

# Sanitation and Hygiene

# Introduction

This module is part of a training program on General Food Safety Requirements for the Food Industry.

This program was developed through a partnership facilitated by the Partnership Training Institute Network (PTIN) of the Food Safety Cooperation Forum (FSCF) of the Asia Pacific Economic Cooperation (APEC) Forum. The educational content was designed by faculty at Michigan State University with additional content contributed by the Grocery Manufacturers Association of America. Funding for this effort was provided by The World Bank Group.

To learn more about the APEC FSCF Partnership Training Institute Network, please visit <http://fscf-ptin.apec.org/>.

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# Module Overview

Appropriate sanitation and hygiene practices are critical elements of a environment conducive to producing safe food. These prerequisite food safety programs are particularly important for minimizing the potential for contamination of food products with pathogenic microorganisms.

Effective sanitation and hygiene programs also are essential to producing foods that are free from quality defects such as spoilage microorganisms, filth, hair, insects and other contaminants that may not represent a direct food safety hazard.

Elements of sanitation and hygiene programs in food facilities typically are required by law in most jurisdictions, so persons responsible for food safety in establishments should be cognizant of legal requirements pertaining to sanitation and hygiene.

This learning module focuses on requirements relating to sanitation in food facilities and personal hygiene of food workers as described in the Codex Alimentarius General Principles of Food Hygiene. The following topics will be discussed:

- Cleaning and sanitation
- Personal hygiene

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# Section 2-1: Cleaning and Disinfection

## Section Overview

Effective cleaning and disinfection in a food production factory is extremely important as it reduces the risk of contamination from microorganisms that can cause food borne illnesses. It is important to have effective cleaning and disinfection procedures in place as unsatisfactory cleaning and disinfection may result in the continual redistribution of contaminating microorganisms.

This learning module covers the requirements for cleaning and disinfection. The following topics will be discussed:

- System development
- The importance of cleaning and disinfection
- Legal and customer requirements
- Appropriate use of cleaning and disinfection chemicals
- Cleaning procedure
- Chemical disinfectants
- Cleaning and disinfection management
- Monitoring effectiveness

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# Learning Objectives

At the conclusion of this section, the learner will be able to:

- define and understand the terms cleaning and disinfection,
- describe the principles of and reasons for cleaning and disinfection,
- discuss legal and customer requirements concerning cleaning and disinfection in food facilities,
- describe the different types of food soils and list appropriate cleaning agents for each of these soils,
- discuss factors that influence cleaning efficiency,
- describe the appropriate procedures for cleaning and disinfecting equipment, utensils and food contact surfaces,
- describe different methods for heat and chemical disinfection and discuss the advantages and disadvantages of each method,
- describe factors affecting the action of chemical disinfectants, and
- describe primary considerations regarding management of cleaning and disinfection procedures.

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# System Development

As a person responsible for food safety within the factory, you must develop effective systems to ensure that the staff is fully aware of:

- the importance of effective cleaning and disinfection,
- good practices in effective cleaning and disinfection, and
- cleaning and disinfection management systems.

Any system will have to be clearly and concisely documented and communicated effectively to appropriate staff within the company.

It is important to work closely with key company staff to ensure that they clearly understand the importance of such systems and the ways they can influence effective compliance.

Since the responsibility for food safety rests with you, direct verification of systems is extremely important. You should personally monitor activities on a regular basis and record your findings.

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# The Importance of Cleaning and Disinfection

As a food safety manager you must understand how cleaning and disinfecting significantly affects the safety and quality of foods.

Accumulated soils on equipment used for the production of food can support the growth of pathogenic microorganisms that can compromise the safety of products. This is why it is important to have a defined cleaning and disinfection schedule for all equipment and any other food contact surfaces. Regular cleaning and disinfection will significantly reduce the risk of potential microbiological contamination.

The risk of allergen contamination also can be eliminated by effective cleaning, if shared equipment lines are identified and cleaned between different product batches. Good examples where cleaning between production runs is important to manage allergens are the production of dairy based drinks and juices using the same production lines (milk is an allergen) and the production of dry cereals containing nuts and nut-free products (tree nuts can be allergenic).

