

JIFSAN Good Aquacultural Practices Program

Effective Cleaning and Sanitizing Procedures



By Alan Parker



Why Is Effective Cleaning and Sanitizing So Important?

Effective cleaning and sanitizing helps protect the health of the animals by controlling the transmission of animal diseases. It controls human health by preventing transmission of human diseases in foods. Cleaning and sanitizing helps prevent pest infestations by reducing residues that can attract and support pests. It also improves the shelf life and sensory quality of food products.

Effective Cleaning and Sanitizing

Effective cleaning and sanitizing is done by identifying areas and items to be cleaned. Then, effective chemicals and application methods must be selected. Clean is completed first, then sanitizing is done in 2 steps. You should perform Cands regularly, and validate that the program has been performed correctly.

What Should be Cleaned and Sanitized?

All surfaces that may contact the food product, such as utensils, knives, tables, cutting boards, conveyor belts, ice makers, ice storage bins, hands, gloves, and aprons. Surfaces that do not directly contact the product such as walls, ceilings, floors and drains have a profound effect on environment.

What Else Should be Cleaned and Sanitized?

Cleaning tools like brooms, mops, squeegees, buckets, sponges, scrapers, foaming equipment, water guns, etc., should be cleaned and sanitized. Cleaning tools can be a major source of microbial contamination if not cleaned. Cleaning tools should be washed and sanitized after every use. They should be stored clean, dried, and secured.

The Cleaning Step

Cleaning is the complete removal of unwanted matter using appropriate detergent chemicals under

- recommended conditions. Cleaning personnel need
- a working understanding of the type of substances
- to be cleaned the basic chemistry of its removal. As
- we will see later, cleaning and sanitizing need to be
- performed in two separate steps. It is impossible to
- sanitize a surface that is still dirty. There must be
- an effective rinse after the cleaning step to remove
- detergent residue that can interfere with the action
- of chemical sanitizers.

Characteristics of Food Soils

- Soil is any unwanted matter on the surface of an
- object that one desires to be clean. Cleanliness is
- an unnatural condition, because all surfaces are
- constantly being soiled. Special care must be taken
- to ensure that all soil is removed and that it is not
- redeposited on the substrate.

- Soil may be classified as visible and invisible, the
- latter category being primarily microorganisms,
- such as bacteria, yeasts, and molds.

- Soil is best identified by characteristics that give
- information on how it may be dissolved, because
- the object of cleaning is to dissolve or to suspend
- soil and then to wash it away.

- Some food soils can be dissolved in water such
- as simple carbohydrates (sugars), some simple
- mineral salts (NaCl), and some starches. There
- are also food soils that dissolve in alkali, like
- proteins, starches associated with proteins or fats,
- and bacterial films (biofilms). There are food soils
- that dissolve in acid, like hard water hardness salts
- (calcium and magnesium salts), and more complex
- mineral films, including iron and manganese
- deposits. Finally, there are those that dissolve with
- surfactants, which include fats, oils and greases,
- many food residues, inert soils such as sand, clay,
- or fine metals, and some biofilms.

What are Biofilms?

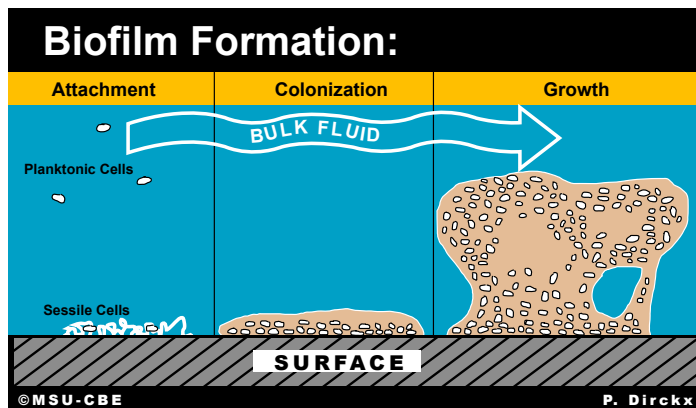
- Biofilms are a collection of microorganisms, mainly
- bacteria, growing together in a matrix of polymers
- secreted by the microorganisms. Once microbes

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grow into well-developed biofilms, cleaning and sanitation become much more difficult. Biofilms have a shielding effect on the bacterial cells within them, and normal cleaning and sanitizing methods may not eliminate them. Biofilms MUST be removed or prevented from forming on surfaces. Disease-producing bacteria, including *Listeria*, can be 1,000 times harder to eliminate if it is living in a protective biofilm. Biofilms can be very difficult to remove from surfaces, and are known to have an increased biocidal resistance due to the biofilm structure protecting the microorganisms. Biofilms can be a continual source of pathogenic and spoilage organisms if not completely removed.

