How Do You Really Know That Your Plant Is Clean?

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Topics

- What is clean?
- Why do we need to clean?
- How do we clean?
- What about biofilms?
- Importance of verification

What is clean?

- CODEX - The removal of soil, food residues, dirt, grease or other objectionable matter.
- Criteria to judge cleanliness
  - Visual
  - ATP
  - Microbiological tests

Better question – what is sanitation?

- Incorporate a disinfecting step…
- Disinfection: Reduction by means of biological or chemical agents and/or physical methods in the number of viable microorganisms on surfaces, in water or air to a level that does not compromise food safety and/or suitability.

(Codex - https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B1-1969%252FCXC_001e.pdf)

Quantifying sanitation, examples

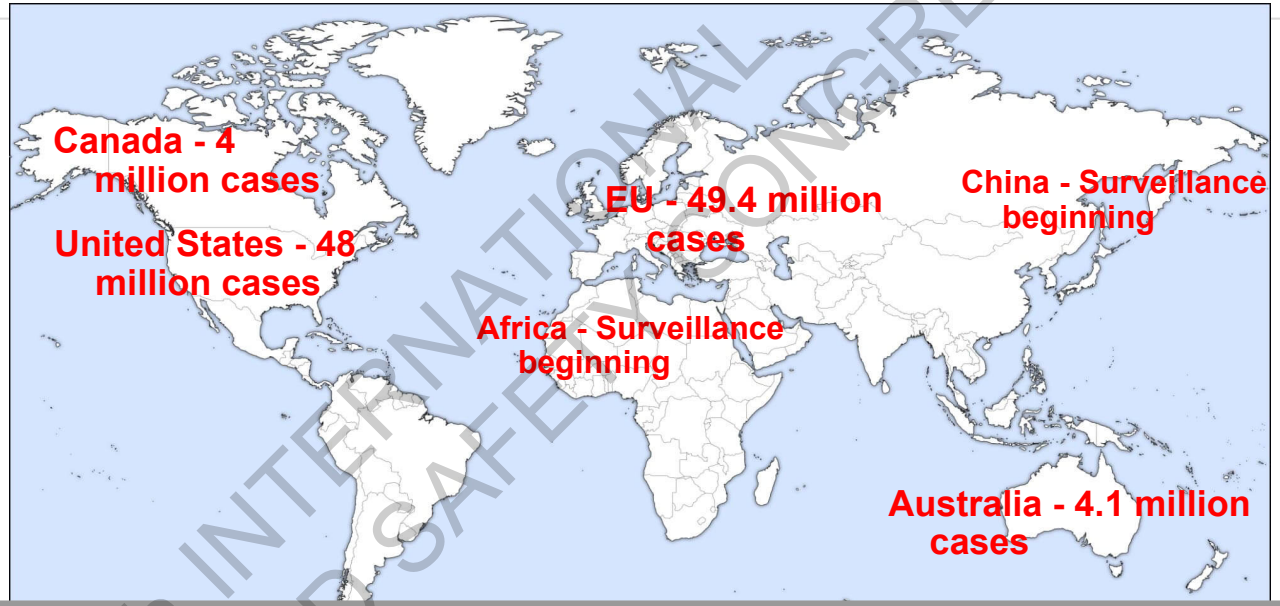
- US, For Quaternary Ammonium products
  - Food contact surface – reduce contamination by 5 logs, 30s
  - Noncontact surface – reduce contamination by 3 logs
  - Standard test organisms
- EU includes
  - Bacterial suspension test – 5 log reduction, 5 min
  - On a hard surface carrier in the presence of interfering substances – 4 log reduction
  - Standard test organisms

Source: US EPA, AOAC Germicidal Detergent Sanitizer Test and EN standards 1275, 1040, 1276, 1650, 13713, 13697

Why do we do sanitation?