With respect to the factory premises, if residues of food are not cleaned within your factory (for example spillages and poorly maintained waste containers) these accumulated food residues can attract and support pests. These pests can be a source of pathogenic microorganisms, therefore posing a contamination risk to your food products.

Effective cleaning and disinfection can also significantly reduce the level of spoilage microorganisms in the environment and in finished food products, which in turn can also improve the shelf life and quality of food products.

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## The Importance of Cleaning and Disinfection

# Definitions

It is important to understand the difference between cleaning and disinfection.

**Cleaning** is the *removal* of soil, food residue, dirt, grease or other objectionable matter.

**Disinfection** is the *reduction* by means of chemical agents and/or physical methods, of the number of microorganisms in the environment to a level that does not compromise food safety or suitability. This is sometimes referred to as sanitizing.

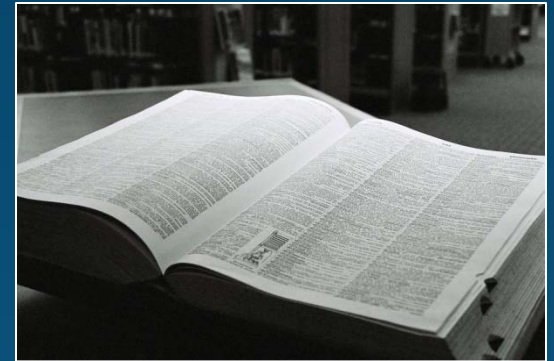


Photo by greeblie/Flickr

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# Legal and Customer Requirements

It is important to understand that there are different requirements for cleaning and disinfection from country to country. Customer requirements can also differ from the legal requirements set by the country of processing or distribution.



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Legal and Customer Requirements

## Legal Requirements

Countries or regions typically specify legislative requirements for cleaning and disinfection in food establishments. You should refer to the local regulations on using cleaning and disinfection products/agents in food product processes as they differ from place to place.

Disinfection agents are typically registered for use in each country by its respective competent authority so refer to the competent authority for correct/legal usage of disinfection agents.

For food products that will be exported to other countries, it is essential to be cognizant of legal requirements in the destination country where the food will be consumed.



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Legal and Customer Requirements

## Customer Requirements

Beyond legal requirements, it is important to note that other factors may impact the cleaning and disinfection chemicals and procedures used by your facility. For example, the customers to whom your company sells food products may impose additional requirements in relation to cleaning and disinfection.

Furthermore, food safety management schemes under which your company may be certified often have specific requirements for cleaning and disinfection. These customer requirements are often more strict than legal requirements so it is important to be cognizant of what the customer requires.



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# Appropriate Use of Cleaning and Disinfection Chemicals

As a food safety manager you have a responsibility to understand how to effectively conduct cleaning and disinfection operations within your facility to reduce or remove possible contamination hazards.

It also is critically important to understand what types of cleaning agents remove different types of food soils and what factors influence cleaning efficiency.



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## Types of Food Soils

There are different types of food soils that you may need to remove from equipment or food contact surfaces in your factory. These are:

1. **Those that dissolve in water:** simple carbohydrates (sugars), some simple mineral salts, some starches.
2. **Those that dissolve in alkali:** proteins, starches associated with proteins or fats, bacterial films (biofilms).
3. **Those that dissolve in acid:** hard water hardness salts (calcium and magnesium salts), more complex mineral films, including iron and magnesium deposits.
4. **Those that dissolve with surfactants:** fats, oils, greases, many food residues, inert soils such as sand, clay or fine metals, some biofilms.

To carry out effective cleaning or disinfection you will need to understand what type of food soil you are dealing with. The above shows that many food soils are not simply cleaned by water but rather require the use of specific cleaning compounds.

