Celebrating 60 Years
1953
BIRKO®
2013
Diamond Anniversary

your partner in food safety

Principles of Cleaning and Sanitation

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Citrus Industry Workshop:
AVOIDING RECALLS – MANAGING FOOD SAFETY RISKS IN CITRUS PACKINGHOUSES
Visalia, CA – January 2015

The Birko Story

Chad Equipment, LLC
A Birko Company

Early Birko facility in Denver

60 Years of Success

- Founded in 1953, Birko is a 3rd generation family-owned manufacturer of cleaning and process chemistry for food producers
- Chad Equipment, LLC, a Birko company, is a leading supplier of equipment for pathogen intervention and chemical handling


Birko's headquarters in Denver

- *PMA Gold Circle Member*
- *ColoradoBIZ Magazine Top Manufacturing Company 2013*

Who Do We Work With?

Chad Equipment, LLC
A Birko Company

Customer base includes leading food and beverage producers

Tyson Foods, Inc.

STONE BREWING CO.

Our Approach to Food Safety

your partner in food safety

Chad Equipment, LLC
A Birko Company

MULTIPLE-HURDLE INTERVENTION STEPS

- Effective Cleaning & Sanitation Products and Procedures
- Products and Equipment to Control Contamination in the Processing Environment
- Use of Antimicrobial Intervention Products Applied Directly to Product at Key Steps in the Production Process

QUESTION

Chad Equipment, LLC
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What is the purpose of cleaning and sanitation?

The “Why?” of Sanitation

Prevents Foodborne Illness

- Regulations tell us we have to - FSMA, FDA etc.
- Risk Management Issue
  - Product Liability
  - Personal Liability
- Brand Reputation

Effective sanitation is the cornerstone of quality

Sanitation Safety (i)

- Heavy soil loadings require strong chemicals and high temperatures!
- Learn about the products and risks – train team members
- Chemical damage to the body starts by
  - (1) Skin contact
  - (2) Absorption through the skin (HF, DMSO)
  - (3) Inhalation
  - (4) Eye contact
  - (5) Ingestion
- Make sure that Safety Data Sheets (SDS) are available to all employees

Sanitation Safety (ii)

- Always wear appropriate PPE (Personal Protective Equipment)
  - Gloves, Safety Glasses, Goggles, Face Shield, Boots, Rain suit
- Label all buckets and tanks to avoid mixing incompatible chemicals

LOCK OUT TAG OUT

- **De-energize, lock & tag out all energy sources on processing equipment**

  Electrical, hydraulic, pneumatic and water/chemical
- Use waterproof covers on electrical boxes and moisture sensitive equipment.