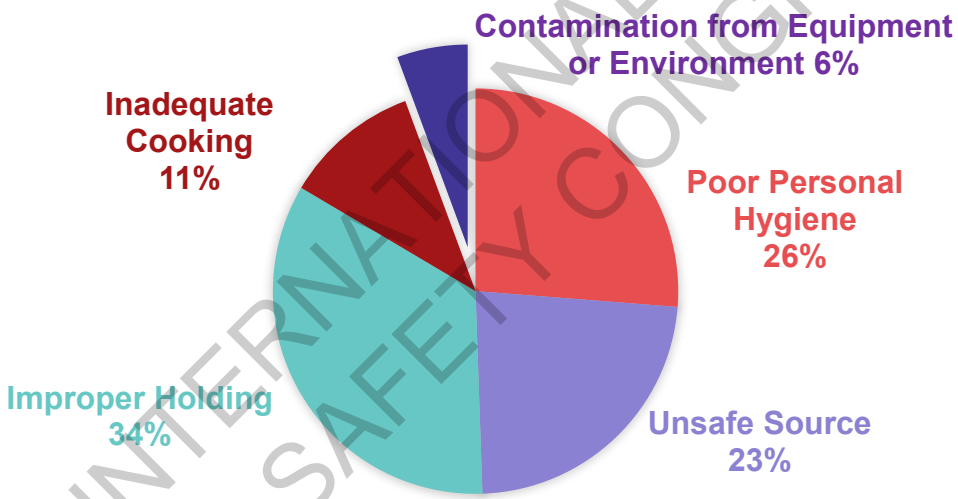
- Product safety
- Product quality - extend shelf-life
- Comply with government regulations

To prevent foodborne illness…



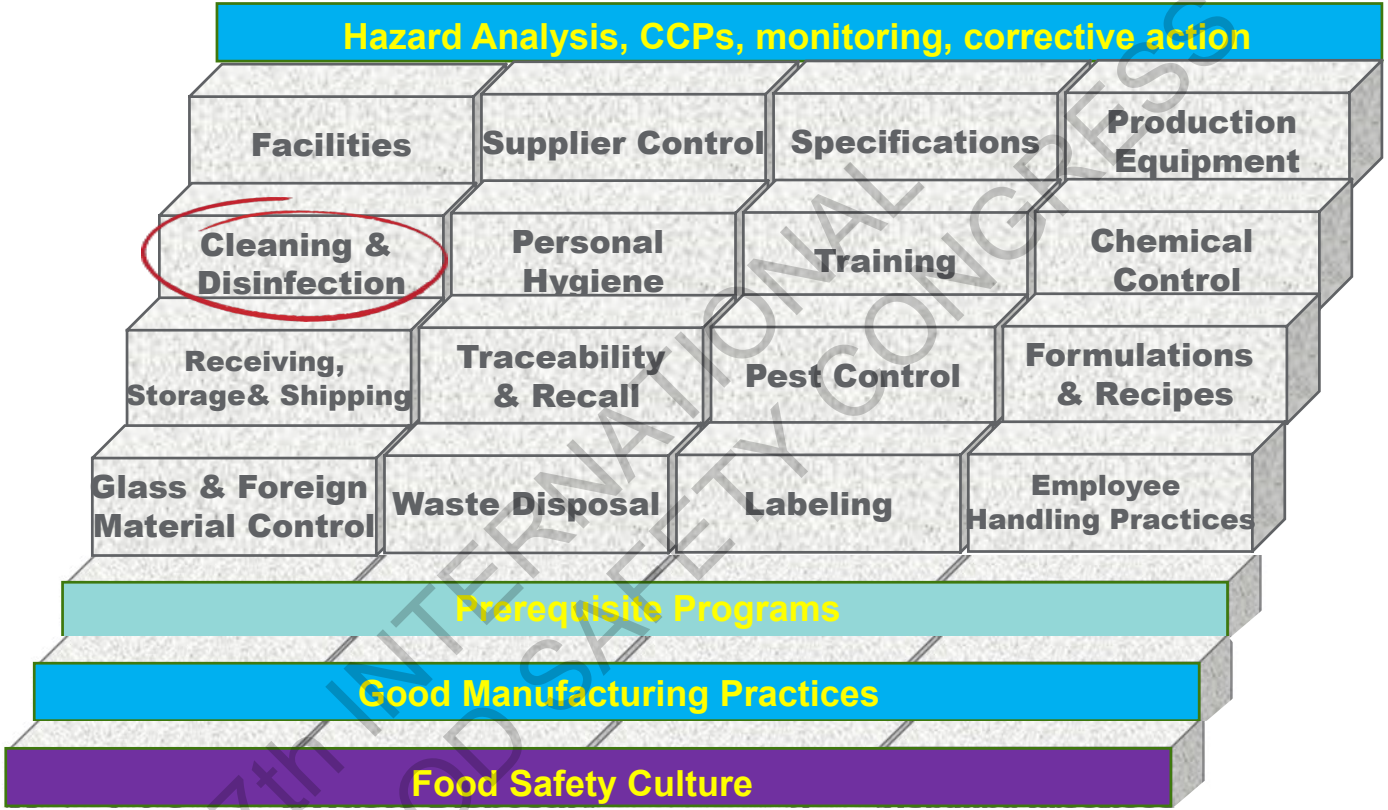
Global foodborne illness estimate: 600 million cases and 420,000 deaths

