Cleaning and Disinfection

FSKN 6

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GFSI Basic Level

- The organisation shall ensure appropriate standards of cleaning and disinfection shall be maintained at all times and throughout all the stages.

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Outline of Presentation

- Importance of Cleaning and Disinfection
- Definitions
- Regulations and Customer Requirements
- Appropriate Use of Cleaning and Disinfection Chemicals
- Cleaning and Disinfection Management
- Monitoring Effectiveness

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The Importance of Cleaning and Disinfection

- Accumulated soils on food equipment and in the food environment can support the growth of pathogenic microorganisms that can contaminate foods and potentially harm consumers.
- Food contact surfaces must be cleaned and disinfected on a routine schedule to minimize this potential contamination.

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The Importance of Cleaning and Disinfection

- On shared equipment lines, effective cleaning procedures also are critical to reduce the risk of cross-contamination of foods with potential allergens.
- Examples
  - Shared processing lines for dairy products and juices.
  - Shared equipment for dry cereals containing nuts vs nut-free products.

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The Importance of Cleaning and Disinfection

- From Farm to Fork
  - Helps prevent transmission of human diseases by foods.
- Helps Prevent Pest Infestations
  - Food residues can attract and support pests.
- Improves the shelf life and quality of food products.

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Definitions from Codex Alimentarius General Principles of Food Hygiene

- Cleaning
  - The removal of soil, food residue, dirt, grease or other objectionable matter.
- Disinfection
  - The reduction, by means of chemical agents and/or physical methods, of the number of micro-organisms in the environment, to a level that does not compromise food safety or suitability.
  - Sometimes referred to as “sanitizing.”

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Legal and Customer Requirements

- Laws and regulations in countries or trading blocks typically address cleaning and disinfection requirements.
- Disinfection agents (sanitizers) typically are registered for use in each country by its respective competent authority.

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Legal and Customer Requirements

- Some cleaning requirements are simply best practice based on science and industry experience.
- Some requirements imposed by customers or demanded by food safety management schemes may be more strict than legal requirements in certain jurisdictions.

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APPROPRIATE USE OF CLEANING AND DISINFECTION CHEMICALS

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Four Types of Food Soils

1. Those that dissolve in water:
   - Simple carbohydrates - sugars
   - Some simple mineral salts (NaCl)
   - Some starche
2. Those that dissolve in alkali:
   - Proteins
   - Starches associated with proteins or fats,
   - Bacterial films (biofilms)

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Four Types of Food Soils

3. Those that dissolve in acid:
   - Hard water hardness salts (calcium and magnesium salts)
   - More complex mineral films, including iron & manganese deposits
4. Those that dissolve with surfactants:
   - Fats, oils, and greases
   - Many food residues
   - Inert soils such as sand, clay, or fine metals
   - Some biofilms

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Types of Cleaning Compounds

- 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).
- Complex Phosphates
  - Emulsify fats and oils, disperse and suspend oils, peptize proteins, soften water by sequestering, and provide rinsability characteristics without being corrosive.

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Types of Cleaning Compounds

- Surfactant (Wetting Agents)
  - Emulsify fats, disperse fats, provide wetting properties, form suds, and provide rinsability characteristics without being corrosive.
- Chelating (Organic compounds)
  - Soften the water by sequestering, prevent mineral deposits, and peptize proteins without being corrosive.
- Acids
  - Good at mineral deposit control; and soften the water.

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Factors That Influence Cleaning Efficiency

Choosing the right cleaner for the task.

- Time
  - Increased time improves efficiency
- Temperature
  - Increasing the temperature of the cleaning solution decreases the strength of the bond between the soil and surface, decreases the viscosity, and increases the solubility of the soluble materials and the chemical reaction rate.
- Velocity (Turbulence)
  - Increased velocity provides mechanical action to remove soil and filth ("elbow grease").
- Concentration
  - Increased cleaner concentration can improve efficiency, but this is the least effective variable to change in cleaning.

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Cleaning Procedure

1. Prewash
2. Washing
3. Rinsing
4. Disinfection (Sanitizing)

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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.

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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.