QUESTION

What are we doing during sanitation

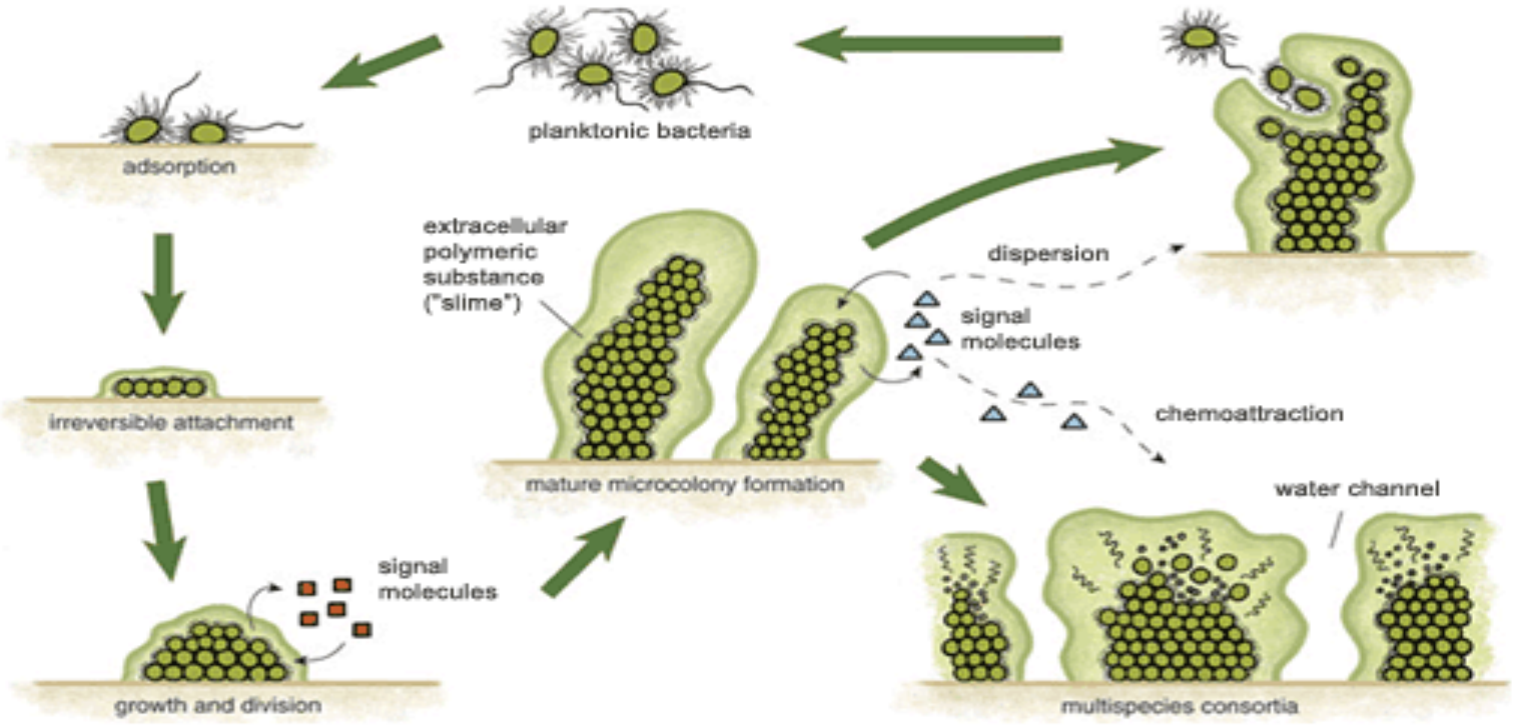
- **Remove Soil**
- **Kill Bacteria**
- **Remove Biofilm**

SOIL

- Definition:
  - Any substance that is found on a surface but is not an intended part of that surface and therefore is unwanted;
  - Any substance that is suspended in air and may deposit on a surface but is not intended to be present there
- Synonyms: Dirt, Contamination, Biofilm
- Produce Plant Soils Include: Dust, mud, grime, manure, mineral deposits, protein, carbohydrates, rust
- SOIL harbors, and provides food for, microorganisms

BIOFILM

BIOFILM



http://www.hygiena.net/images/biofilm-diagram.gif

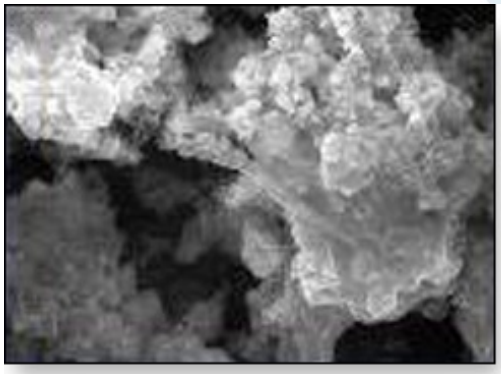
BIOFILM

- Major area of concern for food processors especially for ready to eat items in wet processing areas
- Typically resistant to conventional cleaning and sanitation processes
- Frequent culprit where persistent bacterial contamination is a problem
- Very common in drains
- Specialty products required for removal