Sanitation contributes to foodborne illness

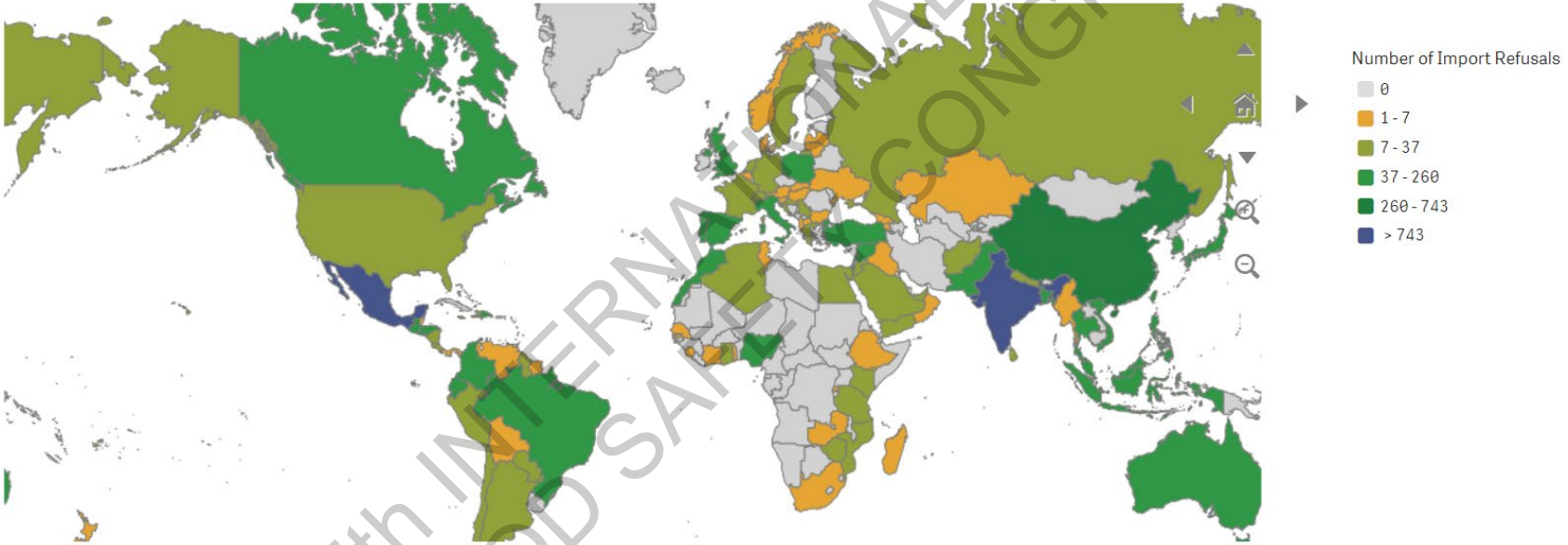


Adapted from CDC 2018 https://www.cdc.gov/fdoss/pdf/2016_FoodBorneOutbreaks_508.pdf

