

Three Compartment Sink Operation



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A critical part of sanitation in a food service establishment is the proper cleaning and sanitizing of food contact surfaces. Foodborne illness often is caused by cross-contamination of surfaces or improper cleaning and sanitizing. It is estimated that 10% of all foodborne illness is caused in this way. This brochure will explain proper cleaning and sanitizing in a food service establishment and how the proper use of a three compartment sink is an integral part of a complete sanitation program.

SANITATION AND SANITIZATION

Sanitation is regulated by government agencies. From the local health department, to the federal Food and Drug Administration, these bodies are responsible for ensuring that food is safe to eat. The ultimate purpose of using detergents and sanitizers in the food industry is to reduce the number of potential food pathogens (organisms that can cause disease) to a level that minimizes the risk of foodborne illness. Sanitizing a surface does not mean sterilization (killing all microorganisms). Small numbers of bacteria, fungi and viruses may survive. This will be discussed later, in detail. Sanitizing is the process of applying a chemical or heat to a previously cleaned food contact surface to kill bacteria and other microorganisms.

Because there are multiple governmental organizations involved, the rules for sanitation can and do vary from area to area. The information provided herein is based upon the federal government requirements, which are generally the baseline for state and local regulations. If there are any questions, the local health department can provide a complete set of rules governing food service establishments in the local area.

FOODBORNE ILLNESS

When a person becomes ill after eating contaminated food, the illness falls into one of two classifications: foodborne infection or foodborne intoxication. The older term, food poisoning, is no longer used by professionals in the food service sanitation industry. A bacteria, such as the bacteria that causes botulism, may excrete chemicals that are toxins (chemicals dangerous to humans). Cooking does not destroy these toxins. If the toxins make a person sick, this is called foodborne intoxication. If food is infected with this type of bacteria, cooking the food may kill the bacteria but leave the toxins in the food. This food would still be dangerous to people and capable of causing disease. If the bacteria producing the toxins are still alive when ingested, they can continue to produce toxins in the body. This is often called a toxin mediated infection, but is really just another form of intoxication. If, on the other hand, the bacteria themselves cause the disease in a person, then the illness is called foodborne infection. Because toxin mediated infections may be listed as a separate classification, some materials may refer to three classes of foodborne illness.

Where do people who get foodborne illness get infected?

Restaurants	51%
Home	14%
Delicatessens/Caterers	12%
Cafeterias	8%
Nursing Homes	5%
Other	10%
	100%

Foodborne illness causes disease in an estimated 24,000,000 to 81,000,000 people every year of which 9,000 to 20,000 die. The Centers for Disease Control and Prevention (CDC) estimates that the annual cost of foodborne

THE MICROORGANISMS (GERMS) CAUSING ILLNESS OR DEATH ARE:

	Out of 100%	Source of Disease Causing Microorganism
Salmonella	15%	Poultry, milk, eggs, meat, and poultry products
Clostridium perfringens	14%	Meats, stews, and gravies
Norwalk virus	22%	Infected people, usually food handlers
Escherichia coli	7%	Meat (especially beef), milk, apple cider
Staphylococcus aureus	5%	Meats, cream sauces, prepared salads
Hepatitis virus	3%	Infected people, usually food handlers
Shigella bacteria	2%	Many foods especially those washed in water
Campylobacter bacteria	2%	Meat, poultry, milk and water
Clostridium Botulinum (botulism)	2%	Canned foods, especially meats
Unknown	28%	Source of these illnesses not determined

illness is \$7.7 to \$23 billion per year. These estimates are very broad, because many, if not most, foodborne illnesses go unreported. The average person gets foodborne illness at least 100 times in their life. Most of the time, the illness is minor enough to not require hospitalization. A person may feel “under the weather” or have “stomach flu” for a few days. Both of these symptoms may be caused by foodborne illness. Coupled with long incubation times (it can take up to several weeks to get sick after exposure), most foodborne illness goes undiagnosed by doctors. This is a sobering reminder of the scope of the problem. The number of bacteria present and the person’s overall health and resistance to disease determine the severity of the illness.

Food is at the highest risk of being contaminated in a restaurant during preparation and service. Food spends most of its time in the “danger zone” (41–140°F) during these times. Bacteria grow and multiply rapidly within this temperature range.

CLEANING

In a food service establishment, objects to be cleaned can be broadly split into two groups: food contact surfaces and nonfood contact surfaces. Nonfood contact surfaces include freezer doors, floors, walls, the outsides of equipment and other surfaces where food contact does not occur. Nonfood contact surfaces should be placed on a cleaning schedule so that they are cleaned regularly or any time that they become visibly dirty.