What are Biofilms?

A collection of microorganisms, mainly bacteria, growing together in a matrix of polymers secreted by the microorganisms.



Courtesy of MSU Center for Biofilm Engineering

Spoilage organisms such as *Pseudomonas* grow in biofilms and can be sloughed off during production, contaminate the food, and accelerate spoilage. The polymers secreted by the bacteria close to the surface are strong adhesives making the cells very difficult to remove. The cells in a biofilm actually take on specialized functions and can communicate with each other in a rudimentary way (called Quorum Sensing).

Water

Called the universal solvent, water is the basis for all surface cleaners. Water is a good solvent—by itself it has the ability to clean many soiled surfaces. Cleaning with water alone is the yardstick by which we measure the effect of cleaning chemicals. Other active ingredients are added to enhance the effect. Detergents aid water in removing soil.

Water – Cleaning Function

Water comprises approximately 95-99% of cleaning solutions

Water's many functions in cleaning:

- Pre-rinse, to remove gross soils
- Soften soils left on the surface
- Carry detergent to the surface to be cleaned

Carry wastes away from the surface being cleaned

Rinse detergent off of the surface

Water quality, particularly its mineral hardness, can drastically alter the effectiveness of a detergent.

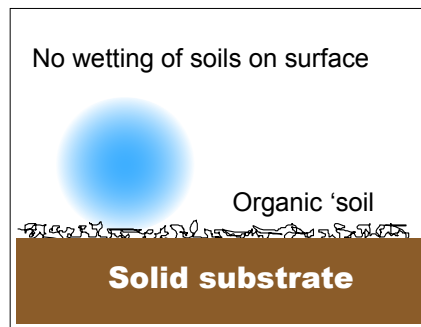
Water Hardness

Surface Cleaners

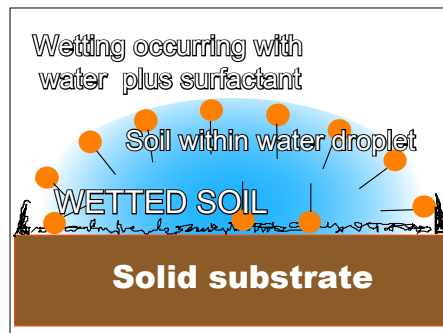
Surfactants Make Water Wetter

A surfactant (surface active agent) is a substance that lowers the surface tension of a solution. Surfactants also foam, emulsify, and disperse soils in solution. Surfactants have anionic, cationic, or nonionic (neutral) chemical structures.

Water Alone



Water + Surfactant



Detergent or Cleaning Agent

Both soaps and detergents help water to emulsify fats and to suspend solid soil particles. Soaps are made from fats and lye, while detergents are synthetic chemicals. Soaps and detergents act by reducing the surface tension of water, which increases water's interaction with soils, surrounds and lifts the soil from the surface, and allows water to flush the surrounded soils away. Proteins will hydrate and swell when they come into contact with water, which helps alkalis to react with them, forming soluble salts.

Characteristics of a Good Detergent

Rapid and complete solubility in water

Good swelling of soil

Good wetting capability of surfaces

Good dispersion and suspension properties

Good rinsing properties

Non-corrosive to surfaces

Non-toxic

Cost effective

Surfaces and Cleaning Substances

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

Application of Cleaners

Manual Cleaning

Equipment manually disassembled

Hand scrubbing and washing

Semi-automatic OPC

High pressure washing and rinsing

Foaming

Mechanical (Clean-in-place or CIP)

Automated cleaning process

Manual Cleaning

Pads, brushes and brooms should be:

1. Dedicated to tasks for which they are designed.
 - Optimizes cleaning effectiveness; and
 - Minimizes cross-contamination between areas of the plant.
2. Designed for the task.
 - Brushes—proper stiffness;
 - Pads—proper cutting properties; and
 - Pressure spray—moderate pressure.
 - Cleaning aids that retain water, such as sponges, wiping cloths, and mops should not be used for routine cleaning.
3. Do not mix uses. For example, never:
 - Use floor brooms / floor squeegees on tables
 - Use green pads used for cleaning waste barrels on grading or packing tables
 - Use the same brush to clean floors on any food contact surface.

High Pressure Washing

- Useful for walls, floors, large equipment and tables.
- Spray can form aerosols mist from irritating chemicals.
- Atomization can spread soil and microorganisms.
- Pressures used:
 - Low Pressure: <15 bar
 - Medium Pressure: 15 to 3 bar

- High Pressure: 30 to 150 bar
- Recommended: < 45 bar.