Part of foundation for food safety programs



US import refusals, often linked to "insanitary manufacture"



https://datadashboard.fda.gov/ora/cd/imprefusals.htm

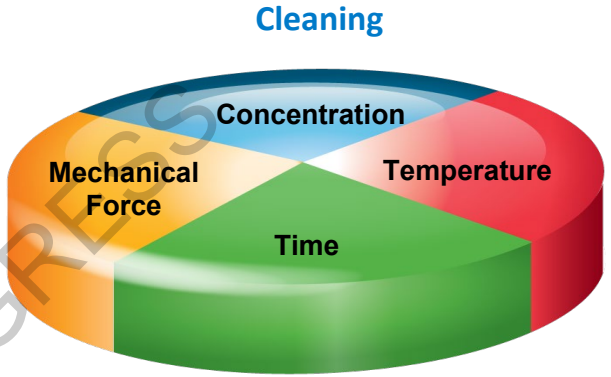
“Optimal Sanitation” = Applying Appropriate Risk Management Practices To Effectively Manage Risks

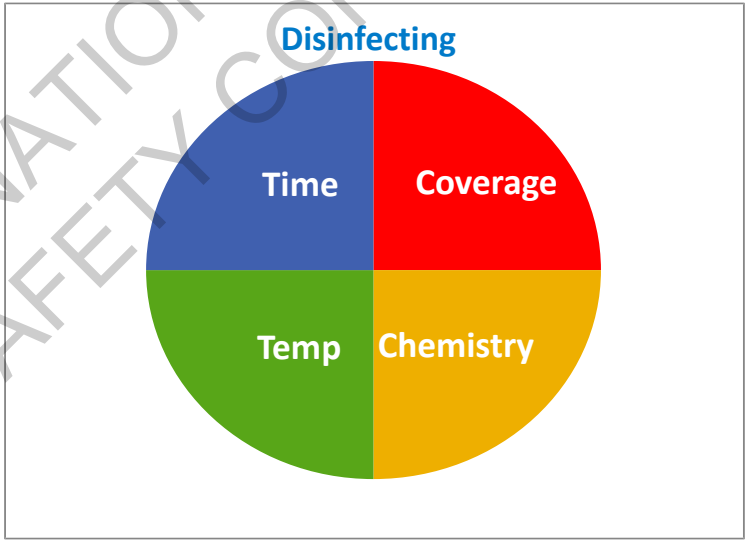
How do we clean?

- Sanitation is Cleaning *and* Disinfecting
- Need to consider
  - Sanitary design
  - Right products
  - Right procedures

CLEANING & DISINFECTING

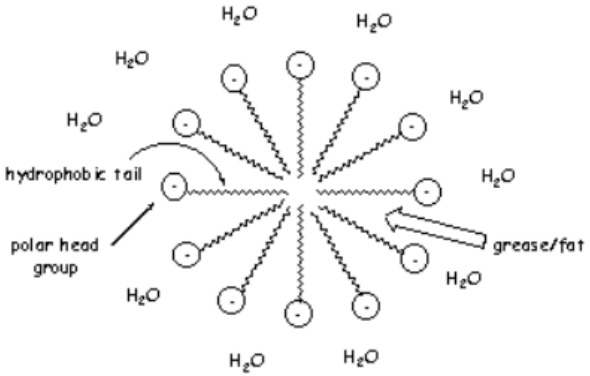
1. Pre-Rinse
2. Clean – use the right cleaner
3. Rinse
4. Disinfect – use the right disinfectant
5. Rinse if needed
6. Verify