Appropriate Use of Cleaning and Disinfection Chemicals

## Types of Cleaning Compounds

You can use different types of cleaning compounds that relate to the food soil you are trying to clean. Using an incorrect compound will not ensure effective cleaning within your factory. These cleaning compounds include:

- **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.
- **Surfactants** – (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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Appropriate Use of Cleaning and Disinfection Chemicals

## Factors That Influence Cleaning Efficiency

There are a number of factors that can influence the efficiency of cleaning. These factors include:

1. **Choosing the right cleaning agent for the task:** Choosing the correct cleaning agent for the food soil is essential. For example, using water to clean fatty/greasy soils will be insufficient as water does not break down these soils.
2. **Contact time:** The longer the time the cleaning agent is in contact with the soil the greater the efficiency of cleaning.
3. **Temperature:** Temperature is very effective at increasing cleaning efficiency as increasing the temperature of the cleaning solution decreases the strength of the bonds between the soil and the surface. It also decreases the viscosity, increases the solubility of the soluble materials and the chemical reaction rate.
4. **Physical energy:** Physical energy (e.g. scrubbing) greatly influences cleaning efficiency. Increasing the physical energy put into cleaning will provide increased mechanical action to remove soil and filth. Velocity and turbulence of cleaning solutions are important factors influencing the efficiency of clean-in-place procedures.
5. **Concentration of the cleaning agent:** The concentration of the chosen cleaner is also important as usually the higher the concentration the increased efficiency. However, changing the concentration of the cleaning agent is the least effective means to influence the efficiency of cleaning.

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# Cleaning Procedure

It is important to know how to effectively clean equipment, utensils and food contact surfaces. The cleaning process is carried out in four stages:

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

These stages must be followed in this order for effective cleaning.

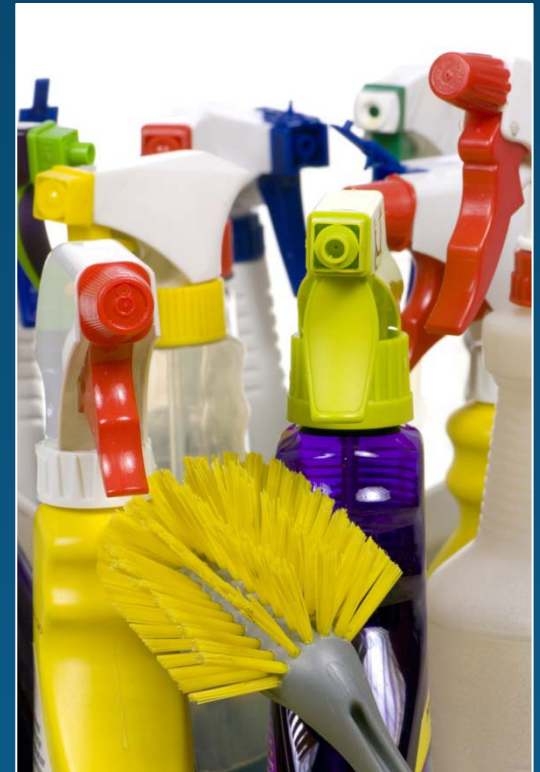


Photo: Public Domain

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## Cleaning Procedure

# 1. Prewash

The prewash stage is used to remove gross food particles from food contact surfaces or equipment before applying a cleaning solution. This is usually carried out by flushing the food contact surface or equipment with cold or warm water under moderate pressure.

It is good practice **not** to use very hot water or steam as it may make cleaning more difficult. This is because it could be cooking the food soil onto the equipment, which makes the bonds between food soil and surface very strong.



Photo by Brian Treanor/Flickr

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Cleaning Procedure

## 2. Washing

The washing stage is where the cleaning compound/solution is used. There are many different methods of washing equipment and food contact surfaces in your factory. These include:

- Soaking
- Spray methods
- Clean in place systems (CIP)
- Foaming
- Gelling
- Abrasive type powders and pastes

Choosing among these methods is usually dictated by the effectiveness of the method and the economic benefit it has for the company.

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Cleaning Procedure

## Washing – Soaking

The soaking method is usually used for smaller pieces of equipment or utensils as they need to be immersed in the cleaning solution. The soaking process breaks down the contact points of the food soil, it also helps if the temperature of the cleaning solution is around 45-50 degrees Celsius as the hotter the cleaning solution the more effective it is. You must be aware that liquid temperatures above 50 degrees Celsius may pose a scalding risk to the operator so monitoring of the temperature is required.