Foam Cleaning - Cling Time

Foaming Techniques

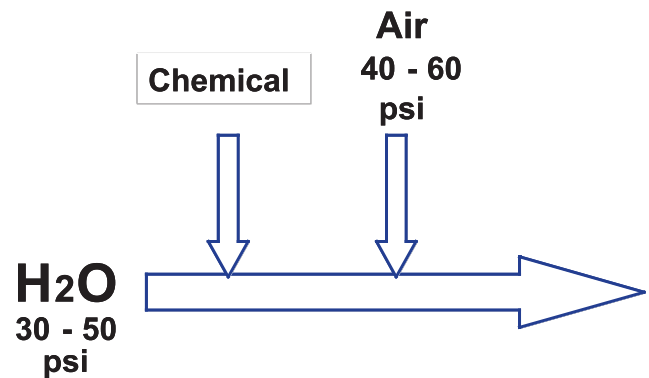
- Pre-rinse to remove loose soil and residues.
- Foam up, rinse down.
- Work in small sections.
- Allow foam to remain on surface 10 to 15 min.
- Be aware of surfaces susceptible to corrosion.
- No advantage in foaming hot solutions.
- Wear protective equipment (goggles, gloves, suit and boots).

Automated Cleaning (CIP)

- Clean-in-place: Cleaning internal surfaces of production equipment without disassembly.



How Foam is Generated



- Tanks, heat exchangers, pumps, valves, pipelines, and other enclosed surfaces.
- Cleaning solutions contact the surfaces by pumped circulation and automatic spraying.

- Contrary to manual cleaning, can use high chemical concentration and temperature.

2. Sanitizing Food Contact Surfaces

Sanitizing is a procedure to treat food-contact surfaces that destroys most disease producing bacteria and viruses, substantially reduces the number of other undesirable organisms, and does not adversely affect the product or its safety for the consumer. Sanitizing can be done with heat or with chemicals.

Sanitizing does not affect bacterial spores—that is beyond the capability of the process. A sanitizer will not sterilize a food-contact surface or a water system. Sterilization refers to the statistical destruction and removal of all living organisms, including spores. The official definition of sanitizing for food product contact surfaces is a process which reduces the contamination level by 99.999% (5 logs) in 30 sec. Disinfectants are stronger chemicals that produce a much larger reduction of microorganisms. They are generally not used in food applications.

Thermal Sanitizing

Steam

- Limited application
- Expensive
- Difficult to regulate
- Difficult to monitor contact time and temperature
- It is a physical hazard

Hot water

- 80-85° C, for >30 seconds
- Easy to apply
- Effective
- Non-corrosive
- High energy costs
- Safety concerns

Prepare a Surface for Sanitizing

- For a sanitizer to be effective, the surface being sanitized must be physically clean. One cannot sanitize a dirty surface—organic soils will consume the sanitizer. Detergent residues must be rinsed well—they will neutralize many sanitizers.
- Detergents are alkaline, most sanitizers are acidic.
- Detergents have negative charge, sanitizers have positive charge. Spraying a surface with a sanitizing solution without first cleaning the surface properly is a waste of time and money.

Chlorine-based Sanitizers

- The most commonly used sanitizers in food applications are chlorine gas, sodium or calcium hypochlorite, and organic chlorine (Sodium Dichloroisocyanurate). All form hypochlorous acid (HOCl, the most active form) in aqueous solution. The activity of chlorine is affected by pH. Temperature destabilizes chlorine., and chlorine is rapidly inactivated by organic matter.
- Corrosiveness to surfaces is a major disadvantage when using chlorine, and high temperature increases the risk of corrosion. Chlorine is less affected by water hardness when compared to other sanitizers. Chlorine has some advantages and disadvantages, as do all types of sanitizers.
- The principal disadvantage of most chlorine-based sanitizers is instability. They are affected by the acidity of the water in which they are diluted.

Broad-spectrum Germicides.

- The term “Broad Spectrum” when applied to a sanitizer means that it will attack a wide variety of different types of microorganisms, including gram-positive bacteria (*Listeria* and *Staphylococcus*), gram negative bacteria (*E. coli* and *Salmonella*), viruses, fungi (both yeasts and molds), as well as many parasites. Broad-spectrum germicides act on microbial membranes, cellular enzymes, DNA, and protein. Iodine-based sanitizers have been used as antimicrobial agents since the 1800s and have a broad spectrum of activity They are a powerful sanitizer in strong acidic aqueous solutions. They are generally used at 12.5 to 25 ppm available iodine, and can cause staining on some surfaces, especially plastics.