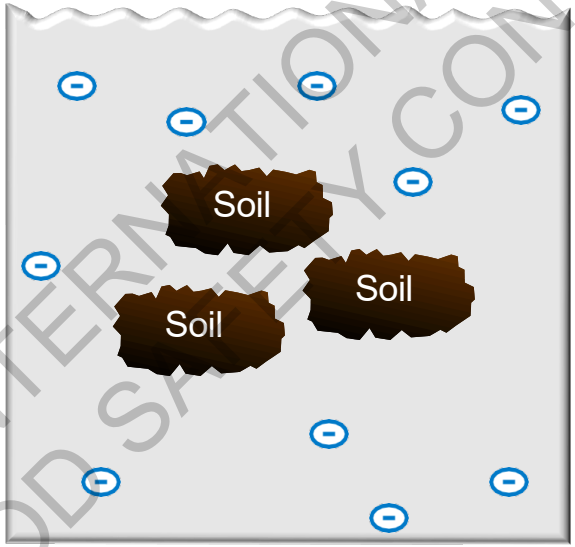


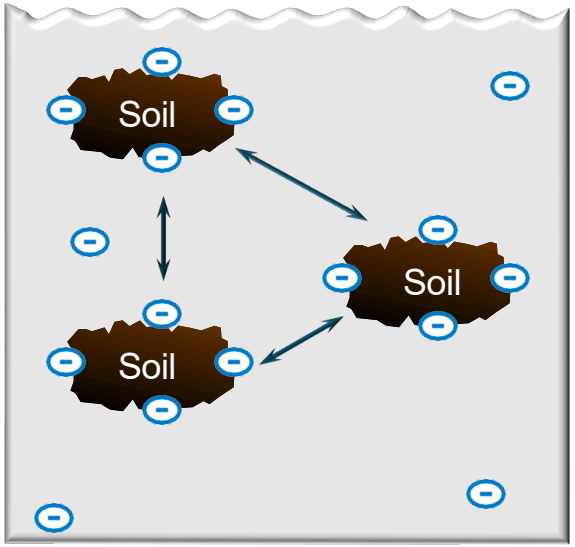


Chemistry of cleaning

Alkaline ingredients disperse or dissolve organic soil particles by charge repulsion







Cleaner functions

- Chemicals are selected to remove soils
- Selected for the soil, the substrate and adhesion
- Alkaline Cleaners: pH > 9 (sodium hydroxide, phosphates)
  - Dissolve proteins, sugars, and starches
  - Dispersion of soils
  - Saponification of fats
- Acid Cleaners: pH < 2 (nitric, phosphoric, sulfuric acid)
  - Dissolve proteins, sugars, starches, and minerals (i.e., stone)
- Solvents
  - Dissolve fats, greases, and oils
- Oxidizing Agents (sodium hypochlorite, hydrogen peroxide)
  - Hydrolyze proteins

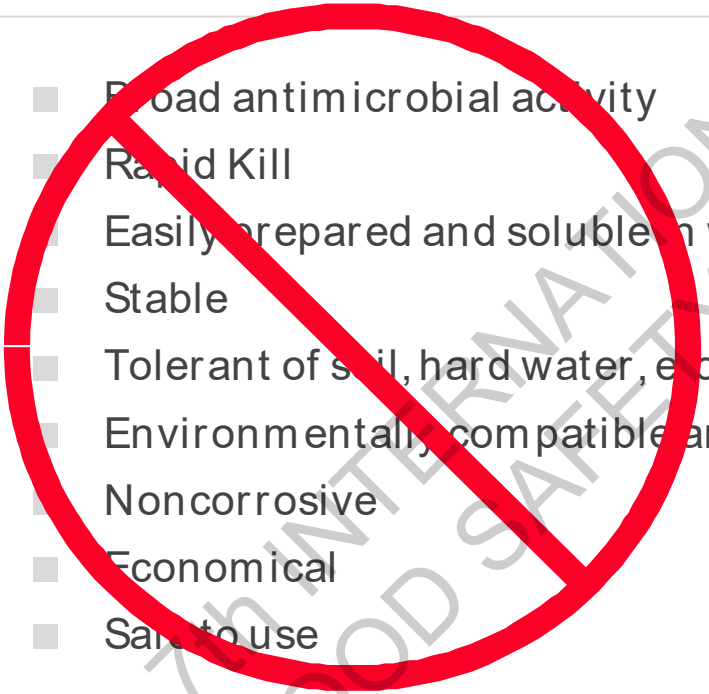
To maximize disinfectant effectiveness

- Need clean surface
  - Intimate contact with contaminant
- Considerations
  - Temperature
  - Concentration
  - Contact time
  - pH
  - Composition of makeup water
  - Number and type of microorganisms