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Cleaning Procedure

## Washing – Spray Method

Using a fixed or portable spraying unit is an effective method to wash food soil off equipment and food contact surfaces. It usually involves using a pressured cleaning solution directly on the surface, such as hot water or steam. The temperature of the solution should not be too high as it can cook the food soil, making it difficult to clean.

Use of high-pressure sprayers in food facilities should be done judiciously. You must be careful to not spread contamination around the facility by using water pressures that are too high or by indiscriminately spraying water and cleaning solutions in the facility.



Photo: Ronell Managed Services LLC

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Cleaning Procedure

# Washing – CIP and COP

## Clean in Place Systems (CIP)

Clean in place systems are typically used to clean equipment that cannot be readily broken down for manual cleaning. This approach is very commonly used in factories that produce liquid products, such as juice or dairy production. CIP systems are automated cleaning systems which generally are used in conjunction with a permanent-welded pipeline system. These systems are usually designed to have a very high flow rate that increases the turbulence of the solution which provides the energy to remove food soil

## Clean Out of Place Systems (COP)

Cleaning out of place refers to manually breaking down equipment to clean and disinfect to ensure food soil is removed effectively. It is important to have equipment that can be cleaned effectively, so buying easy to clean equipment is advised.

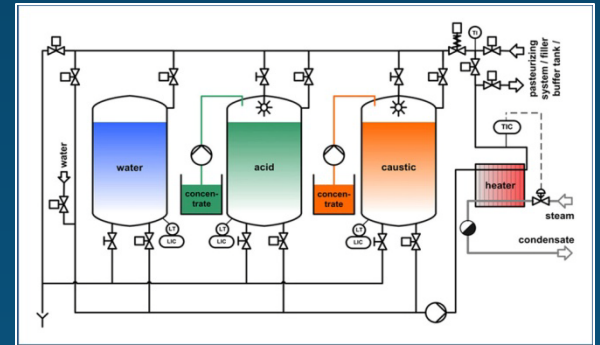


Illustration: Fischer AG

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Cleaning Procedure

## Washing – Foaming

Washing with foaming cleaners has benefits as the foam can cling to surfaces without surface runoff or rapid drying. This means the contact time of the cleaning solution on the food soil is increased, which improves the cleaning efficiency.

Foaming solutions use a blend of surfactants added to a highly concentrated solution of either alkaline or acid cleaners. When a foam generator is applied, usually water, it produces stable, copious foam..



Photo: Amity International

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Cleaning Procedure

## Washing – Gelling

The gelling method uses a concentrated powdered-gelling agent which, when dissolved in hot water, forms a viscous gel. The desired cleaning product is then added to this gel, which is then sprayed onto the surface that requires cleaning. This is a very effective method to clean equipment and food contact surfaces as the gelled cleaner will cover the food soil for and is left for a period of time. The longer it is left the more effective the cleaning will be. After the appropriate contact time, the gelled cleaner is then removed by a warm water rinse and the food soil comes away at the same time.

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Cleaning Procedure

## Washing – Abrasive Type Powders and Pastes

Abrasive powders and pastes are used for removing more difficult food soils. You must ensure that the area cleaned by these abrasives is rinsed thoroughly to remove residues of the cleaning products.

Use of abrasive cleaners on stainless steel should be exercised with caution, as these products can scratch surfaces and thereby create an environment where microorganisms can live.

Metal 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

Rinsing is the removal of all traces of the cleaning solution with clean potable water.

Using unclean water for rinsing will mean the washing process was pointless and it will need to be washed again.