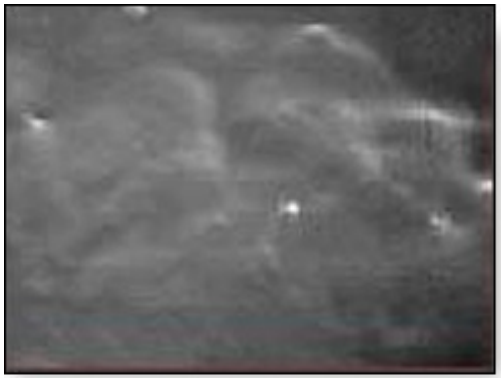
Biofilms

- Bacteria attach themselves to surfaces in moist, temperature-permissive environments and begin forming colonies.
- As these colonies grow they produce a protective, adhering matrix which may repel cleaning chemicals and sanitizers

Before Treatment



After Treatment



Biofilms

- Biofilms are a leading source of bacteria in the food plant environment because of the presence of moisture
- Many of the problem bacteria such as *Listeria* and *Salmonella* readily produce biofilm protected colonies
- Not removing the biofilm means that colonies continue to produce more bacteria, releasing them into the plant
- “Most general cleaning and sanitation products will not penetrate or detach the sturdy polysaccharide biofilm matrix”.

QUESTION

What are the pre-requisites for an effective sanitation program

Prerequisites

TO CLEAN SUCCESSFULLY YOU NEED:

- Knowledgeable Supervision & Management Commitment
- A Cleanable Plant and Cleanable Equipment
- An Operational Cleaning and Sanitation Program
- Adequate Supply of Potable Hot Water Suitable, Functioning Sanitation Equipment
- Effective Cleaning Chemicals and Sanitizers
- Adequate Numbers of Trained Personnel
- Ongoing Employee Training in Sanitation and Safety

SUPERVISION & MANAGEMENT

- Cleaning is a Key Management Responsibility
- Teamwork is key & needs to involve:
  - Management
  - Sanitation Department
  - Maintenance Department
  - QA/QC
  - Production

All departments and personnel must understand and believe in the importance of effective cleaning and sanitation

CLEANABILITY

- Materials of construction

Stainless Steel and some plastics	A
Aluminum and other soft metals	B
Wood other porous materials	C

DOCUMENTED PROGRAM

- Sanitation Plan
- What you clean
- When you clean it - Frequency
- How you clean it
  - Disassembly (?), Products, Dilution rates
- Verification
- Sanitation step = product, ppm, contact time

Water Quality Considerations

- Water needs to be potable
- Water Chemistry can have a profound effect on cleaning!
- Plant water should be analyzed for:
  - Hardness - both Ca & Mg – reacts form soap scums
  - Silicates
  - Iron
- Some water conditioning may be required
- Water Chemistry can vary seasonally & by source
- Retest or review annually

Temperature and Pressure

- 130F to 140F adequate for most cleaning applications
- Check temperature at point-of-delivery
- Hot, hot is not better! Excessively hot water can cook proteinacious material on to surfaces
- New technologies make maintaining a consistent supply of hot water, simple and efficient
- Sufficient pressure to dislodge gross soils
- Sufficient pressure to support the number of hoses in use
- Above 160 psi pressure will *atomize* material into the air

Sanitation Equipment

- Sprayers and Hoses
- Plant pressure should be sufficient
- <160 psi to avoid atomization
- Temperature Setting optimum = 130° F to 140° F
- Adjustable spray pattern
- Water saving designs
- Pressure Washers for field

Equipment – Foamers

- Portable
- Wall-Mounted
- Centralized Systems
  - High Efficiency
  - Reduce Water Use
  - Reduce Chemical Use
  - Speed Up Cleaning Process
  - Save Labor

CHEMISTRY

Cleaning Agents

- Acid Cleaners
- Alkaline Cleaners
- Caustic Cleaners
- Chlorinated Caustic Cleaners
- Neutral Cleaners
- Solvent-Based Cleaners
- Combination Cleaners (Blend On-Site)

Selecting Cleaners

- **Soil to be removed**
- **Substrate**
  - Stainless steel
  - Softer metals
  - Plastics or synthetic
  - Porous materials

Mechanisms of Cleaning

Primary

- Hydrolysis
- Dissolution
- Displacement/Dispersion
- Emulsification

Supplemental

- Peptizing
- Chelation
- Buffering

(For detail, please see Appendix)