Follow disinfectant label instructions

- Prepare only in potable water
- Use fresh solution
  - Not reused
- Accurate concentration
  - Too low - questionable efficacy
  - Too high - violates regulation

Ideal sanitizer



- Broad antimicrobial activity
- Rapid Kill
- Easily prepared and soluble in water
- Stable
- Tolerant of soil, hard water, etc.
- Environmentally compatible and non-toxic
- Noncorrosive
- Economical
- Safe to use

ECOLAB

Sanitary design principles for production equipment

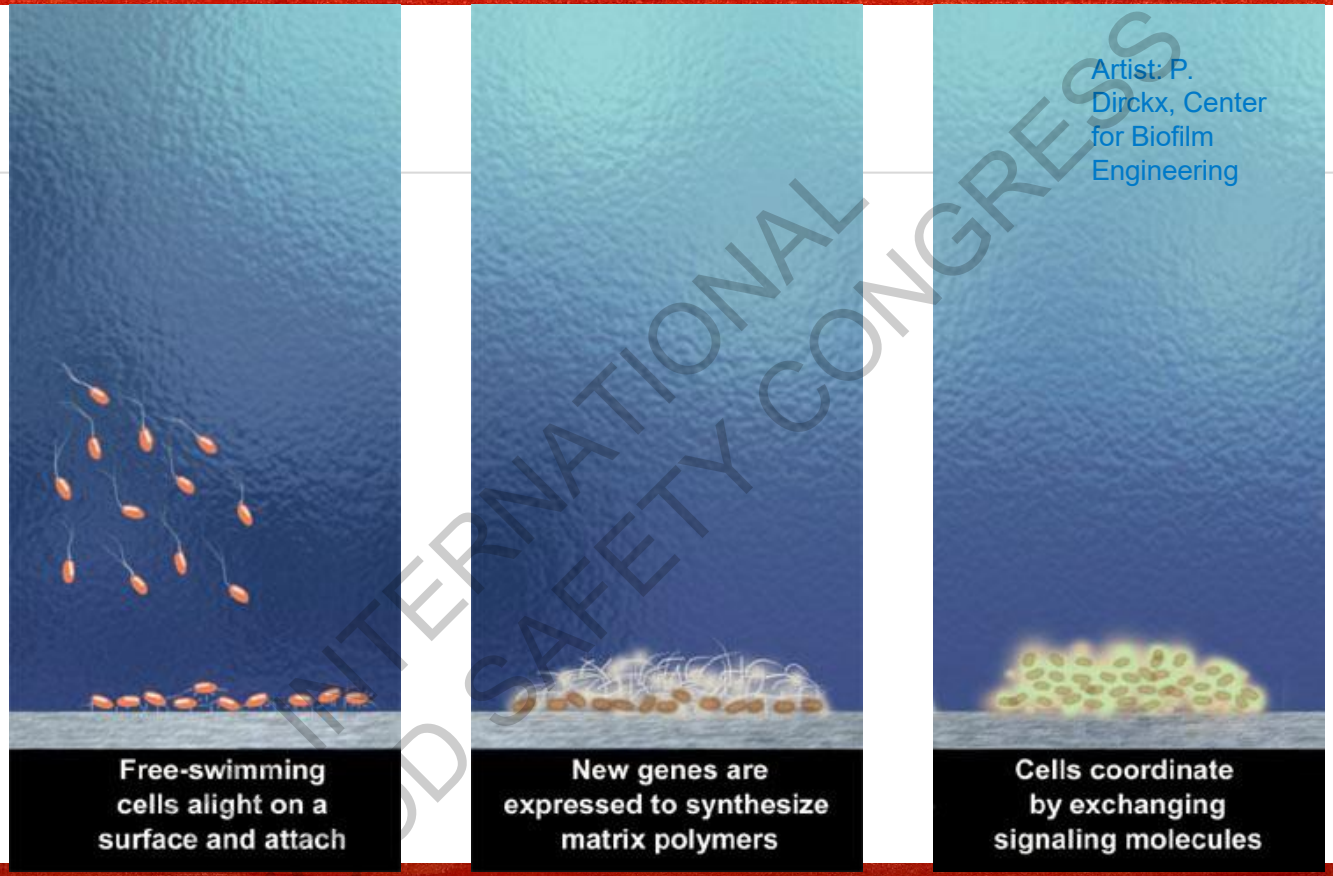
- Cleanable
- Made of compatible materials
- Accessible for inspection, maintenance, cleaning, sanitation
  - If you can't see it, you can't clean it!
- No product or liquid collection areas
- Hollow areas eliminated or sealed
- No niches
- Sanitary operational performance
- Hygienic design of maintenance enclosures
- Hygienic compatibility with other plant systems
- Validated cleaning & sanitizing procedures