Other Sanitizers

Quaternary ammonium compounds (Quats) are cationic surfactants. They have fair wetting properties and react strongly with cell walls of certain microorganisms. Quats are more effective than chlorine against yeasts, molds and gram-positive microorganisms like *Listeria monocytogenes*, but less effective against gram-negative bacteria such as coliforms, *Salmonella*, and *E. coli*. Quats are incompatible with soaps and anionic detergents. Most cleaners are anionic, so surfaces must be thoroughly rinsed between cleaning and sanitation. Quats are excellent environmental sanitizers for floors, walls, drains, and equipment. They are non-corrosive to metals and stable at high temperature, but highly affected by water hardness.

Recommended Use Levels for Quats

Walls & Ceilings for Mold	2,000 5,000 ppm*
Equipment Sanitizing	200 ppm
Floors & Drains	800 ppm
Floor Mats	1,800 ppm
Foot Baths	2,400 ppm
No Rinse	< 200 ppm

Acid-anionic sanitizers are surface-active sanitizers, but negatively charged. Formulations include inorganic and organic acids plus a surfactant. Carboxylic acids (fatty acids) are some times incorporated as well. They are unaffected by hard water or organic soils. The dual function of acid is that it can be used for rinsing and sanitizing in one step. These sanitizers must be used at low pH. Activity above pH 3.5–4.0 is minimal. Acidity, detergency, stability, and noncorrosiveness makes them highly effective. Acid-anionic sanitizers are broad spectrum against bacteria and viruses, but not very effective against yeasts and molds. Peroxyacetic acid (PAA) is an equilibrium mixture of acetic acid and hydrogen peroxide in an aqueous solution. It is a very strong oxidizing agent and has a stronger oxidation potential than chlorine. It has a pungent acetic acid odor, and can be used to control odor and biofilms from food contact surfaces, and as a microbial control agent for sanitizing surfaces of equipment, floors, walls, and indoor processing and packaging facilities.

Methods of Applying Sanitizers

Working With Concentrated Chemicals

- Follow label instructions carefully.
- Always store concentrated chemicals in original container.
- Work with proper dilutions.
- Wear protective equipment recommended by manufacturer.

Cleaning and Sanitation Basic Steps

- Flush or sweep surfaces to remove gross soil.
- Wash the surface with the appropriate cleaning compound.
- Flush the cleaner from the surface.
- Apply a sanitizer.
- Flush the sanitizer.

Sanitation Standard Operating Procedures

- SSOP is a written document.
- Describes chemicals, concentrations, application methods and timing for every part of the plant.
 - Master Sanitation Schedule: What, When, Who?
 - Cleaning and Sanitizing Procedures: How?
 - Cands Records: Shows that procedures and schedule were followed

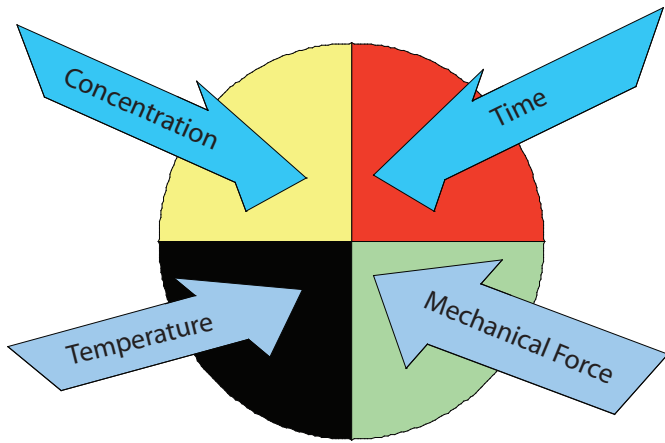
Cleaning and Sanitizing Validation

- Cleaning and sanitizing procedures should be regularly monitored for effectiveness.
 - Pre-operational inspections or audits
 - Microbial sampling of the environment or of food contact surfaces
- Establish criteria to be met
 - No visible residue present
 - Micro counts within acceptable limits

Validation Methods

- What everyone can do:
 - Visual Inspection (Best Verification Method)

- Surface appearance: visible debris, soil build-up, color of equipment surface (white films, stains, etc.), biological growth (i.e., mold) and odor
- Use simple tools:
 - Eyes
 - Nose
 - Flashlight
 - Scraper
 - Common Sense



• Typical Corrections

• **Observation:** Sanitizer concentration from dispenser varies day to day.

• **Correction:** Repair or replace chemical proportioning equipment and train cleaning crew in its proper use.

• **Observation:** Juncture of two table tops trap food debris.

• **Correction:** Separate tables to allow access for cleaning.

• **Observation:** Table work surfaces show signs of corrosion.

• **Correction:** Refinish or replace damaged equipment and switch to less corrosive cleaning compound.

• Cleaning and Sanitizing Validation

- Right chemicals and concentrations
- Application time
- Solution temperature if applicable
- Mechanical force or action