no greater than specified by the manufacturer's label.

4. 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 reaction in general are speeded up by raising the temperature. However, a higher temperature also generally lowers surface tension, increases pH, decreases viscosity and effects other changes which may enhance its germicidal action. It should be noted that chlorine compounds are more corrosive at high temperatures, and iodine tends to sublime at temperatures above 120 degrees Fahrenheit.

5. pH of solution - the pH of the solution exerts a very pronounced influence on most sanitizers. Quaternary compounds present a varied reaction to pH depending on the type of organisms being destroyed. Chlorine and iodophor generally decrease in effectiveness with an increase in pH.

6. Time of exposure - sufficient time must be allowed for whatever chemical reactions that occur to destroy the microorganism. The required time will not only depend on the preceding factors, but on microorganism populations and the populations of cells having varied susceptibility to the sanitizer due to cell age, spore formation and other physiological factors of the microorganisms.

III. DISHWASHING MACHINES

Dishwashing machines belong to one of two categories: the hot water or chemical sanitizing type. Standards for manufacturers' of these dishwashing machines are provided by NSF International as Standard number 3. Part of the standard requires:

1. Hot water sanitizing machines shall specify the following on a permanently attached data plate:

   A. The minimum temperature of the wash water in the tank (unless numerically indicated at the location of temperature indicating device);

   B. The minimum temperature of pumped rinse in the tank, if applicable (unless numerically indicated at the location of temperature indicated device);

   C. The minimum temperature of the final sanitizing rinse at the spray arm manifold (unless numerically indicated at the location of temperature indicting device);

D. The minimum and maximum pressure in the final sanitizing rinse line with the rinse in operation (not required for machines with a pumped final sanitizing rinse);

E. The minimum wash and final sanitizing rinse cycle times (stationary rack machines only);

F. The maximum conveyor speed (conveyor machines only).

The specifications for hot water sanitizing

Type of Dishwashing Machine	Minimum wash temp.	Minimum sanitizing rinse temperature	Maximum sanitizing rinse temperature	Sanitizing rinse pressure
stationary rack, single temp.	165˚F (74˚C)	165˚F (74˚C)	190˚F (90˚C)	20 psi ± 5 psi (138 kPa ± 34kPa)
stationary rack/dual temperature	150˚F (66˚C)	180˚F (82˚C)	195˚F (90˚C)	20 psi ± 5 psi (138 kPa ± 34kPa)
single tank conveyor	160˚F (71˚C)	180˚F (82˚C)	195˚F (90˚C)	20 psi ± 5 psi (138 kPa ± 34kPa)
multiple tank conveyor	150˚F (66˚C)	180˚F (82˚C)	195˚F (90˚C)	20 psi ± 5 psi (138 kPa ± 34kPa)

(2) Chemical sanitizing machines shall specify the following on a permanently attached data plate:

A. The minimum temperature of wash water in the tank (unless numerically indicated at the location of temperature indicating device);

B. The minimum temperature of pumped rinse in the tank, if applicable (unless numerically indicated at the location of temperature indicating device);

C. The minimum temperature of the chemical sanitizing rinse (unless numerically indicated at the location of temperature indicating device);

D. Type of chemical sanitizer and minimum concentration in the chemical sanitizing rinse;

E. The maximum and minimum pressure in the chemical sanitizing rinse line with the rinse in operation (not required for machines with a pumped final sanitizing rinse);

F. The minimum wash and chemical sanitizing rinse cycle times (stationary rack machines only);

G. The maximum conveyor speed (conveyor machines only).

Data plate specification for the chemical sanitizing rinse

Sanitizing solution type	Final rinse temperature	Concentration
Chlorine	min: 120°F (49°C) *	min: 50 ppm (as NaOCl)
Iodine	min: 75°F (24°C)	min: 12.5 ppm - max: 25 ppm
Quaternary Ammonium	min: 75°F (24°C)	min: 150 ppm - max: 400 ppm

* For glasswashing machines using chlorine sanitizing solution, the minimum final rinse temperature specified by the manufacturer shall be at least 75°F (24°C).

The following are general requirements for a successful dishwashing operation

1. Selection of the proper dishwashing machine, correctly sized to suit the needs of the particular operation.
2. Properly sized and installed water heating equipment to supply the dishwashing operation.
3. Effective layout of the equipment and utilization of labor.
4. Training of the operator in the use and the maintenance of the equipment and the correct use of detergents and/or other chemicals used in the dishwashing process.
5. Managerial surveillance of the operation to determine that the dishwashing procedure is carried out properly by the trained personnel.
6. A protected dish handling and storage system to assure clean dishes when required for use.