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Washing Methods

- Soaking
  - Immersion in a cleaning solution
  - The cleaning solution should be hot (~50 degrees Celsius) and the equipment permitted to soak for 15 - 30 minutes before manually or mechanically scrubbed.
- Spray method
  - Spraying cleaning solution on the surface.
  - This method uses a fixed or portable spraying unit with either hot water or steam.

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Washing Methods

- Clean in Place Systems (CIP)
  - 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.
  - “Clean out of Place” (COP) refers to manual breakdown and cleaning and disinfection of equipment.

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Washing Methods

- Foaming
  - Utilizes a concentrated blend of surfactant developed to be added to highly concentrated solution of either alkaline or acid cleaners.
  - 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.

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Washing Methods

- 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.

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Washing Methods

- 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.

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Cleaning Procedure

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

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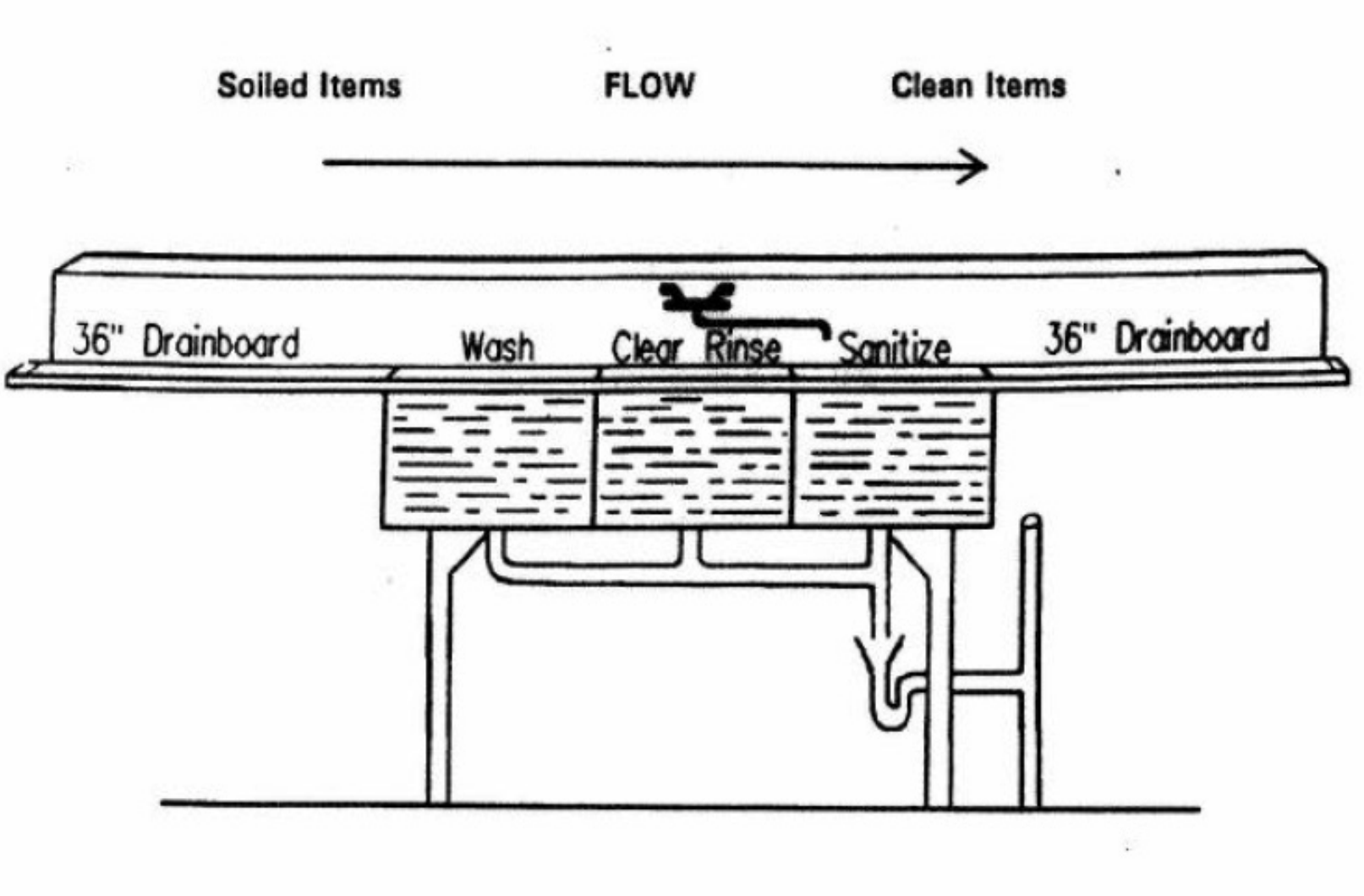
Typical 3-Compartment Sink for Warewashing