Food contact surfaces include dishes, glasses, flatware, pots, pans, food preparation counters, knives, cutting boards, kettles, steamers, grills, serving utensils, coffee urns, soft-serve ice cream machines and any other surface that can reasonably be anticipated to contact food. Flatware, dishes, pots, pans, knives, cutting boards and other food preparation surfaces must be cleaned and sanitized between uses. If a surface is going to be used repeatedly for cooking or preparing the same food, the surface should be cleaned and sanitized regularly throughout the day, not just at closing.

All authorities stress the importance of thorough cleaning and rinsing of surfaces prior to sanitization. Cleaning and rinsing reduces the number of organisms on equipment surfaces, which reduces the amount of time the sanitizer needs to work.

Cleaning must be performed prior to sanitizing a surface, or the sanitizer may be ineffective. Unclean processing and

packaging equipment provide an excellent environment for bacteria to grow. Sponges can no longer be used in food service establishments for cleaning or sanitizing because they can harbor bacteria. Dedicated wiping cloths should be used for cleaning and sanitizing so there is no cross-contamination from surface to surface. When not in use, cloths should be stored in a container of sanitizing solution to control bacteria growth. If they are left on counter tops, bacteria can begin to multiply. By leaving them in a sanitizer solution when not in use, the cloths stay sanitary.

Proper cleaning procedure for food contact surfaces involves the use of the 5-step procedure:

1. **Prescrap** (remove gross food soils)
2. **Wash** (in or with a suitable detergent solution)
3. **Rinse** (with clean potable/tap water)
4. **Sanitize** (with a suitable sanitizer at an appropriate concentration and temperature for 1 minute)
4. **Air Dry** (never towel dry because of cross-contamination)

In the case of immobile objects, such as mixers and large kettles, the 5-step procedure is applied directly to the equipment. In the case of mobile objects, glasses, plates, serving utensils, serving pans, the objects are either run through an industrial dishmachine to clean and sanitize or they are washed manually in a three compartment sink. For more information on dishmachines and warewashing, review the U S Chemical publication “Understanding the Warewash Environment and Warewash Product Selection.”

THREE COMPARTMENT SINK OPERATION

The two steps in the three compartment sink procedure that use chemicals are the washing and sanitizing steps (although rare today, sanitizing can also be done by heat alone). A three compartment sink is, as it sounds, three compartments set up side by side. Older food service establishments may only have two compartment sinks. If this is the case, a dishpan must be used to provide the third sink. The first sink contains pot & pan detergent solution. The second is potable (tap) water. The third is the sanitizing solution. There will also be a rack or drainboard to allow ware to air dry.

There usually is a garbage disposal and overhead sprayer hose before the first sink to allow for easy removal of the gross food soils remaining on the ware. Prescraping is the first step in the 5-step procedure. After prescraping, the ware goes into the first sink which has a pot & pan detergent solution at about 100–120°F in the sink. Once washed, the

ware is immersed in the second tank, which contains potable/tap (drinking quality) water. This rinses off the detergent residues.

The ware is then immersed for 60 seconds in the third sink, which contains the sanitizing solution. For each type of chemical sanitizer, there is a minimum concentration of the sanitizer that must be present. One of the most common mistakes dishwashers make is only briefly immersing the ware in the third sink. It must stay immersed for 60 seconds to comply with the Environmental Protection Agency's (EPA) requirements. Some states require even longer immersion times. For example, at the time of this writing, the State of Wisconsin requires a 2 minute immersion in a three tank sink operation. The temperature of the sanitizing solution should be 75–120°F.

POT & PAN DETERGENTS

Emulsification is the name of the cleaning process used by pot & pan detergents. Emulsification is the process by which soils are broken down, held in suspension, and prevented from depositing back onto ware being washed. Once food soils are removed from ware, it is equally important for good sanitation that the food soils not be allowed to recoat the ware. Pot & pan detergents help do both cleaning and preventing soil redeposition. Emulsification does not change the soil other than breaking it down into smaller bits, which are easier to remove from ware.

The main components of pot & pan detergents are surfactants. The word surfactant is a shorthand way of referring to a chemical that is a "surface active agent," meaning that it reduces the surface tension of water. The main characteristic of surfactants in pot & pan detergents is that they foam. However, foam does not clean. It is just a visual indication that surfactants are present. The foam disappearing is a visual indication that the surfactant is consumed and that it is time to change the water in the sink. It can be demonstrated that by filling the sink and then adding the detergent, ware can be washed just fine without the foam. However, people are conditioned through their experiences at home to expect copious amounts of foam when washing ware manually.

