Cleaning and Disinfection Processing Plants and Equipment

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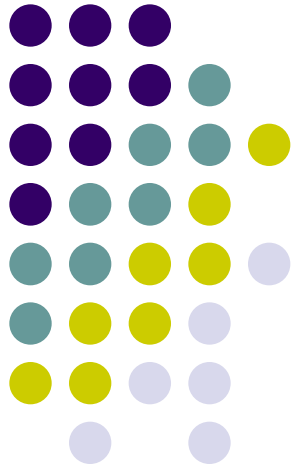
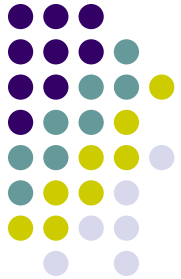


Cleaning and Disinfecting



- To reduce the risk of food contamination, strict cleaning and disinfecting procedures must be followed with all equipment, utensils, containers, and manipulation installations.

What to clean and disinfect?

- All processing plant equipment, containers, utensils, and installations.

What to clean and disinfect?

- Same procedures should be applied to disinfection:
  - tools
  - containers
  - floors, walls
  - all surfaces in contact with raw materials (meat → future food) during:
    - rearing
    - hauling
    - transportation to processing plant

Cleaning Procedures

- **Cleaning includes the use of:**
  - physical methods
    - (like scrubbing)
  - chemical methods
    - (detergents, acids, alkalis)
- Eliminates dirt, dust, food residues and other surface residues.
  - (grease, blood, feathers, meat residues, feces residues, etc.)
- These methods may be utilized in combination or separately.

Detergent

- Material that reduces superficial tension in water (allowing for penetration), thus increasing its ability to interact with aqueous and organic means.

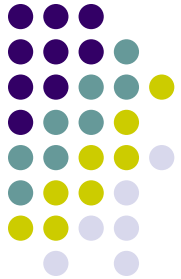
Detergent

- This property grants detergents the ability to remove and / or eliminate contaminating substances.
- Displaces and suspends unwanted articles from processing and equipment surfaces.

Detergent

- Rinsing with water then removes suspended particles.

Characteristics of a Good Cleaning Agent (Detergent):



- Complete and rapid solubility
- Non-corrosive to metallic surfaces
- Good wetting agent
- Good dispersion or suspension properties (does not settle)
- Good rinsing properties
- Germicidal
- Low cost
- Non-toxic

Detergents

Type of surface	Recommended Cleaning Substance	Frequency of Use
Stainless Steel	Alkaline, non-abrasive acid Alkaline, abrasive acid	Daily Weekly
Metals (copper, aluminum, galvanized surfaces)	Moderately alkaline substances with corrosion inhibitors	Daily
Wood	Tensoactive detergents	Daily
Rubber	Alkaline substances	Daily
Glass	Moderately alkaline substances	Daily
Concrete Floors	Alkaline	Daily

Cleaning

- To prevent contamination of meet products:
  - all equipment and utensils must be cleaned and disinfected according to indications and frequencies established in the Standard Sanitation Operation Procedures, or when circumstances so require.

Cleaning

- Thorough cleaning requires adequate instruments:
  - sponges
  - brooms
  - scrapers
  - brushes
  - high pressure water guns
    - (prevent spattering and aerosols)
  - buckets

Cleaning

- Cleaning instruments may constitute an important source of biological dangers if not manipulated correctly.

Cleaning

- Instruments must be **washed and disinfected** after being used, and regularly replaced to prevent growth of microorganisms in surfaces.
  - It is recommended that they be "color coded".
    - (This facilitates detection of instruments being used in wrong areas.)

Cleaning

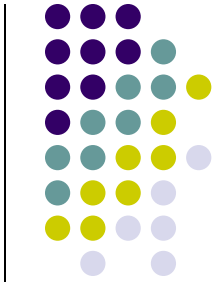
- Cleaning procedures cannot guarantee reduction of microorganisms.
- Nevertheless, they can minimize the formation of bio-films.
  - (Which protect microorganisms)

Cleaning and then disinfection

- To eliminate microorganisms, it is necessary to treat clean surfaces with **chemical agents** generally known as **disinfectants or agents of disinfection**.

