CLEANING: DO IT RIGHT OR ELSE!

USAID PROJECT NO. 263-0264

Agriculture-Led Export Businesses

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Dear Processor:

Proper cleaning of your food plant is recognized as being an essential element for assuring safe, wholesome and high quality food. It is, in fact, considered one of the basic prerequisites for HACCP. If you have not yet made a commitment to keeping your plant clean, please do so before you make the commitment to developing and implementing HACCP. The lack of a good cleaning program will compromise your efforts to properly implement program. In other words, look at cleaning like it is the leg of a table. If you remove that leg, the table will fall down. The same holds true with a HACCP program without prerequisites.

We have prepared this manual to provide you with a better understanding of the importance of cleaning and how it should be done. If you require any additional information or have any questions, please do not hesitate to contact us.

Good luck,

TECHNICAL SERVICES

CLEANING: DO IT RIGHT OR ELSE……

Richard F. Stier

INTRODUCTION

A prevailing theme in the programs offered by the Agricultural Led Export Business project has been HACCP and the prerequisite programs that all processors must (shall, not should) have in place before they go about developing and implementing a HACCP program. One of these programs is sanitation, which includes cleaning and sanitizing. Cleaning or cleaning up is one of those activities in which most of us were indoctrinated in as children. How many times were you told to "*Clean up you room*!" or "*Be sure you wash your hands before dinner*!" We were asked to pick up our rooms so they would look better, and your parents wouldn't stub a toe on a toy or something else if they came in. Washing your hands was to assure that you wouldn't contaminate food and maybe get sick. The same rationale sort of applies in a food plant. We clean and then sanitize to assure that foods and ingredients are not contaminated, which could cause illness or injury. Keeping your plant and grounds clean and well maintained eliminates harborage sites for pests, reduces the potential for contamination, minimizes the chances of injury (which can really cost you if you are found liable) and helps to create a pleasant work place. It also is good business. The first thing that a visitor to your facility sees is the grounds. If things are poorly maintained, that first impression can linger. If the visitor is a potential buyer, you may have lost a sale. If he or she is a regulator, they may just look at the plant a little closer.

We also clean because it is the law. In the United States, both USDA and FDA regulations mandate plants and process equipment be cleaned and sanitized. Agencies throughout the world have similar regulations or guidelines. The FDA regulations, for example, state that food contact surfaces not only be must be cleaned, but they must be manufactured from materials that allow them to be cleaned. For example, 21 CFR, part 110.40(a) states in part:

> *"All plant equipment and utensils shall be so designed and of such material and workmanship as to be adequately cleanable and shall be properly maintained".*

The Codex Alimentarius Basic Texts on Food Hygiene specifically address cleaning and sanitizing. In Section VI, 6.1.1 under Maintenance and Cleaning Codex says;

> *Cleaning should remove food residues and dirt that may be a source of contamination. The necessary cleaning methods ad materials will depend on the nature of the food business*."

The Codex guidelines form the basis for programs to assure that things are done the same way or are in harmony throughout the world. Since there are some 150 nations whose total population includes 97% of all people on the earth who belong to Codex Alimentarius, these guidelines indicate an international belief in the system. Adherence to Codex guidelines will become an essential element for doing business internationally.

The bottom line is that cleaning is an activity that is not only required in food regulations worldwide, but it is an activity that makes good business sense. It not only helps assure food safety, but it can help protect your investment. Equipment that is not cleaned may pit from accumulation of food soils and may even not operate correctly.

WHAT IS CLEANING?

The most important part of your sanitation program is cleaning. Most people talk about cleaning and sanitizing in one breath, but of the two cleaning is most important. Dennis Bogart of GW International defines cleaning as "*The removal of soil particles from surfaces by mechanical, manual or chemical means*." He emphasizes that cleaning prepares the surface for sanitizing. If the surface is not clean, it cannot be properly sanitized. If you fail to remove the soil, dirt or food particles, the surface is DIRTY……so focus on cleaning first.

There are five basic steps in wet cleaning and sanitizing, which will be the focus of this piece. These basic steps hold true for almost all types of soil and food processing systems. They are;

1) Flush or sweep the excess soil from the surface with water of an appropriate temperature
2) Use the appropriate cleaner and method to clean the surface. It may be necessary to scrub.
3) Flush the cleaner from the surface with water of an appropriate temperature
4) Apply the appropriate sanitizer
5) Rinse the sanitizer from the surface with clean water, if not using non-rinse sanitizers.

Bogart also emphasizes the first step, flushing or removal of excess soil, as the most important step in the process. Cleaners are not designed to deal with gross contamination, so you need to get rid of large pieces of food, dirt, and chunks, or in other words the visible soil, first and foremost.