CHARACTERISTICS OF POT & PAN DETERGENTS

Because pot & pan detergents are all designed to clean in the same way, all pot & pan detergents have common characteristics. They all:

- A. Foam**
- B. Are mild to skin and pH neutral**
- C. Use the emulsification process to clean**
- D. Are surfactant based**
- E. Have a pleasant scent**
- F. Have color**

While scent and color are not necessary for product performance, people expect that the products they use in industry should look and smell as they do at home. If pot & pan detergents have common characteristics, there must also be things that distinguish between them. They are:

- A. Use dilution**
- B. Surfactant levels**
- C. Color and scent**

The quality of a pot & pan detergent is communicated through its use dilution. A product with a use dilution of 1 ounce in 10 gallons of water is far more concentrated than a product with a use dilution of 1 ounce in 3 gallons of water. The better the product, the higher the use dilution. The use dilution is related to the surfactant level, but high quality blends of surfactants can perform better at lower concentrations than lower quality surfactant blends.

When using higher quality pot & pan detergents, control in dispensing is an issue. For low quality products, "glugging" the detergent can be acceptable, but usually leads to product overuse and higher costs. When using high quality pot & pan detergents, measurement is essential in controlling costs. U S Chemical offers the following devices and/or systems to measure pot & pan detergent including: jug or pail pumps, wall mounted pumps, faucet feeders, the Freedom Specialty System and the Ultra Active Specialty System.

THREE COMPARTMENT SINK COST ANALYSIS

The cost analysis for a pot & pan detergent and sanitizer is performed in the same way. Here the pot & pan detergent is shown, but the approach is the same for the sanitizer. To do a pot & pan detergent cost analysis, we need to know three things:

- 1. Size of the sink**
- 2. Cost/Case or pail for the pot & pan detergent**
- 3. Use dilution for the pot & pan detergent**

The formula for calculating the sink size is:

$$\frac{(L \times W \times D)}{231} = \text{gallon capacity of the sink}$$

Note that the length, width and depth are measured in inches.

When measuring the depth, it is important to remember that the sink will not be filled completely with water. We only measure to the water level that the dishwasher uses. Some sinks have a sticker or label to identify how full the sink should be. U S Chemical supplies stickers for this purpose. If there is no sticker, ask the dishwasher. Usually the sink is filled from 6 to 12 inches below the lip of the sink. Having calculated the sink capacity (here assumed to be 15 gal), a three step approach yields the cost per sink for the pot & pan detergent.

1. Determine the number of ounces of detergent needed to charge the sink. Do this by dividing the sink capacity by the use dilution. If our detergent is diluted at a rate of 1 ounce detergent/ 5 gallons of water, 3 ounces of detergent are needed.

**Sink Size = Ounces of Detergent/Sink
Use Dilution**

Example: $\frac{15 \text{ gal}}{5 \text{ gal}} = 3 \text{ oz. of Detergent}$

2. Determine the Cost/Ounce for the pot & pan detergent. There are 640 fl. oz. in a 5 gallon pail. There are 512 fl. oz. in a 4 x 1 gallon case. Divide the cost per case or pail by the ounce per case.

**Cost/Case or Pail = Cost/Ounce of Detergent
Oz./Case or Pail**

Example: $\frac{\$64.00/\text{pail}}{640 \text{ fl. oz./pail}} = \$0.10 / \text{oz.}$

3. Determine the cost/sink for the pot & pan detergent. Multiply the cost per ounce by the number of ounces needed per sink.

Cost/Ounce x Ounces/Sink= Cost/Sink

Example: $\$0.10 \times 3 \text{ oz.} = \$0.30/\text{sink}$
Therefore, the cost is approximately 30¢ per sink.

This method can be used to compare the cost per sink for two different pot & pan detergents. The better quality pot & pan detergents always cost more per case or pail to buy, but either cost less per sink to use or a sink of detergent solution lasts longer. Again, the cost analysis for the sanitizer is done the same way.

SANITIZERS

The other chemical product used in three tank sinks are sanitizers. A sanitizer is an antimicrobial agent that kills 99.999% of specific test bacteria under conditions

prescribed in the official AOAC test method. Effective cleaning is 90% of the overall sanitation effort in that cleaning removes most of the organisms present. The job of the sanitizer is to kill the remaining organisms. A sanitizer is tested against only a few difficult to kill bacteria, but it is expected to perform equally well against other bacteria of lesser resistance. The Environmental Protection Agency (EPA) requires that sanitizers be tested against Escherichia coli, Staphylococcus aureus, and Salmonella typhi. These organisms cause a significant amount of foodborne illness, so they are very important to food service establishments.