Disinfection Procedures

Food contact surfaces



Disinfect:

- To adequately treat surfaces (which are clean or free of visible debris) with an effective process aimed at destroying or substantially reducing microorganisms that pose a threat to public health.
  - Other unwanted microorganisms are also eliminated.
    - (Those that shorten shelf life of product)

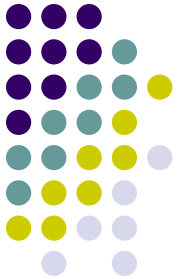
Disinfection Procedures

Food contact surfaces

- **Disinfection:**
  - Should not impair product quality or safety to consumers.

Disinfection Procedures

Food contact surfaces



Disinfection entails the application of:

- accumulative heat, or
- chemical agents
  - on clean surfaces, to effectively achieve a reduction of representative microorganism populations in **99.999%** when tested (U.S. Public Health Service, FDA,1997).

Disinfection

- Is not a substitute cleaning procedure.

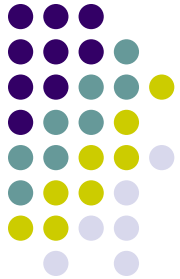
Disinfection

- Organic and inorganic matter affects the germicidal action of many disinfection agents.
  - Always clean to eliminate dust, dirt, and residues before applying a disinfection agent.

Disinfection

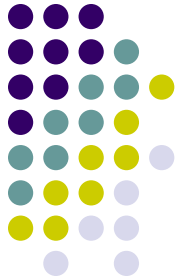
- Good manufacturing practices (GMPs) can also prevent the formation of biofilms by bacteria.
  - (as protection from disinfectants)

Recommended frequency of cleaning and disinfection



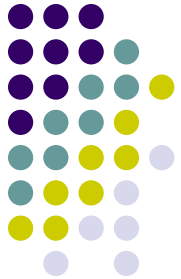
Area	Frequency
All processing equipment	Daily
Floors and drainages	Daily
Trash containers	Daily
Storehouses (storage areas)	Daily
Walls	Weekly
Refrigerators	Weekly / Monthly
Freezers	Semi-anually

Specialized Cleaning is Essential to Listeria Control



- Listeria can grow in microscopic films if your establishment is not adequately and regularly cleaned and disinfected.
- Biofilms can protect Listeria from the effect of cleaning and disinfecting agents.
- You should employ the adequate detergent, disinfectant, and proper procedure to eliminate Listeria.

General Cleaning and Disinfecting Procedures



Step 1 – Remove all visibly exposed product

Step 2 – Dry clean / sweep area

Step 3 – Wet area to be cleaned (carefully)

Step 4 – Clean and scrub area

Step 5 – Rinse

Step 6 – Disinfect

Step 7 – Air dry / store adequately

Step 1 – Remove all visibly exposed product

Step 2 – Dry clean / sweep area

Remove waste, food residues, and other debris

Step 3 – Wet area to be cleaned (carefully)

Step 4(a) – Apply detergent

Apply detergents with foamers

Cortesía de Hydro Systems Company

Step 4(b)- Vigorously scrub area

Step 5 – Rinse (carefully)

Step 6 - Disinfect

Be sure to use the correct amount of disinfectant: use “Test Strips” or other tests if necessary

Step 7– Air dry / store adequately

Cleaning Tips

- NEVER use high pressure hoses to clean drainages and limit use in other areas
- NEVER use compressed air to clean equipment
- NEVER begin cleaning and disinfection if there is any exposed product in area
- NEVER do wet cleaning in the midst of a work shift
- NEVER nest already cleaned and disinfected utensils (containers, trays, buckets, etc.)
- NEVER allow mist or aerosol from water used in cleaning to come into contact with already cleaned and disinfected surfaces (as is the case of surfaces which are close to a floor being washed)