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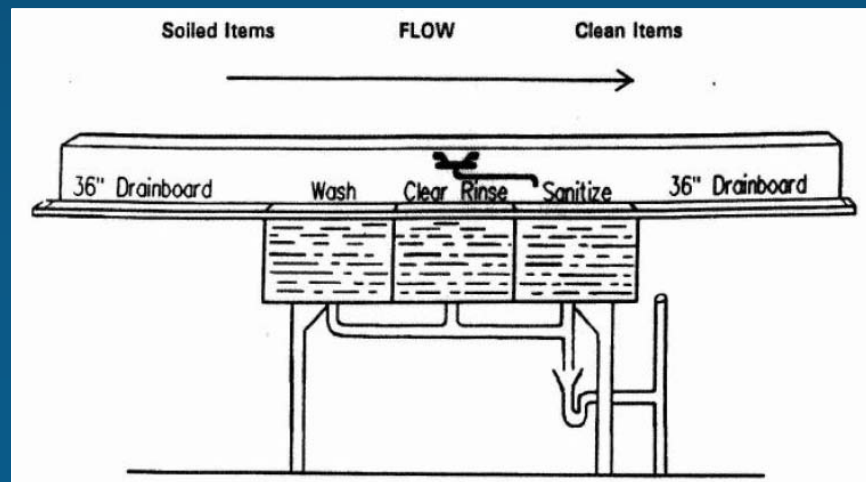
Cleaning Procedure

## 4. Disinfection (Sanitization)

The last stage of the cleaning process is disinfection (sanitization). Disinfection is a process using either heat or chemicals that will reduce the bacterial count, including pathogens, to a safe level on equipment and food contact surfaces in your facility. Disinfection is only conducted after washing and rinsing has been completed. You cannot effectively disinfect a surface if it has not been cleaned.

Disinfection procedures can be done with either heat (from hot water or steam) or by using chemicals (sanitizers).

The illustration below depicts a standard three-compartment sink used for manual warewashing. The first compartment is used for washing, the second for rinsing with potable water, and the third for sanitization.



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Cleaning Procedure

## Heat Disinfection – Hot Water

Using hot water as a disinfectant can be very effective. The high temperature is thought to coagulate the protein molecules within the cells of the microorganisms. This will kill the vegetative microorganisms. Microbial spores are much more resistant than vegetative cells and can survive heat disinfection processes.

The use of hot water has some advantages that include it being readily available, inexpensive and nontoxic.

Recommendations<sup>a</sup> for the use of hot water as a disinfectant are:

- Sanitization can be accomplished by either pumping the water through assembled equipment or immersing equipment into hot water.
- When pumping it through equipment, the temperature should be maintained to a 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 at least 171°F (77°C) or above for 30 seconds.
- The water temperature at the manifold for mechanical warewashing equipment must be 165°F (74°C) for a single stationary rack or 180°F (82°C) for all others.

<sup>a</sup>Source: US Food and Drug Administration. 2009 Model Food Code.

<http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodCode/FoodCode2009/>

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## Cleaning Procedure

# Heat Disinfection – Steam

Using steam as a disinfectant can be very effective but steam is also very difficult to work with and can be dangerous for staff to use. Therefore, its use as a disinfecting agent should be carefully considered. Steam is usually used when certain equipment is difficult to disinfect or when chemical sanitizing agents are contraindicated, such as for sanitizing oak barrels in wineries.

Recommendations for the use of steam as a disinfectant are:

- 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 above 200°F (93°C) for at least 5 minutes as checked at the outlet end of the assembled equipment.

The table shows the positive and negative points for using hot water or steam for disinfection.

## Pros and Cons of Heat Disinfection Using Hot Water or Steam

Hot Water	Steam
<ul style="list-style-type: none"><li>• Easy to apply</li><li>• Effective</li><li>• Non-corrosive</li><li>• High energy costs to generate</li><li>• Safety concerns</li></ul>	<ul style="list-style-type: none"><li>• Limited application</li><li>• Expensive to generate</li><li>• Difficult to regulate</li><li>• Difficult to monitor contact time and temperature</li><li>• It is hazardous</li></ul>

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# Chemical Disinfectants

Chemical disinfectants can be very effective but you must be aware of factors that affect the efficacy of the chemical being used as a disinfectant.

The most common chemical disinfectants used internationally are:

- Chlorine (e.g. sodium hypochlorite)
- Quaternary ammonium compounds (Quats)
- Iodophors
- Peroxyacetic acid



Photo: Tracy Hunter / Flickr

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## Chemical Disinfectants

# Chlorine as a Disinfection Agent

Chlorine is the most widely used disinfecting agent in the food industry. It is effective against many types of microorganisms, is relatively easy to prepare and use, and is inexpensive. Other advantages and disadvantages of using chlorine as a disinfectant are listed in the following table.