All sanitizers are required to be registered with the Environmental Protection Agency (EPA). The EPA requires specific information that must be on the label including the active ingredient(s), proper use dilutions and precautionary information. In addition, sanitizers must be registered in every state in which they will be sold. To be used in a food service establishment, a sanitizer must be registered with both the state where it is being used and the EPA.

There are four types of chemical sanitizers sold by U S Chemical. They are:

1. **Quaternary Ammonium Chlorides (quats)**
2. **Acid-Anionic**
3. **Chlorine**
4. **Iodine**

Each sanitizer has a minimum concentration that must be maintained to be effective. In the case of chlorine and iodine, those sanitizers are dosed at higher concentrations than are needed to sanitize because they are less stable and break down. By dosing at a higher concentration, some of the sanitizer can break down while still maintaining a necessary concentration for sanitizing. For the acid-anionic sanitizer, rather than maintaining a specific concentration, a specific pH must be maintained to sanitize. The minimum concentrations for the four sanitizers are:

1. **Quats - 200 ppm**
2. **Acid-anionic - pH not more than 4.5**
3. **Chlorine - 50 ppm**
4. **Iodine - 12.5 ppm**

Chlorine is typically dosed at 100 to 200 ppm. Iodine is typically dosed at 25 ppm. All of these dosing concentrations are subject to the labeling requirements and the local health codes which vary from state to state.

SANITIZER TEST PAPER USAGE

Both after being prepared and at regular intervals while being used, sanitizer test papers are used to monitor sanitizer concentrations. Each chemical sanitizer has a

specific test paper that is to be used. The names of the test papers available from U S Chemical are:

Sanitizer Type	Test Paper Type	Immersion time
Quaternary	QT-10	10 seconds
Acid-Anionic	Short Range	10 seconds
Chlorine	Chlorine	Dip & Read
Iodine	Iodine	20 seconds

To use a test strip:

1. Remove a 1.5” strip of clean dry test paper from the container. Make sure the proper test paper is selected based on the sanitizer being tested.
2. Dip the strip of test paper in clean, fresh, room temperature (75°F) sanitizer solution for the proper amount of time (see chart above). If the sanitizer solution is not room temperature, take a sample of the sanitizer solution in a small container and allow to stand for several minutes until it has cooled to room temperature BEFORE testing.
3. Immediately compare the test paper to the color chart on the test paper container.

Note that testing sanitizer solution that is not at 75°F will produce erroneous results. If the sanitizer solution is 200 ppm, raising the temperature of the sanitizer solution 20°F will double the concentration shown on the test paper. To receive an accurate reading from a sanitizer test paper, it is critical that the temperature of the sanitizer solution being tested is 75°F.

QUATERNARY AMMONIUM COMPOUNDS, QUATS

Quaternary ammonium compounds, known in the industry as “quats,” have found use in food service for a variety of reasons. Consider the following:

Quaternary Ammonium Compounds—Advantages

1. Noncorrosive at use dilution
2. Handles organic matter better than any other sanitizer
3. Residual bacteriostatic effect (up to several hours)
4. Temperature stable
5. Mild, nonirritating to skin at use dilution
6. Nontoxic at use dilution
7. Odorless, excellent deodorizers
8. Can perform light duty cleaning
9. Can handle up to 30 grains per gallon (500 ppm) of water hardness

Quaternary Ammonium Compounds—Disadvantages

1. Foaming can be a problem
2. Easily neutralized by pot & pan detergent residues
3. When used in glass washing, can kill the foam head on beer
4. Has a high use concentration (200 ppm)

ACID-ANIONICS

Acid-anionic sanitizers are a combination of anionic surfactants (surfactants carrying a negative charge) that have antimicrobial properties and a strong acid, such as phosphoric acid. The pH control offered by the acids enhances the antimicrobial effectiveness of the surfactant. There is a synergistic effect of acids and certain anionic surfactants. This means that together they kill more germs than both do when used separately. The acid-anionic sanitizer manufactured by U S Chemical is a combination of phosphoric acid and an alkyl aryl sulfonate type anionic (negatively charged) surfactant.

Because of the acid in this type of sanitizer, these products are the most effective in hard water. Acid-anionics remain active in the presence of hard water of up to 60 grains hardness. Acidanionics kill fast against both gram positive and gram negative bacteria.