Detergent Components

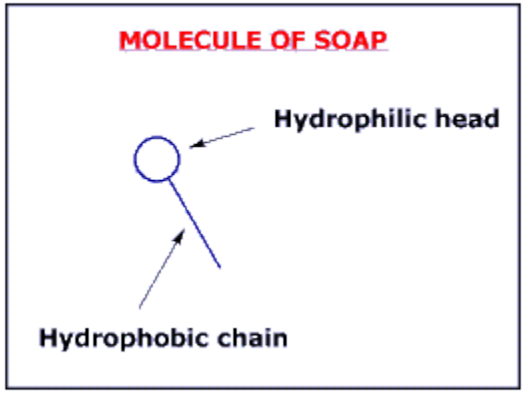
- Surfactants and Wetting Agents – aid soil penetration, emulsification
- Builders – improve surfactant performance by lessening water hardness (chelators)
- Solvents – help dissolve or disperse fatty soils
- Corrosion Inhibitors – protect substrate surfaces from adverse effects of acidic, caustic and chlorinated cleaning compounds

Surfactants

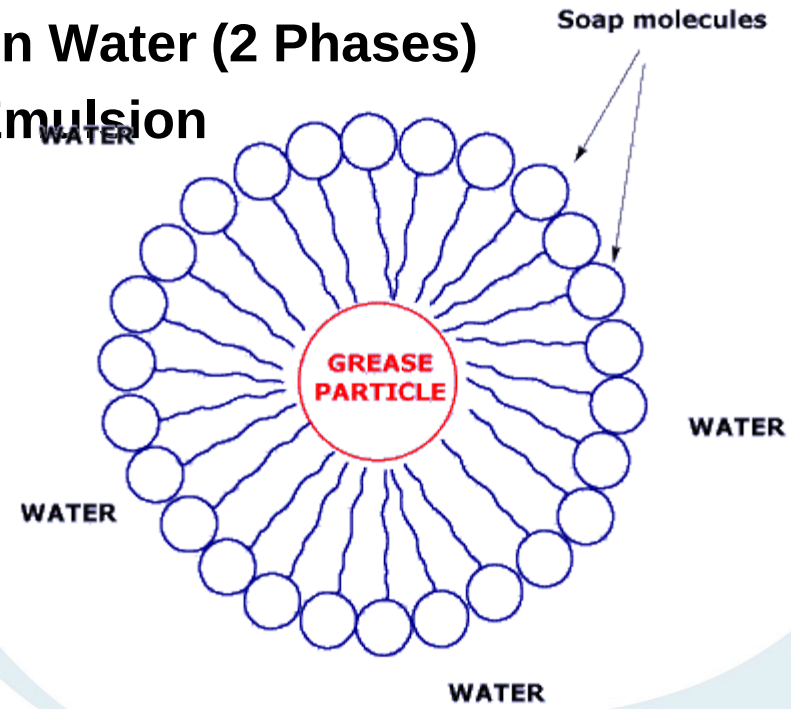
Surfactants Reduce Surface To Promote Wetting and Emulsion Formation

Water + Oil ➔ Oil Globules in Water (2 Phases)

Water + Oil + Surfactant ➔ Emulsion



http://www.silviamar.com/Documents/soap.htm



Question

WHAT ARE THE ACTUAL STEPS IN THE CLEANING CYCLE

CLEANING PROCESS

Dry Clean-Up / Dry Pick-Up ("Rough clean")

- Remove all product and packaging materials
- Sweep, scrape, scoop all gross soil

Pre-Rinse / Rough Down Rinse / Wash Down

- Top to bottom
- Perimeter toward the center
- Inspect – is area ready for foaming