There are many different sources of chlorine that are used commercially, these include:

- Sodium Hypochlorite ( $\text{NaOCl}$ ) – liquid (5.25, 12.75 or 15%)
- Calcium Hypochlorite [ $\text{Ca(OCl)}_2$ ] – solid (65 or 68%)
- Chlorine Gas ( $\text{Cl}_2$ ) – Gas cylinders
- Chlorine Dioxide ( $\text{ClO}_2$ ) – generated on-site from sodium chlorite + acid

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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## Chemical Disinfectants

# pH Influences on Chlorine as a Disinfectant

The effectiveness of chlorine as a disinfectant is dramatically influenced by the pH of the solution. At high pH (low acidity), the hypochlorite ion ( $\text{OCl}^-$ ) will predominate in solution, whereas the hypochlorous acid form ( $\text{HOCl}$ ) is predominant at low pH (high acidity). Hypochlorous acid is the form of chlorine that kills microorganisms, whereas the hypochlorite ion is ineffective. Therefore, pH is a very important variable to control when using chlorine as a disinfectant. It is generally recommended that chlorine-based sanitizing solutions be maintained at pH 6.5 – 7.5 for optimal effectiveness.

Regardless of the form of chlorine used (e.g. sodium hypochlorite, calcium hypochlorite, chlorine gas, etc.), the agent which ultimately is responsible for killing microorganisms is hypochlorous acid.



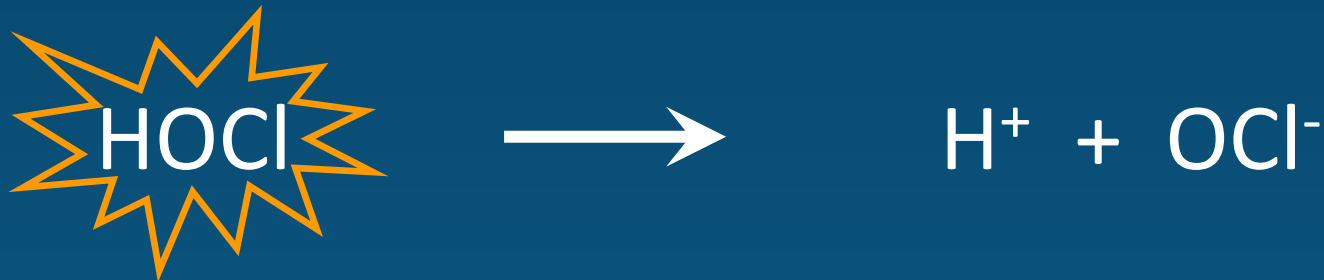
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## Chemical Disinfectants

# High and Low pH

A high pH converts the hypochlorous acid into the hypochlorite ion ( $\text{OCl}^-$ ), which is relatively ineffective in killing microorganisms.



At lower pH (i.e. below pH 7.5) the hypochlorous acid form (HOCl) will predominate. At low pH (i.e. below pH 6.0), chlorine can be corrosive to the equipment you are trying to disinfect. Low pH also can cause a chlorine odor as chlorine gas is evolved from the solution, which can create unpleasant and even unsafe working conditions for staff.

Good practice guidance recommends the pH of chlorine sanitizing solutions should be between 6.5 and 7.5. This will give the optimum effectiveness as a disinfectant and will reduce the risk of corrosion and odor.

The pH of chlorine solutions can be easily adjusted. If the pH is too high you can add an acid, such as hydrochloric (inorganic) or citric acid(organic). If the pH is too low you can use an alkaline material, such as sodium bicarbonate or diluted sodium hydroxide.

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Chemical Disinfectants

## The Effect of Water Temperature and Organic Matter on Chlorine as a Disinfectant

Higher temperatures of water will make chlorine more effective at killing microbes, but if the temperature gets too high the chlorine will be vaporized (lost from the solution as a gas). This reduces the effectiveness of the chlorine solution and the evolved gas can be a health risk to staff.