Cleaning Utensils

-Never alternate the use of utensils. For example,

<u>NEVER</u>:

- Use brooms or floor squeegees on wok tables
- Use cleaning pads or brushes intended for garbage containers on work or packing tables
- Use the floor drainer cleaning brush on food contact surfaces
- Use brushes, pads, brooms, or squeegees previously used on raw product areas to clean finished product areas

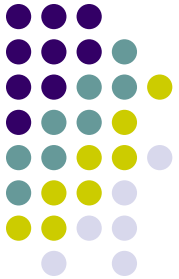
-DAILY CLEAN AND DISINFECT all brooms brushes and pads after establishment has been cleaned and disinfected

-PROPERLY STORE cleaning products and utensils

Listeria Control and Prevention

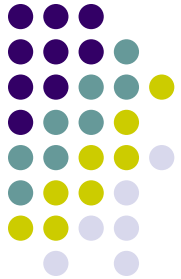
- Use a disinfectant rotation schedule
- Utilize special, aggressive cleaning and disinfection procedures when tests indicate the existence of Listeria “hot spots”
- Perform monitoring and testing to determine the effectiveness of cleaning and disinfection controls

Considerations When Selecting a Disinfecting Agent



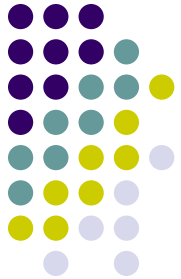
- Type of equipment and kind of surface to be disinfected
- Water hardness and pH
- Available disinfecting equipment
- Effectiveness against important pathogens associated to types of products processed or processing environment
- Effectiveness in practical conditions

Selection of Disinfecting Agents



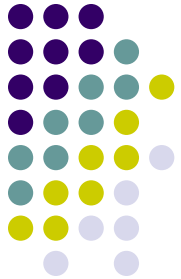
- Will greatly depend on:
  - target microorganism
  - type of processed product
  - surface material in direct contact with product
- Other important considerations are:
  - type of water
  - cleaning procedure utilized

Selection of Disinfecting Agents



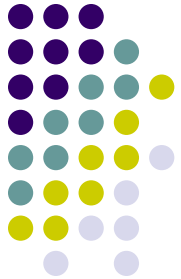
- Those with an ample action spectrum for the destruction of pathogenic microorganisms in different equipment surfaces are recommended

Selection of Disinfecting Agents



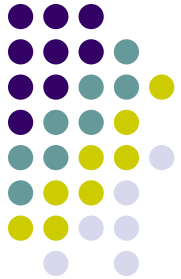
- Use of alternative agents is necessary in some disinfection activities
- A rotation program for cleaning and disinfecting agents:
  - should reduce the probability of pathogens developing resistance against a specific agent

Commonly Used Agents for Equipment Disinfection Include:



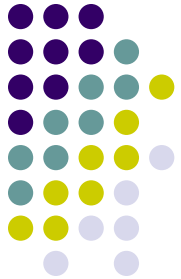
- Chlorine and chlorination agents, including hypochlorite compounds
- Quaternary ammonium compounds (Quats)
- Strong acids and alkalis

Chlorine and Chlorine Compounds



- Among most effective disinfection agents when adequately used
- Chlorine activity is dramatically affected by:
  - pH
  - temperature
  - organic charge
  - contact time

Chlorine and Chlorine Compounds



- Chloration agents produce a rapid effect over an ample range of microorganisms and **are cheap!**
- They are highly corrosive to metals and might also bleach equipment.
  - Once adequate contact time is up, immediate rinsing of equipment surfaces is recommended

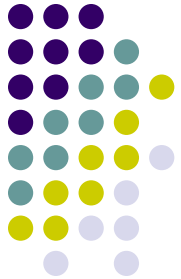
Free Residual Chlorine

- **Total Chlorine** = chlorine demand + free residual chlorine
- **Free residual chlorine** quantity is very important in disinfection of plant facilities.
  - the speed at which bacteria are destroyed is proportional to free residual chlorine concentration (Gavin y Weddig, 1995).