Cleaning Process

Chemical Cleaning

Foaming application

Hand Scrub

Rinsing - removes the cleaning chemicals *before they dry*

Inspection of cleaned surfaces – re-clean if needed

Sanitizing

Application of an approved compound to kill bacteria

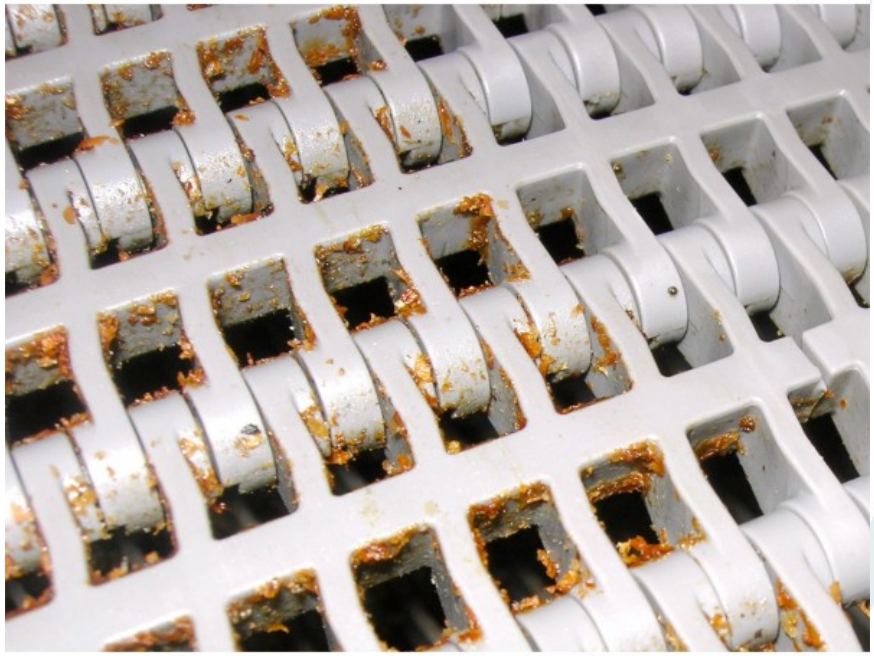
CIP Cleaning

- CIP (Clean-In-Place) – applicable to juice producers
- Enclosed tanks and pipe work are cleaned using the system's own circulating pumps or an external CIP system.
- Low-foaming cleaners and sanitizers are used
- Follows the same general steps outlined above
- The CIP process may be fully automated on larger systems

Situations to avoid

- Use of high pressure water, air - aerosols
- Inattention to door seals, gaskets, o-rings
- Standing water or drain backups
- Hollow rollers, crannies, nooks
- Mops and foam pads (any multiple use cleaning aids)
- Porous surfaces that can soak up liquids
- Joints, “sandwiches” on equipment
- Spaces inaccessible to sanitation procedures
- Inattention to ventilation systems
- Excessive humidity

Manual Cleaning Failure



Automated CIP Systems

Sanitizers

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Effective Cleaning is 99% of the sanitation job. The remaining 1% is the job of sanitizers

Sanitizers

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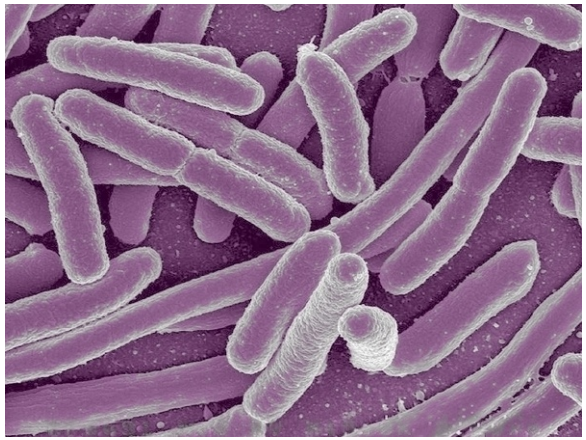
Produce Bacteria

- ***Listeria spp.***
- ***Salmonella spp.***
- ***Escherichia coli***



Organic vs. Conventional Process and Product will impact choice of sanitizers

TERMINOLOGY

Sanitizers and Sanitizing

Sanitizers are not disinfectants.