The majority of commercial spray-type dishwashing machines on the market today will do the job required of them. The major problems with this type of equipment are operational and require periodical surveillance. Selection of a particular machine for a given operation requires knowledge of the demands to be placed on the machine, type of utensils to be washed, quantity of utensils at peak periods, etc. A properly sized dishwashing machine engineered to conform to the requirements of NSF International standard 3, properly installed and maintained will do a satisfactory job.

When preparing to check a dishmachine, begin by reviewing the operational requirements listed on the data plate of the machine. Then check the following:

- Scrape trays clear.
- Conveyor-type machines-curtains intact, clean and in proper position.
- Conveyor speed according to manufacturer’s specifications.
- Overflow standpipe in place and not blocked or leaking.
- Wash and rinse pump inlet unobstructed.
- Tank interior clear of buildup of lime, food soils, etc.
- Wash and rinse nozzles clear of obstructions and lime deposits.
- End caps in place on wash and rinse arms.
- Rinse line strainer clear.
- Wash and rinse thermometers accurate or properly calibrated.
- Pressure regulator functioning properly.
- Flow pressure 15 to 25 pounds per square inch (psi) (where required).
- Building water pressure adequate.
- Rinse arm nozzle alignment correct.
- Dishes properly racked.

Proper sanitization in a dishmachine depends on heat accumulation from washing, power rinsing (on some types of machines), and final rinsing. Therefore, each of these cycles must be operating at the proper temperature. To insure this, the following should be determined:

- No lime deposits in heating elements.
- Machine tank gas heater jets not obstructed.
- No excessive ventilation draft in the removal of steam and condensation.

- Maximum-registering, mercury-filled thermometers and thermo-labels (paper thermometers that change color from silver to black when reaching specified temperatures) may be used to confirm the effectiveness of heat sanitization.

- The maximum-registering, mercury-filled thermometer, to give accurate readings, should be attached (rubber bands or clips may be used) in a vertical position. It should also be taken out of any case or guard when used. Thermo-labels are attached by pressure-sensitive adhesive tape preferably on a clean dry china plate.

- A thermometer can be attached at the gage cock to check the calibration of the final rinse thermometer without removing the final rinse thermometer sensing bulb. However, the thermometer to be attached should have an immersion mark on it and must have a special connection that will allow movement of the stem through the opening presented when the valve is turned on. The sensor must be inserted into the flowing stream of water or serious errors in readings can occur since cooling will take place between the rinse flow line and the thermometer location. Check the thermometer that is being used as the calibrating thermometer. Immerse it in the hot water to the immersion mark on the thermometer and take a comparison reading. There will be a difference in reading if the bulb is not immersed to this depth each time. Temperatures must be checked with the rinse activated and water flowing in the line.

- As water falls through space after leaving the rinse spray arms, the drop in temperature is rapid. The temperature developed at the dish surface can be 10° F. to 20° F. lower than the temperature in the manifold. Therefore, a reading on the maximum-registering thermometer of at least 160° F. or a color change in thermopaper at 160° F. should be acceptable.

- Unless the machine is used just prior to testing, run the machine through at least two complete wash and final rinse cycles before taking readings.

- Close adherence to manufacturer's specifications as listed on the machine data plate is very important.

The following is a list of common problems experienced in dishwashers together with suggested remedial action

Symptom	Possible Cause	Suggested Cure
Soiled Dishes	Insufficient detergents	Use enough detergent in wash water to insure complete soil suspension

Symptom	Possible Cause	Suggested Cure
Soiled Dishes	Wash water temperature too low	Keep water temperature within recommended ranges to dissolve food residues and to further facilitate heat accumulation (for sanitation).
Soiled Dishes	Inadequate wash and rinse times	Allow sufficient time for wash and rinse operations to be effective. (Time should be automatically controlled by timer or by conveyor speed).
Soiled Dishes	Improperly racking or placing	Rack according to size and type
Film	Water hardness	Use an external softening process. Use more detergent to provide internal conditioning. Use a chlorinated cleaner. Check temperature of wash and rinse water. Water maintained above recommended ranges may precipitate film.
Film	Detergent carryover	Maintain adequate pressure and volume of rinse water.
Film	Improperly cleaned or rinsed equipment	Prevent scale buildup in equipment by adopting frequent and adequate cleaning practices. Maintain adequate pressure and volume of water.
Greasy films	Low pH, insufficient detergent, low water temperature	Maintain adequate alkalinity to saponify greases, check detergent, and water temperature.
Greasy films	Improperly cleaned equipment	Unclog all wash and rinse nozzles to provide proper spray action. Clogged rinse nozzles may also interfere with wash tank overflow.
Streaking	Alkalinity in the water	Use and external treatment method to reduce alkalinity
Spotting	Rinse water hardness	Provide external or internal softening
Spotting	Rinse Water temperature too high or too low	Check rinse water temperature. Dishes may be flash drying, or water may be drying on dishes rather than draining off.
Spotting	Inadequate time between rinsing and storage	Allow sufficient time for air drying.
Foaming	Detergent	Change to a low sudsing product.