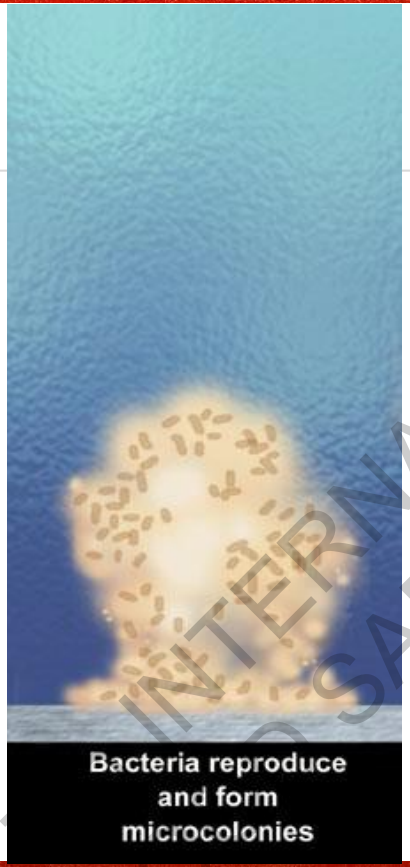
Based on Principles of Sanitary Design American Meat Institute (AMI)

Biofilm

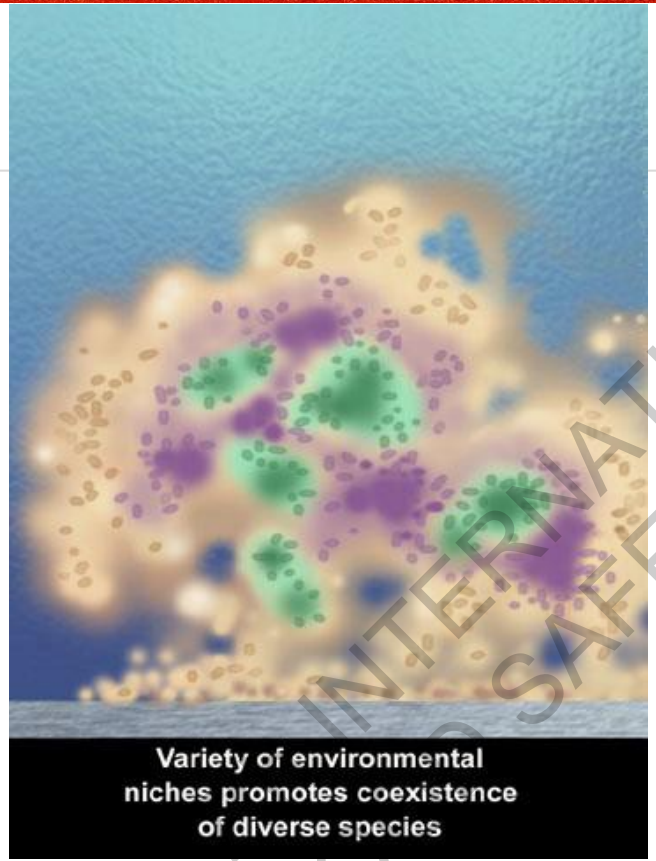
A biofilm community

- Bacteria, other microbes
- Built on and encapsulated in matrix of polysaccharides
- Consists of microbes, proteins, carbohydrates, minerals, food soils
- May be present as dry film, or gel like slime
- Some visible, many are not