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Clean First, Then Sanitize

- You cannot effectively sanitize a surface that is not clean!

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Disinfection (Sanitizing)

- A process which destroys a disease causing organisms which may be present on equipment and utensils after cleaning.
- Two General Methods
  1. Heat Disinfection
  2. Chemical Disinfection

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Heat Disinfection

- 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 protein molecules in the cell.
  - The use of hot water has several advantages in that it is readily available, inexpensive and nontoxic.

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Heat Disinfection

- Hot water (cont.)
  - 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.
  - The water temperature at the manifold for mechanical warewashing equipment must be:
    - single temperature stationary rack = 165˚F (74˚C)
    - all others = 180˚F (82˚C)

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Heat Disinfection

- Steam
  - 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 (93˚C) for at least 5 minutes.
  - When steam is used on assembled equipment, the temperature should be maintained at 200˚F (93˚C) for at least 5 minutes as checked at the outlet end of the assembled equipment.

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Pros and Cons of Heat Disinfection

Hot water

- Easy to apply
- Effective
- Non-corrosive.
- High energy costs
- Safety concerns

Steam

- Limited application
- Expensive
- Difficult to regulate
- Difficult to monitor contact time and temperature
- It is hazardous

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Chemical Disinfectants

Most common chemical disinfectants:

- Chlorine (e.g. sodium hypochlorite)
  - Typically used at 50 – 200 ppm
- Quaternary ammonium compounds (Quats)
  - Typically used at 200 – 400 ppm
- Iodophores
  - Typically used at 12.5 – 25 ppm

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Factors Affecting the Action of Chemical Disinfectants

1. Contact of the disinfection agent
   - In order for a chemical to react with microorganisms, it must achieve intimate contact.
2. Selectivity of the disinfection agent
   - Certain disinfectants 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.

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Factors Affecting the Action of Chemical Disinfectants

3. Concentration of the disinfection agent
   - In general, the more concentrated a disinfectant, 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.
   - More is not always better!
   - Make certain you are using disinfectants in the correct range of concentration.

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Factors Affecting the Action of Chemical Disinfectants

4. Temperature of solution
   - All of the common disinfectants 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.
   - 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˚F (49 ˚C).

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Factors Affecting the Action of Chemical Disinfectants

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

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Factors Affecting the Action of Chemical Disinfectants

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.

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Chlorine

- Sodium Hypochlorite (NaOCl)
    - Liquid (5.25, 12.75 or 15%)
- Calcium Hypochlorite [Ca(OCl)2]
    - Solid (65 or 68%)
- Chlorine Gas (Cl2)
    - Gas cylinders
- Chlorine Dioxide (ClO2)
    - Generated on-site from sodium chlorite + acid

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Chlorine as a Disinfection Agent

Advantages	Disadvantages
• Relatively inexpensive	• Unstable during storage
• Rapid action	• Affected by organic matter content (loss of germicidal effect)
• Wide action against many microorganisms	• Viruses tend to be resistant
• Colorless	• Corrosive
• Easy preparation and use	• Efficacy is lowered when the pH of the solution increases
• Easy to determine concentration	• Irritating to skin; toxic at high levels
• Not affected by water hardness	• Dissipated by hot water

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Water Temperature

- At higher temperatures, available chlorine kills microbes faster.
- Higher temperatures also cause more rapid loss of chlorine activity.

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Organic Matter in the Water

- Organic matter reacts with chlorine and quickly reduces the amount of chlorine available to kill microbes.
- However, this chlorine may still be measured by total chlorine test kits.
- Need to measure available chlorine.
- Use kits that measure free (or available) chlorine levels.
  - Total chlorine kits can measure both free and bound chlorine.