If there is organic matter present in water this can reduce the effectiveness of the chlorine as a disinfectant as the chlorine reacts with the organic matter, thereby reducing its concentration. If organic matter is present, chlorine concentration should be monitored frequently. Automatic titration of chlorine concentration (via monitoring of oxidation-reduction potential) and pH may be desirable in systems which have a high organic load (e.g. using chlorine to sanitize water in fresh produce washing operations).

It is good practice to test for free (or available) chlorine levels within the sanitizing solutions to ensure that effective chlorine concentrations are maintained.



Photo: Deardorff Fitzsimmons Corp.

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Chemical Disinfectants

## Concentrations of Chlorine in Sanitizing Solutions

Chlorine disinfectants are most commonly used at concentrations of 50 – 200 parts per million (ppm). However, it is important to comply with regulations governing the appropriate use of chlorine and other disinfectants in your particular jurisdiction, or for the markets where your food products will be sold (if exporting).

In the United States, chlorine-based sanitizing solutions in food facilities can be used with the following provisions:

- Such sanitizing solutions are used, followed by adequate draining, before contact with food.
- Sanitizing solutions shall not exceed 200 ppm available chlorine. No potable water rinse is required after sanitizing if using chlorine at concentrations at or below this limit.

Sample mixing formulas for chlorine disinfectants based on 5.25% sodium hypochlorite are on the next page.

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## Chemical Disinfectants

# Mixing Formulas for Disinfectants Based on 5.25% Sodium Hypochlorite

Desired chlorine concentration	Amount of chlorine bleach (5.25% sodium hypochlorite) needed	Amount of water
50 ppm	$\frac{3}{4}$ teaspoon (3.7 mL)	1 gallon (3.78 Liters)
50 ppm	1 tablespoon (15.8 mL)	4½ gallons (17.0 Liters)
50 ppm	2½ tablespoons (37.0 mL)	10 gallons (37.8 Liters)
100 ppm	1½ teaspoons (7.4 mL)	1 gallon (3.78 Liters)
100 ppm	2 tablespoons (29.6 mL)	4½ gallons (17.0 Liters)
100 ppm	5 tablespoons (73.9 mL)	10 gallons (37.8 Liters)
200 ppm	3 teaspoons (14.8 mL)	1 gallon (3.78 Liters)
200 ppm	4 tablespoons (59.1 mL)	4½ gallons (17.0 Liters)
200 ppm	10 tablespoons (148 mL)	10 gallons (37.8 Liters)

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## Chemical Disinfectants

# Quaternary Ammonium Compounds

Quaternary ammonium compounds are synthetic surface-action agents. The most common ones are cationic detergents. These are poor detergents but have excellent germicidal action. Germicidal action is not completely understood but is associated with enzyme inhibition and leakage of cell constituents.

The following table lists the advantages and disadvantages of using quaternary ammonium compounds 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 commonly used dilutions	
Broad spectrum of antimicrobial activity	
Long shelf life	

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## Chemical Disinfectants

# Iodophors

Iodophors are soluble complexes of iodine which are usually combined with non-ionic surface-active agents. Iodophors generally are used at concentrations up to 25 parts per million. One very common use of iodophore sanitizers is in foot baths used at entrances to food processing rooms.

The following table lists the advantages and disadvantages of using iodophors as a disinfection agent.

Advantages	Disadvantages
Rapid bactericidal 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 indicates presence)	

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## Chemical Disinfectants

# Peroxyacetic Acid

Peroxyacetic acid is made from an equal mixture of acetic acid and hydrogen peroxide in an aqueous solution. Peroxyacetic acid is a very strong oxidising agent and has a stronger oxidation potential than chlorine.

It is commonly used to control odor and biofilms on food contact surfaces. It is also used as a microbial control agent for sanitizing surfaces of equipment, floors, walls, and indoor processing and packaging facilities.