- Sanitizers kill most bacteria present
  (5 Log Reduction = 10^5 down to 1)
- Post Rinse sanitizers – used on food contact surfaces without a subsequent rinse
- Disinfectants kill nearly all bacteria present
  (6 Log Reduction = 10^6 down to 1)
- Sterilization kills <u>ALL</u> bacteria present

Hard Surface Sanitizers

- Chlorine / Sodium Hypochlorite
- Quaternary Ammonium Compounds (“Quats”)
- Iodophors
- Peroxyacetic Acid (“PAA”)
- Ozone
- Electrolyzed Water
- Acidified Sodium Chlorite (ASC)/Chlorine Dioxide

Use Precautions

- Sanitizers should be precisely mixed to an application concentration to meet predetermined requirements as defined in your SSOPs
- Under-mixing or over-mixing can be problematic
- Sanitizers are applied after the cleaning rinse step, usually with a low-pressure spray applicator. All surfaces of equipment and environmental surfaces to be sanitized are wetted
- Contact Time!

Use Precautions

- “Post-Rinse Sanitizers” are allowed to remain on equipment and other surfaces without rinsing.
- The label will specify a minimum amount time necessary for sanitizing.
- Visibly wet sanitizer remaining on food contact surfaces may require removal prior to the shift start

Field/Harvest Operations

Many Challenges

- Uncontained environment – exposed to the elements
- Wild flora and fauna
- Limited sanitary facilities – bathrooms and hand washing facilities
- Materials not amenable to cleaning
- Temporary transient labor pool not invested in sanitation program
- TIME – Do I Harvest or Do I Clean?

High Risk Areas

Field/Harvest Operations

Suggested Solutions

- Provide hand and equipment washing facilities
- Supervise their use especially after bathroom use
- Mandate cleaning between lots/field areas
- Power Wash and Sanitize harvest equipment between lots/fields and nightly
- Use off season to deep clean equipment

Field/Harvest Operations

Chemistry Considerations

- Non-stainless steel, soft metal and porous surfaces
- Paint, seal or replace where possible
- Mild non-caustic detergents
- Cleaning is key as proper sanitation may be difficult
- Peracetic acid as principle sanitizer
- Fogging an option of the off season

PACKING SHEDS

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Many Challenges – Similar to Field

- Relatively Uncontained Environment – open barn with roof but no side walls
- Not built with sanitation in mind
- Pest Control – insects, birds rodent vectors
- Limited sanitary facilities – bathrooms and hand washing facilities
- Materials not amenable to cleaning
- Temporary transient labor pool not invested in sanitation program
- TIME – Do I Harvest or Do I Clean?

PACKING SHEDS

Suggested Solutions – short term

- Pest Control – repel, barriers, traps
- Provide hand and equipment washing facilities
- Supervise their use especially after bathroom use
- Mandate cleaning between lots
- Develop appropriate SSOPs and use them between lots/fields and nightly
- Use off season to deep clean
- Protect packaging materials from contamination

PACKING SHEDS

Suggested Solutions – Long Term

- Remodel or rebuild with a sanitation focus
- Eliminate hard to clean or porous materials
- Build in pest control pest exclusion strategies
- Use off season to deep clean

PACKING SHEDS

- Non-stainless steel, soft metal and porous surfaces
- Paint, seal or replace where possible
- Mild non-caustic detergents
- Cleaning is key as proper sanitation may be difficult
- Peracetic acid as principle sanitizer
- Fogging an option of the off season

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Discussion and Questions

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Produce Cleaning and Sanitation (reference)

Hydrolysis

"Breaks compounds apart by reaction with water"

- **Caustics and acids with extreme pH**
- **Extreme pH can be corrosive to soft metals (brass, galvanized surfaces)**

Produce Cleaning and Sanitation (reference)

– Dissolution

"Dissolving soil from a substrate into a liquid to form a solution."

- **Dissolving the soil through whichever means works best - water, solvents, like or opposite pH).**
- **An example of dissolution is removing hard water scale with acid. The calcium does not change, just dissolves.**

Produce Cleaning and Sanitation (reference)

– Displacement / Dispersion

"Penetrates between the soil and substrate and lifts the soil off suspending it in water"

- **Alkaline, non-caustic products use displacement by suspending the soil in solution.**
- **Frequently employ peroxide chemistry to lift soils from the surface**
- **Dispersing agents keep the soil in suspension to aid rinsing**

Produce Cleaning and Sanitation (reference)

– Emulsification

"Dispersing oil in water"

- **Surfactants (detergents) pull greasy, oily soils into water and keeps them there**

– Peptization (opposite = "flocculation")

"Breaks soils into smaller pieces."