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Iodophores

- Soluble complexes of iodine in an organic polymer
- Used in combination with acid cleaning agents
- Highly effective against a wide spectrum of bacteria
- Short contact time

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Iodophores as Disinfection Agents

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 (49˚C)
Less affected by organic matter than chlorine.	Less effective against bacterial spores than hypochlorites.
Non-corrosive and non-irritation to skin. Generally spot free drying.	May stain some plastics and porous surfaces.
Stable - long shelf life.	Relatively expensive.
Visual control (color)	

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Quaternary Ammonium Compounds

- Type of cationic detergent which are poor detergents but excellent germicides.
- Used widely in the food and meat industry
- Effective against a wide spectrum of bacteria
- Used on surfaces heavy contaminated with organic matter where chlorine will be corrosive

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Quats as Disinfection Agents

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.	

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Peroxyacetic Acid

- Equilibrium mixture of acetic acid and hydrogen peroxide in an aqueous solution.
- Very strong oxidizing agent and has a stronger oxidation potential than chlorine.
- Pungent acetic acid odor.
- Used in CIP systems
- Used to sanitize surfaces of equipment, floors, walls, and indoor processing and packaging facilities.

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Peroxyacetic Acid as a Disinfection Agent

Advantages	Disadvantages
Non foaming.	Corrosive to soft metals.
Effective at low temperatures (5 to 40°C).	Concentration difficult to monitor.
Environmentally safe (Breaks down to O_2, CO_2, H_2O).	Rapidly decomposed by organic matter.

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CLEANING AND DISINFECTION MANAGEMENT

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What Should be Cleaned & Disinfected?

- All surfaces that may contact the food product:
  - Food bins, containers, totes
  - Equipment food contact surfaces
  - Utensils, knives
  - Tables, cutting boards, conveyor belts
  - Ice makers, ice storage bins
  - Hands, gloves, aprons
- Surfaces that do not directly contact the product - walls, ceilings, floors and drains
- Any surface that can have “drip” into food product.

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What Should be Cleaned & Disinfected?

- Cleaning Tools:
  - Brooms, mops, squeegees, buckets, sponges, scrapers, foaming equipment, water guns, etc.
- Cleaning tools can be a major source of microbial cross-contamination if not cleaned.
- Cleaning tools should be washed and sanitized after every use.
- Stored clean, dried and secured.

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Example - Recommended Cleaning Schedules

Type of Surface	Recommended Cleaning Substance	Frequency of Use
Stainless steel	Alkaline, not abrasive Acid, not abrasive	Daily Weekly
Metals (copper, aluminum, galvanized surfaces)	Moderately alkaline substances with corrosion inhibitors	Daily
Wood	Detergents with surfactants	Daily
Rubber	Alkaline substances	Daily
Glass	Moderately alkaline substances	Daily
Concrete Floors	Alkaline	Daily

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Sanitation Standard Operating Procedures (SSOPs)

- SSOP is a written document - an operations manual.
- Describes chemicals, concentrations, application methods and timing for every part of the plant.
  - **Master Sanitation Schedule**: What, When, Who?
  - **Cleaning & Sanitizing Procedures**: How?
- Cleaning and sanitation verification records show that procedures and schedules were followed.

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Monitoring Effectiveness

- Work with staff to make sure they understand the need for hygiene and cleanliness
- Record reviews.
  - Were procedures followed and conducted at the appropriate times?
  - Were corrective actions recorded?

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Monitoring Effectiveness

- Regular pre-operational and inter-operational inspections.
  - Keep records of observations.
  - Inspection should be thorough, and use tools like flashlight (torch) checks, analytical monitoring procedures like ATP testing or swabs for microbial populations.
  - Note that properly cleaned and disinfected food contact surfaces will not be sterile, but should have low total counts of microorganisms.
- Adjust procedures if monitoring indicates potential for problems.

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Summary

- Cleaning and disinfection are two distinct procedures.
- You must clean first, then disinfect.
- Choose the correct chemicals or processes for both steps.
- Develop a procedure for each operation and make certain these procedures are followed.
- Keep records of what you do.

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QUESTIONS?

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