We realize that many readers are bakers or snack producers and, therefore, operate in fairly dry environments. So, dry cleaning is what you do. When your raw materials or finished products include such materials as flours, grains, and other dry materials, moisture in the plant can create real problems. These

operations use brooms, brushes, shovels, and, most often, vacuums systems to remove waste and spillage. The vacuum systems that are used may be portable or there may be a central system. Some of the processors who were interviewed for this article discouraged the use of centralized vacuum systems, expressing a concern that such systems could become infested and create other problems. In dry processing operations, the greatest concerns are not microorganisms but insects and rodents. These kinds of products are too dry to support the growth of microorganisms, but they will attract other pests. An important concept is to keep dry plants dry. If water is used at any time during the cleanup, you need to wet clean the plant not dry clean it.

PRINCIPLES OF CLEANING

To properly clean a surface requires more than just flushing and the application of soap and water. Processors need to understand the type of soil that must be removed, the role of water and its chemical characteristics, the type of surface that one wishes to clean, how the cleaner will be applied and who will be doing the work. Understanding these basic issues allows a processor to make intelligent choices on the types of cleaners that can be used. Many processors simply do not have the necessary expertise to make these decisions. It is for this reason that food safety and sanitation professionals generally recommend that processors work with a ***competent and knowledgeable*** supplier of cleaning chemicals and supplies. Note that we have emphasized the words competent and knowledgeable. You are not doing yourself any favors if you buy from an operation that simply brokers these materials without a good support staff to back them up. They may not have the necessary expertise to assure that you get the right chemicals and supplies to do the job. The use of the wrong materials or their improper use may not only not do the job properly but may actually leave your operation dirtier than it was when your started. Let's look at these basics and how they affect the decision making process.

Type of Soil - In food processing operations, the type of soil is based on its major component. Programs will need to be organized to remove fats, proteins, carbohydrates, including sugars or mineral salts. These basic components of food will be affected by the kind of processing operation. For example, in deep-fat frying, the fats react with oxygen, other food stuffs and hot metal to form thermal or oxidative polymers. Removing these materials from a surface is more complex and requires more work and energy than simply removing oil. The type of cleaner that you select must be one that will be effective against the soil in question. What works in one situation will not work for all. This selection process will be addressed later.

Water - Water is almost a universal solvent. Flushing with water is the all important first step in removing visible soil. Cleaning compounds are used with water to enhance the cleaning ability of the water. Water carries detergents to the soil to be removed, it carries detergents and soils away from the surface and

it can be used to sanitize a surface; assuming it is hot enough or contains antimicrobial compounds or sanitizers. Before selecting a cleaning compound, processors need to understand basic water chemistry and microbiology. Water used for cleaning should be of good microbiological quality. The following guidelines were drawn from a publication developed by Ecolab, Inc.

SUGGESTED MICROBIOLOGICAL STANDARDS FOR WATER CLEANING/SANITIZING APPLICATIONS

Pathgenic Bacteria	None
Total Plate Count	< 500/mL
Coliforms	< 1/mL
Psychrotrophs	< 10/mL

The chemistry of the water, particularly water hardness, profoundly affects the performance of cleaning chemicals. Water hardness affects detergent consumption and may cause the formation of films, scale or precipitates on equipment surfaces. Failure to properly understand water chemistry can cost you money in both how much detergent is used and the time required for cleaning. Hardness is easy to measure, however, and is measured in grains or ppm. The following table defines water hardness.

HARDNESS CLASSIFICATION

CLASS	ppm	gpg*
Soft	0 - 60	0 - 3.5
Mod. Hard	60 -120	3.5 - 7.0
Hard	120 - 180	7.0 - 10.5
Very Hard	>180	> 10.5

gpg - Grains per Gallon 17.2 ppm $CaCO_3$ = 1 gpg

Type of Surface - Food contact surfaces must be manufactured from materials that are both easily cleanable and resistant to the product being manufactured. The metal of choice for food processing equipment that contacts food is stainless steel. Belts and conveyors may be made of teflon, plastics, rubber or other materials that are resistant and easy to clean. Operators need to understand what the other parts of the equipment are manufactured from, however. Aluminum, black iron and other metals pose special challenges. Aluminum is a soft metal and is attacked by both acids and improperly buffered alkalis. Black iron will rust, which creates a rough surface, and thereby, can create other problems. When working with a chemical supplier be sure that you let the vendor know exactly what he is being contracted to have cleaned. It is imperative that you be honest and open with your supplier. They cannot do their job if you are not. Remember, suppliers are your partners in business.

Application and By Whom - How the cleaner is applied and by whom is another issue that processors need to address. Food processors may clean throughout the work day, at the end of the day or they may do both. Most operators do some work during the work day (reducing gross soil), and conduct full-blown

cleaning and sanitizing operations after hours. Who do you get to do this work? We have already talked about the importance of cleaning in assuring safety and protecting your capital equipment. Why then do so many operators put their newest, worst or least trained people on the cleanup crew? Cleaning is too important to relegate to the dregs of your workforce. Be sure that your crew is properly trained, well paid and supplied with the tools and chemicals to do the job right. To create esprit d'corp, some operations "*have dubbed*" their cleaning crew as sanitation engineers. If the workers take pride in their job and work, there is a much better chance that they will do it properly.