Chlorine and Chlorine Compounds

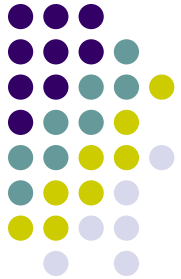
- Disinfecting agents with 2-7 ppm free residual chlorine concentration have significant bacterial power
- Might be applied to conveyors and equipment utilizing continuous / intermittent sprayers or by immersion or shower
- Higher concentration solutions (20-50 ppm) might be used for equipment and cleaning

Chlorine and Chlorine Compounds



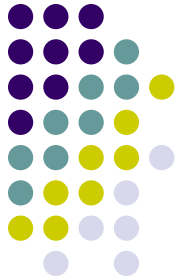
- Important considerations to attain an efficient disinfection:
  - contact time,
  - pH
  - temperature

Chlorine and Chlorine Compounds



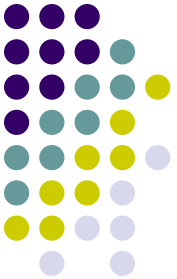
- Increasing chlorinated water temperature:
  - could cause considerable chlorine reduction except when solution contains organic nitrogen interacting with chlorine to form chloramines, which have germicidal power.

Chlorine and Chlorine Compounds



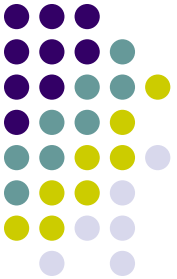
- Many operations inject water with chlorine gas to prepare disinfecting solutions.
  - Water temperature is an important consideration, given that it affects chlorine gas solubility (Gavin y Weddig, 1995).

Quaternary Ammonium Compounds (Quats)



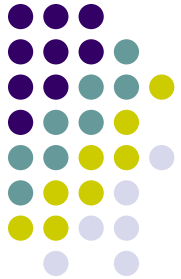
- Good detergent characteristics:
  - no color, low metal corrosiveness, non-toxic.

Quaternary Ammonium Compounds (Quats)



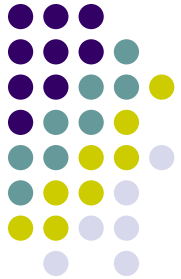
- Good disinfecting agents although some selective to certain types of bacteria.
  - **<u>Non-effective</u>** for *E. coli* and *Pseudomonas aeruginosa*.

Quaternary Ammonium Compounds (Quats)



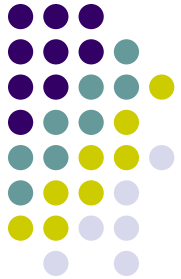
- Due to its selectiveness, a chlorine treatment must be occasionally applied to maintain adequate disinfection of plant.

Quaternary Ammonium Compounds (Quats)



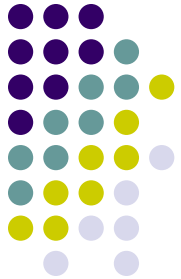
- Solutions should be utilized at levels between 200 and 1,200 milligrams per liter.
- When dealing with hard water, higher concentrations are needed.

Quaternary Ammonium Compounds (Quats)



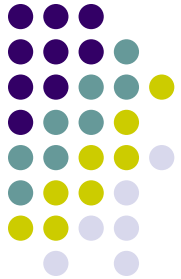
- Not greatly affected by organic matter.
- Not compatible with soap or anionic detergents.
- Tend to adhere to equipment surfaces, making it necessary to abundantly rinse with potable water after application.

Quaternary Ammonium Compounds (Quats)



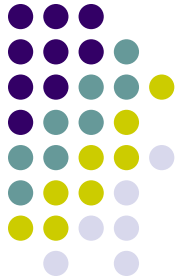
- Due to low corrosive nature, they are generally utilized in the disinfection of floors, walls, roofs and other parts of refrigerated compartments.
- Limitation:
  - inactivated by wood, cotton, nylon, cellulose sponges and some plastics (Gavin y Weddig, 1995).