- **Necessary in recycled solutions to keep soil from re-depositing on the surface.**
- **Phosphates help peptize soil.**

Produce Cleaning and Sanitation (reference)

- **Chelation / Sequestration**
  - **Chelators complex metal ions (EDTA, heptonate, phosphonates)**
  - **Help to mitigate the effect of hard water on cleaning chemicals**
- **pH Buffering**

"Stabilize the pH of cleaning solutions by neutralizing any added acid or alkali."

  - **Holds the pH where you want it to be.**
  - **Extends the effective life of cleaning solutions**

Produce Cleaning and Sanitation (reference)

- Dry Pick-Up
  - Gets all large scrap material off tables, belts and floors
  - Squeegees and shovels are used to collect material and place it in “inedible” barrels.

Produce Cleaning and Sanitation (reference)

- Wash Down
  - Water sprayers are used to remove material from all surfaces and move it to a collection point.
  - Excessively hot water can cook residues onto equipment surfaces.
  - Our target water pressure is <160 psi.

Produce Cleaning and Sanitation (reference)

- Wash Down
  - Work systematically from top-to-bottom and from the perimeter of the room toward a drain or central collection point.
  - Squeegees and shovels, identified for cleaning purposes only, are used to pick up larger deposits to facilitate floor rinsing.
  - All troughs and drains are to be cleared for the next step.
  - Visual inspection confirms that this step has been completed satisfactorily.

Produce Cleaning and Sanitation (reference)

– AVOIDING CROSS CONTAMINATION

DRAINS

- Clean drains before cleaning the rest of the room
- Drain cleaning can create aerosols that can re-contaminate previously cleaned surfaces

AIR HANDLING SYSTEMS

- Very efficient at spreading contamination around your plant
- Cooling coils and air ducts need to be cleaned periodically

Produce Cleaning and Sanitation (reference)

- Cleaning
  - Chemicals are selected for the specific soil, soil adhesion and substrate to be cleaned:
    - Alkaline Cleaners > pH 9 for fats and some proteins
    - Acid Cleaners < pH 2 for mineral deposits and some proteins; have some antimicrobial effect

Produce Cleaning and Sanitation (reference)

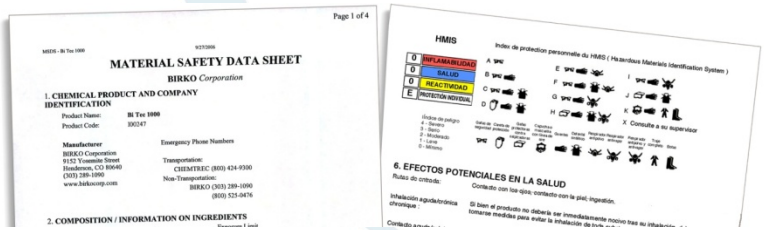
- Cleaning
  - Chemicals are selected for the specific soil, soil adhesion and substrate to be cleaned:
    - Neutral Cleaners for hand scrubbing and for sensitive surfaces and equipment
    - Solvent-Based Cleaners for fats, oils and greases

Produce Cleaning and Sanitation (reference)

- Cleaning
  - Cleaning chemicals should always be mixed according to manufacturer's directions
  - Under-mixing may result in an ineffective and inadequate cleaning job
  - Over-mixing can be dangerous to worker health and is a waste of chemical

Produce Cleaning and Sanitation (reference)

- Cleaning
  - Your chemical supplier is always the best source of information on the selection of the proper chemical for a specific job.
  - OSHA requires that plants have an MSDS (Material Safety Data Sheet) for each chemical, readily accessible to all employees



Produce Cleaning and Sanitation (reference)

– **Cleaning Chemical Application**

Many chemical cleaning agents are formulated with a foaming agent for this step.