Acid-Anionics—Advantages

1. Fast kill times
2. Kills a wide spectrum of microorganisms
3. Noncorrosive to stainless steel
4. Nonstaining
5. Removes and controls hard water/lime buildups
6. Good detergency and rinsability in addition to sanitizing activity
7. Best hard water tolerance of any sanitizer
8. Mild to the hands
9. Odorless in solution—excellent for manual glasswashing

Acid-Anionics—Disadvantages

1. Effective at acid pH only
2. Generates foam
3. Somewhat expensive

CHLORINE

Chlorine is commercially available as liquid sodium hypochlorite (bleach, NaOCl) and dry chlorine bleach, which is the salt form of isocyanuric acid. Hypochlorites can cause corrosion and pitting of stainless steel and other metals. Because of this they are rarely used as overnight equipment sanitizers. Salts of isocyanuric acid (dry chlorine) are used in a similar way to sodium hypochlorite. They are also corro-

sive, but more stable in storage and use. Hypochlorites are effective sanitizers at a 50 ppm concentration. Hypochlorites are usually dosed at 100-200 ppm because of their unstable nature. Hypochlorites are effective only on clean surfaces for sanitization.

Chlorine based sanitizers are the most widely used because they are inexpensive and they have great killing power against a wide range of bacteria. Chlorine in an aqueous solution, even at very low concentrations, exhibits fast bactericidal action, but chlorine compounds have no residual effect on sanitized surfaces. Once a surface that has been sanitized with chlorine is dry, bacteria that contact the surface may reproduce. Iron, aluminum, copper, nickel or cobalt all affect the stability of chlorine and cause it to break down.

Hypochlorites—Advantages

1. Inexpensive
2. Fast germ kill
3. Kills a wide spectrum of microorganisms
4. Non-toxic at use dilution
5. Only sanitizer approved for use in low temperature dish machines, primarily because chlorine does not foam

Hypochlorites—Disadvantages

1. Inactivated by organic residues
2. Corrosive to skin and ware
3. Effectiveness decreases as pH increases (detergent residues)
4. Degrades rubber and some plastics
5. Unstable in storage, short shelf life, temperature unstable
6. Deactivated by iron and other metals in the water supply
7. Strong odor
8. Dissipates/breaks down quickly
9. React with acids (delimers) or ammonia producing hazardous vapors

IODINE

Iodine was discovered in 1812 by the French scientist Courtois. Its ability to kill microorganisms wasn't discovered until 1874. Iodine is most effective below a pH of 6.0, so sanitizing solutions of iodine are always acidic. Iodine is unstable, so when it was discovered that iodine could be reacted with certain surfactants to make iodophors, the door was opened for use as a sanitizer. Iodophors are stabilized with an acid, such as phosphoric acid. This aids in the control of hard water (limescale) buildups. Iodophors are used at

a pH of about 4.0– 5.0. Some tests have shown that 1 part available iodine is equivalent in “killing ability” to 3 to 6 parts available chlorine.

Iodophors have rapid germicidal activity in hard water and cold water. They are nontoxic at use dilution, nonirritating to skin, and have detergency in addition to germicidal activity. Solutions of iodophors of 10 ppm or above have an amber color. As the concentration falls, the color changes to yellow indicating that more sanitizer is needed. Iodophors are more expensive than chlorine, are corrosive to galvanized iron, aluminum and copper, stain some plastics, decompose to release iodine above 120°F, and form purple complexes with starches. Higher temperatures affect the effectiveness of the iodophors. At temperatures above 120°F, iodine will become volatile and come out of solution as a corrosive gas. Iodophors should never be used over 120°F for this reason.

Iodophors—Advantages

1. Long shelf life
2. Contains surfactant which aids in cleaning and rinsability
3. Good for cold water rinse bar glass sanitizers
4. Acidic nature prevents lime/hard water film formation
5. Less sensitive to organic matter than hypochlorites
6. Water hardness doesn't affect germ kill
7. Broad spectrum germicide
8. Noncorrosive to ware and hands
9. Nontoxic at use dilution
10. Visual indication of product presence

Iodophors—Disadvantages

1. Has an odor and foams
2. Cannot be used at temperatures above 120°F
3. Can stain surfaces and ware, especially in concentrated form
4. Effectiveness decreased with increasing pH, such as alkaline detergent carryover

SUMMARY

Control of disease caused by foodborne microorganisms is a topic in the news nearly every day. As discussed herein, the correct procedures for cleaning and sanitizing in the foodservice environment are critical to the protection of both workers and the dining public. If additional information on this topic is needed, please contact U S Chemical Training Department.