Iodine Compounds (Iodophores)



- Widely utilized to disinfect food processing equipment and surfaces.
- Most commonly used:
  - Ethanol-Iodine solutions
  - Iodine and Iodophore aqueous solutions
    - These are combinations of elementary iodine and anionic tensoactive nonilophenol etoxilates or carriers like polivynilpirrolidone.

Iodine Compounds (Iodophores)

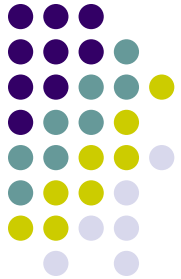


- 6-13 ppm of free iodine (pH 6.6-7.0) during 3-15 seconds.
  - (Population of vegetative bacterial cells can be reduced in 90%)
- Spores are more resistant to Iodine than vegetative cells (Beuchat, 1998).
- Cleaning of equipment surfaces:
  - A 25-50 milligrams of Iodine per liter (ppm) at a 3-4 pH is recommended.

Iodophores

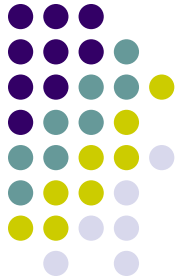
- Most frequently utilized compounds in the food industry (Gorny, 2001).
- Wide action spectrum
- Efficient against yeasts and molds
- Very convenient when an acid cleaner is needed
- Rapid effect and wide antimicrobial activity

Iodine Compounds (Iodophores)



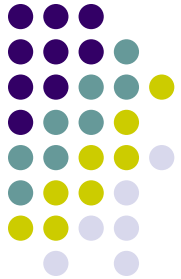
- Less corrosive than chlorine at low temperatures, which is an advantage.
  - they vaporize at temperatures higher than 50° C (122° F), which is the moment at which they can be highly corrosive, and their effectiveness decreases at low temperatures (Beuchat, 1998).

Iodine Compounds (Iodophores)



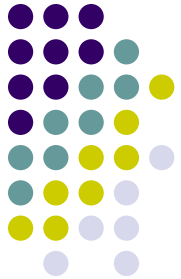
- Most effective at 2-5 pH range but can remain active in slightly alkaline conditions depending on other factors.

Iodine Compounds (Iodophores)



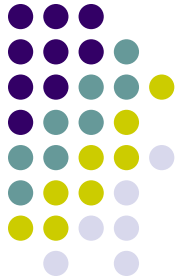
- Effectiveness lost in the presence of organic material and at a 7 or higher pH.
- Its effectiveness can be visually observed:
  - color is lost when residual Iodine reaches ineffectiveness levels.

Iodine Compounds (Iodophores)



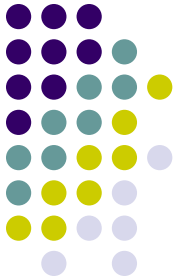
- May produce metal corrosion depending on the composition of solution and nature of surface over which it is applied at high concentrations..
  - For this reason, it is important to abundantly rinse treated surfaces with water after iodophore application.

Iodine Compounds (Iodophores)



- In the case of surfaces not easily affected, iodophores may be applied without a final rinse.

Other Disinfecting Agents



Strong Acids and Alkalis:

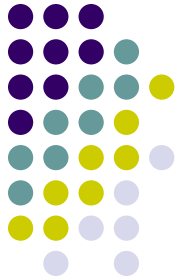
- Besides detergent properties, they present a a considerable anti-microbial activity.
- When applied to processing equipment, it is important to avoid food contamination.
  - Acids or Alkalis may harm consumer
  - All treated surfaces must be abundantly rinsed with water after treatment

Other Disinfecting Agents

Ultraviolet light (UV):

- Sometimes can be utilized as a surface disinfecting agent..
- Low penetration power
  - Mainly used to destroy airborne microorganisms
    - (specially mold spores in air circulation systems)
  - Over packing areas, cold chambers, etc.