The following table lists the advantages and disadvantages of using 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 <sub>2</sub> , CO <sub>2</sub> , H <sub>2</sub> O)	Rapidly decomposed by organic matter

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## Factors Affecting the Action of Chemical Disinfectants

Several factors influence the effectiveness of chemical disinfectants. These factors include the following:

### 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.

### 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 increase 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. Generally, the allowable range of concentration will be specified by laws and regulations.



## Factors Affecting the Action of Chemical Disinfectants (continued)

### 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 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).

### 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 iodophors generally decrease in effectiveness with an increase in pH.

### 6. Time of exposure

- Sufficient time must be allowed for whatever chemical reactions that occur to destroy the microorganisms.
- The required time will not 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.

# Cleaning and Disinfection Management

As a food safety manager you must know how to develop a system to manage cleaning and disinfection operations in your facility.

## What Should be Cleaned and Disinfected?

All equipment, utensils and surfaces in the facility that may contact the food product need to be cleaned and disinfected on a routine basis. This includes:

- Food bins, containers, totes
- Equipment food contact surfaces
- Utensils, knives
- Tables, cutting boards, conveyor belts
- Ice makers, ice storage bins
- Hands, gloves, aprons

It is not just food contact surfaces that need disinfecting. Other surfaces that can pose a safety issue from dripping require disinfection. This includes walls, ceilings, floors and drains.

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Cleaning and Disinfection Management

## Cleaning and Disinfection of Cleaning Tools and Utensils

Cleaning tools include brooms, mops, squeegees, buckets, sponges, scrapers, foaming equipment, water guns, and other tools and utensils. It is easy to forget that these tools and utensils used to clean and disinfect your food facility also require cleaning and disinfection themselves. As cleaning tools are used to remove food soils and microorganisms they pose a significant cross-contamination risk.

All cleaning tools must be washed and disinfected after every use to prevent microorganisms from multiplying. Making sure the cleaning tools are dry and kept in a clean, safe area will also prevent contamination issues.



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## Cleaning and Disinfection Management

# Example of Recommended Cleaning Schedule

The following table provides an example of a recommended cleaning schedule that you may use within your factory. Note that this is just an example for illustrative purposes. The cleaning and disinfection schedule and procedures used in your facility should be developed based on the food products produced, the nature of the equipment and production methods used, and other considerations.

Type of Surface	Recommended Cleaning Substance	Frequency of Use
Stainless steel	Alkaline, not abrasive	Daily
	Acid, not abrasive	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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Cleaning and Disinfection Management

## Sanitation Standard Operating Procedures (SSOPs)

A sanitation standard operating procedure is a written document that a company should produce, which will include descriptions of chemicals used, concentrations, application methods and timing for every part of the factory in relation to cleaning and disinfection. SSOPs should be structured into a master sanitation schedule which describes what is being cleaned, when it will be cleaned, and who is responsible for cleaning. The master sanitation schedule describes all of the cleaning and disinfection procedures carried out in your facility.

Properly executed SSOPs provide your company with security as these include cleaning and disinfection verification records so that there is proof that procedures and schedules were followed.

It is important to note that SSOPs or similar procedures and documentation are sometimes required by country-specific regulations or private food safety standards. For example, the United States Food and Drug Administration requires specific SSOPs for processors of seafood and juice products.



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Cleaning and Disinfection Management

## Monitoring Effectiveness

As a food safety manager you should monitor the effectiveness of the cleaning and disinfection procedures and processes carried out within your facility. You must ensure that staff are made aware and understand the need for hygiene and cleanliness. Records should be made of how the procedures are followed and conducted. These records must be reviewed on a routine basis. If there are any concerns highlighted in the review then corrective action must be carried out and recorded.

Checks must be carried out regularly at pre-operational and inter-operational stages and any issues identified shall have corrective actions made and all changes recorded.



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# Summary

- Cleaning and disinfection are two distinct procedures.
- Thorough cleaning must precede disinfection. You cannot disinfect an unclean surface.
- Choose the correct chemicals or processes for both cleaning and disinfection.
- Develop a procedure for each operation and make certain these procedures are followed.
- Develop a system for monitoring cleaning and disinfection procedures and maintain appropriate records documenting these procedures.



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