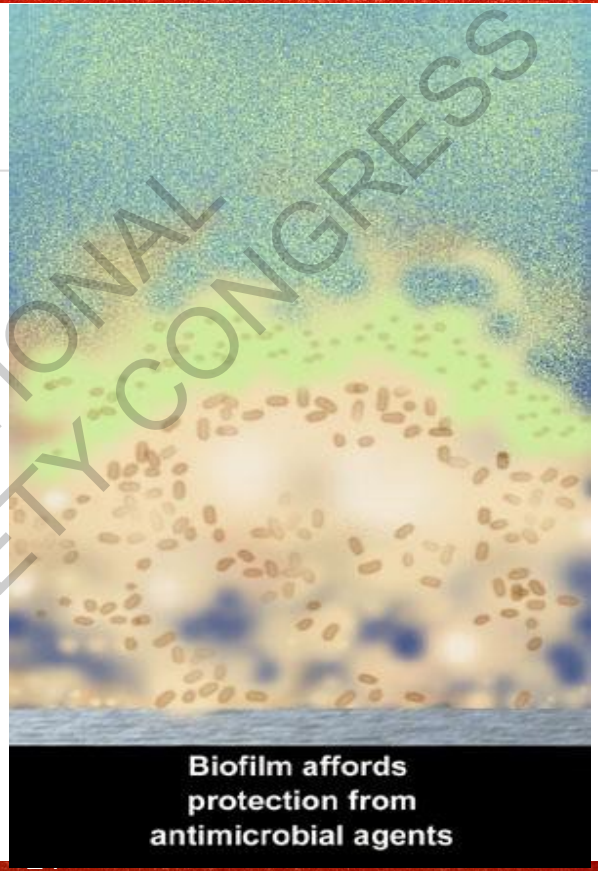




Artist: P. Dirckx, Center for Biofilm Engineering



Variety of environmental niches promotes coexistence of diverse species



Biofilm affords protection from antimicrobial agents

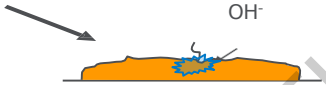
Artist: P. Dirckx, Center for Biofilm Engineering

Cleaning = mechanical force + chemistry

- **Pre-treatment** circulates through system prior to alkaline wash. Active ingredients penetrate biofilm.

Step 1

- **Alkaline detergent addition:** Immediately following Step 1, an alkaline detergent is circulated through the system; the rise in pH and temperature triggers Step 3.



Step 2

- **Over-riding:** pre-treatment and alkaline detergent interact, triggering a reaction that ruptures the biofilm.

Step 3

Step 4

- **Soil removal:** Fragmented biofilm is removed by the cleaning solution and planktonic spores are killed by the chemical sanitizer.

ECOLAB

Cleaning observations

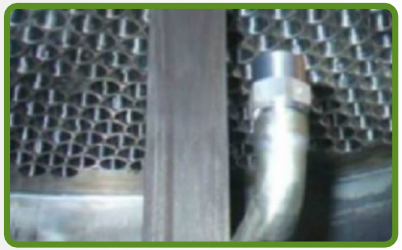
Evaporator

CONVENTIONAL CIP

ENHANCED CIP

Evaporator

CONVENTIONAL CIP



ENHANCED CIP

Why do we need to verify?

- To ensure that the controls actually being properly implemented in a way to control the hazard!

Verification Methods

- Visual inspection
- Calibration of process monitoring and verification instruments
- Targeted testing:
  - Product testing
  - Environmental monitoring
  - Supplier program
- Records review
  - Monitoring records
  - Corrective action records
  - Verification records

Concluding Point:

Optimally Apply Appropriate Risk Management Practices to Effectively Manage Risks

Any questions?

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