Symptom	Possible Cause	Suggested Cure
Foaming	Dissolved or suspended solids in water	Use an appropriate treatment method to reduce the solid content of the water.
Foaming	Food soil	Adequately remove gross soil before washing. The decomposition of carbohydrates, proteins, or fats may cause foaming during the wash cycle.

IV. DEFINITIONS:

Chelation - The action of an organic 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.

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

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

Detergents - Cleaning agents or compounds that modify the nature of water so that it may efficiently penetrate, dislodge and carry away surface contamination.

Disinfectant - usually a chemical agent which destroys germs or other harmful organisms or which inactivates viruses. Most commonly used to designate chemicals that kill growing forms but not necessarily resistant spore forms of bacteria, except where the intended use is specifically against an organism forming spore or a virus, in which instance the spores, too, may be killed or the virus inactivated.

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

Emulsification - is a physical action in which fats are mechanically broken up into very small particles which are uniformly suspended in a solution.

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.

Precipitation - Soften water by precipitating out the hardness.

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

Sanitizing - a process which destroys a disease causing organisms which may be present on equipment and utensils after cleaning. Chemical sanitizer used shall meet the requirements of 21 CFR 178.1010.

Sanitizing Agent - is an agent that reduces the number of bacterial contaminants to safe levels, as may be judged by public health requirements.

Saponification - the chemical reaction between an alkali and a fat in which soap is produced.

Sequestering Agents - compounds which will react with certain ions to form relatively stable, water soluble complexes. Polyphosphates are often used in detergent formulations to prevent precipitation.

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.
Soap - is a sodium or potassium salt with a long chain organic acid.

Soil - matter out of place.

Sterilization - implies the complete destruction of all microorganisms.

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

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

V. QUIZ

1. ___________ is a process which will remove soil and prevent accumulation of food residues.

   A. Chelating
   B. Sanitizing
   C. Sterilizing
   D. Cleaning

2. A cleaning compound that is good at mineral deposit control is

   A. Surfactants
   B. Chelating
   C. Acids
   D. Basic Alkalis

3. A cleaning compound that is good at providing wetting properties

   A. Basic Alkalis
   B. Surfactants
   C. Acids
   D. Complex Phosphates

4. The correct procedure in the cleaning operation is:

   A. Prewash, wash, rinse, and air dry
   B. Prewash, wash, sanitize, rinse, and air dry
   C. Prewash, wash , rinse, sanitize, and air dry
   D. Prewash, wash, and air dry

5. ___________ is a process that will reduce the bacterial count to a safe level.

   A. Sanitization
   B. Sterilization
   C. Cleaning
   D. Chelating

6. Which is the least effective variable to change in the cleaning process:

   A. Increasing the temperature of the cleaning solution.
   B. Increasing the turbulence.
   C. Increasing the contact time of the cleaner.
   D. Increasing the concentration of the cleaner.

7. ___________ is a sanitizer that is effective against a wide variety of microorganisms.

   A. Chlorine
   B. Iodophor
   C. Quaternary Ammonium
   D. Acids

8. _____________ is a sanitizer that is non-corrosive and is slow acting at pH 7 or above.

   A. Chlorine
   B. Iodophor
   C. Quaternary Ammonium
   D. Acids

9. _____________ is a sanitizer that has a broad spectrum of activity and is active over a wide pH range.

   A. Chlorine
   B. Iodophor
   C. Quaternary Ammonium
   D. Acids

10. _______________ is an action of an organic compound attaching itself to the water hardness particle and inactivates them so they will not combine with other material in the water and precipitate out.

   A. Chelation
   B. Deflocculation
   C. Emulsification
   D. Saponification

VI. ANSWER KEY FOR CLEANING AND SANITIZING

1. D
2. C
3. B
4. C
5. A
6. D
7. A
8. B
9. C
10. A

VII. REFERENCES:

"2001 Food Code" Food and Drug Administration

"Commercial Spray-Type Dishwashing and Glasswashing Machines" NSF International Standard.

"Current Concepts in Food Protection Manual." FDA State Training Branch

Jim Shumaker, ECO Lab - Ohio