- **Foam additives allow the chemical to cling to the surface being cleaned and keep it from drying out before it has time to work.**
- **A variety of industrial foaming equipment is available.**

Produce Cleaning and Sanitation (reference)

- Cleaning
  - Foamed chemicals are applied with moderate pressure and allowed a sufficient time to work before being thoroughly rinsed off. Some light pressure washing is possible with a foamer.
  - Refoaming and hand scrubbing of some surfaces may be necessary to remove soil buildup and to clean hard-to-reach areas and intricate equipment.

Produce Cleaning and Sanitation (reference)

- Cleaning
  - A dry surface must be re-foamed before rinsing.
  - Rinse from the top down and from the room perimeter to the drain. Foam should not be visible when thoroughly rinsed.
  - Visually inspect cleaned surfaces and repeat the cleaning step where soil remains.

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Chlorine

- **Approved for all food contact surfaces**

Mode of Action:
- **Oxidation of cellular constituents**
- **Most effective at low pH**

Advantages:
- **An inexpensive sanitizer**
- **Kills a wide range of bacteria**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Chlorine

Disadvantages:

- **Efficacy degraded by organic matter**
- **Corrosive to metals (including stainless steel)**
- **Poor penetration**
- **Temperature volatile**
- **No residual effect**

Common Uses:

- **200 ppm as a post-rinse sanitizer**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

  Quaternary Ammonia Compounds, "Quats"

  - **Approved for all food contact surfaces**

  Mode of Action:

  - **Penetrates cell membranes and inhibits cellular enzymes**

  Advantages:

  - **Exhibit good penetration and surfactency**
  - **Effective across a broad ph range (pH 2 – 10)**
  - **Form a bacteriostatic film**

continued

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

  Quaternary Ammonia Compounds, "Quats"

  Advantages:
  - **Stable with some organic matter**
  - **Active at elevated temperatures (180° F to 200° F)**
  - **Relatively non-corrosive and non-irritating**

  Disadvantages:
  - **Forms a film on equipment**
  - **Can irritate skin at higher concentrations >1000ppm**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

  Quaternary Ammonia Compounds, "Quats"

  Common Uses:
  - **1000 ppm to disinfect floors and drains**
  - **200 ppm for food contact surfaces**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Iodine-Based Sanitizers

- **Approved for all food contact surfaces**

Mode of Action:
- **Causes oxidation of cellular constituents**
- **Most effective at low pH**

Advantages:
- **Kills a wide range of bacteria**
- **Good residual protection**
- **More effective on viruses than other sanitizers**

(*continued*)

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Iodine-Based Sanitizers

Advantages: (continued)

- **Non-irritating to skin**
- **Prevents accumulation of mineral deposits**

Disadvantages:

- **Can stain at very high concentrations**
- **Costs more than Chlorine**
- **Vaporizes at 43° C (110° F)**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Iodine-Based Sanitizers

Common Uses:

- **25 ppm as a post-rinse and hand sanitizer**
  - **150 ppm as a disinfectant wash for boots and other non-food contact surfaces**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Peroxyacetic Acid Sanitizers

- **Approved for all food-contact surfaces**

Mode of Action:

- **Causes oxidation of cellular constituents**

Advantages:

- **Antimicrobial activity over a wide range of temperatures**
- **Effective on biofilms and spores**
- **Tolerant of organic matter**
- **Environmentally benign residue**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Peroxyacetic Acid Sanitizers

Disadvantages:

- **Mildly corrosive at use concentrations**
- **Concentrated product requires appropriate PPE**
- **Product and constituents have low PEL (Permissible Exposure Limit) necessitating appropriate ventilation**

Produce Cleaning and Sanitation (reference)

- **Sanitizers and Sanitizing:**

Peroxyacetic Acid Sanitizers

Common Uses:

- **Suitable as a sanitizer in CIP applications**
  - **Appropriate as a "Day" sanitizer for belts – 150 ppm maximum**
- **Highly effective sanitizer between 85 – 200 ppm**

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