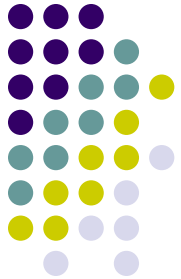
Other Disinfecting Agents



Ozone:

- Some use as processing plant disinfecting agent
- Used to treat water and storage chambers
- Efficient against microorganisms existent in cold water and water recirculation systems.

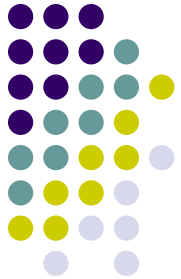
Quality of Water and Disinfecting Agents



Water:

- Main component of disinfecting solutions
- May constitute a factor in the efficiency of disinfection procedures
- Quality must be good

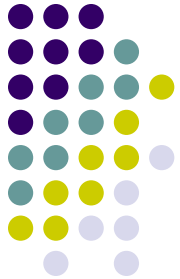
Quality of Water and Disinfecting Agents



Water:

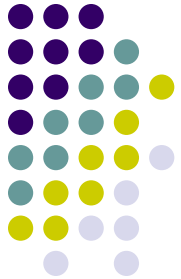
- Organic charge, turbidity, pathogens presence.
  - (may alter the efficiency of disinfection procedures).

Handling of Disinfecting Solutions



- **Recommendations for safe handling of disinfecting agents:**
  - Specific instructions for the handling and use of each product (MSDS) must b carefully followed.
  - Disinfecting agents are classified as ***chemical pesticide substances*** and as such are subject to each country's use and elimination regulations.

Handling of Disinfecting Substances



- **Recommendations for the safe handling of disinfecting agents:**
  - When using alkaline or acid substances, employees must wear protective eyewear and clothing.
  - Disinfecting agents must be kept in an independent installation, away from fresh products and packing materials.

U.S. Law

- **Disinfecting Agents** destined to be used on surfaces permanently or semi-permanently in contact with fod (food packing surfaces not included)
  - are considered pesticides
  - must be registered in EPA (Gorny, 2001).

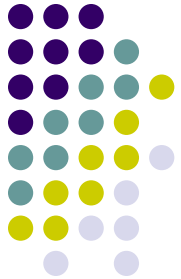
U.S. Law

- Residues left on surfaces in contact with food are chemical pesticide remains and are subject to EPA tolerance regulations.

Application

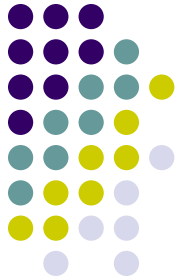
- Protective equipment such as gloves, boots, eyewear, and in some cases masks should be utilized in the application of these agents.
- Operators must be educated in the adequate handling and preparation of disinfection solutions.

Dangerous Mixtures of Disinfecting Agents



- To avoid abrupt neutralization reactions (spattering and/or harmful fumes) mixtures of alkaline and acid disinfecting products sholuld be avoided.
  - (for example, chlorine mixed with ammonia is extremely dangerous).

Dangerous Mixtures of Disinfecting Agents



- Acid products should not be mixed with hypochlorite solutions:
  - (these may produce chlorine gas, which may be toxic).

Summary

1. To reduce the risk of food contamination, strict cleaning and disinfection procedures should be followed for all equipment, utensils, containers and handling installations.

Summary

2. Cleaning includes the use of physical methods (scrubbing) and chemical methods (detergents, acids or alkalis) to remove dirt and many surface contaminants.

   These methods may be used in combination or separately. When selecting the adequate cleaning product, it is important to consider the surface material over which it will act and which material(s) it will remove.

Summary

3. Selection of a disinfecting agent will greatly depend on objective microorganisms, type product(s) processed and surface materials in direct contact with the disinfecting agent.

   Commonly used agents in equipment disinfection include chlorine and chlorine compounds, including hypochlorite and iodine compounds, quaternary ammonia compounds (QUATS) and strong acids and alkalis.

¿Questions?

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