There are different ways that the cleaning crew can deliver the cleaning compounds to the surfaces that they are seeking to clean. How they are applied again depends on the type of cleaner and the operation being cleaned. The more manual or hand cleaning that is required, the milder the compounds that are used and the lower the temperatures employed. Workers whose job is to scrub an oven by hand do not use the same strong alkali that would be used to "boil out" a fryer. One of the least enjoyable parts of hand cleaning is scrubbing, and one of the tools used by many for cleaning are "green scrubbing pads". The operator may not know it, but these green pads are very abrasive and will damage your equipment. Throw them out and invest in ***"white pads"*** or brushes. Cleaning should not damage your equipment.

Food plant workers around the world seem to be very fond of using high-pressure sprays for cleaning. Although these units seem to be effective, they must be used with care. They create aerosols, which can re-contaminate equipment, and may not adequately clean a surface. Due to misting and the creation of aerosols, high pressure systems must be limited to cleaners of intermediate pH and strength. In reality, an operator can generally be more effective cleaning using high volume, boosted pressure applications instead of high pressure systems.

Foam cleaning is an effective means for cleaning large surfaces. Operators must take care to follow the directions, however. If the foam is not allowed to remain on a surface for a long enough period, the surface will not be clean. Leaving the foam on too long will allow dirt that has gone into solution to redeposit on the surface creating a "*mess*" that is even harder to clean. Never let the foam dry on the surface.

There are pieces of equipment (and utensils) that cannot be cleaned where they are used. To properly clean and sanitize these units, a process called COP, or "Clean-Out-Of-Place" is employed. Cleaning knives or spoons that are used in a food plant in a dish washer would be considered a COP operation. In food plants, a common use of COP is for pieces of equipment that are complex and hard to clean. They are dissembled, rinsed and then cleaned and sanitized. COP may occur in a sink with a worker scrubbing to clean, or in tanks specially designed for COP. In these tanks, detergent and agitation are used to clean the

equipment in question. Sanitizing may be done using hot water or chemical sanitizers. Following the operation, the system or utensils are dried where they cannot be contaminated and reassembled prior to use.

The last type of cleaning system is known as Clean-in-Place or CIP. The advantage of CIP systems is that they are of little risk to the worker, if the system is properly maintained and operated. It is essential that the right cleaner be employed in CIP systems, however. Use of a high foam cleaner will create a huge problem for the processor. Advantages of CIP systems include lower labor costs for cleaning, minimized repair and maintenance to equipment, reuse of cleaning solutions, and effective cleaning of cracks and crevices. For any CIP system to be effective, flow through the system must be at a high enough volume to assure that the flow is turbulent, which means flow must be greater than five feet per second. To achieve this flow rate, operators need to understand their processing system. Turbulent flow may be achieved in a 1 ½ inch pipe at a flow rate of 24 gallons per minute, whereas a four inch pipe requires a flow rate of 180 gallons per minute. The same holds true for tanks, ovens or other large vessels. To calculate proper flow in a tank, take the circumference in feet times two. This will give you the minimum flow in gpm needed to clean the tank and have sufficient volumes of cleaner flowing down the sides of the tank for turbulent flow.

SELECTION OF A CLEANER

We now understand all the basic parameters for cleaning. The next step is to select a cleaner. Cleaners act on the dirt on surfaces in one of two ways; they interact with the material on a physical basis by changing the solubility characteristics or they react with the soils on a chemical level to form a substance that can be removed from the surface. Detergents or cleaners contain surfactants, builders, fillers and other additives.

Surfactants - Surfactants are compounds that are composed of two parts; water loving or hydrophilic and a fat-loving or hydrophobic parts. This means that the molecule has parts that are soluble in both oil and water. Surfactants reduce the interfacial or surface tension of water. By lowering the surface tension, they act as a wetting agent. The best example is that of oil or grease on one's hands. Running water over your hands does little to remove the oil, but when you use soap, the surfactant in the soap allows you to remove the oil.

Depending upon the type of surfactant, it can act as wetting agent, an emulsifier or help keep particles in suspension. There are four kinds of surfactant; anionic, cationic, nonionic and amphoteric. Anionic surfactants have a negative charge, are good wetting agents and tend to foam. Cationic surfactants have a positive charge, are poor wetting agents, poor emulsifiers and tend to foam. Nonionic cleaners have no charge and can be high or low foamers, depending upon the formulation. Amphoteric surfactants' charges will change depending if it is in an

acid or alkaline solution. They may foam or be very low foaming and are used in very special formulas cleaning difficult soils.

Builders - Builders are components that increase the cleaning action of a detergent. There are six kinds of builders; alkaline, acid, enzymes, water conditioners, food grade solvents and oxidizing agents. One of the compounds used as an oxidizing agent in detergents used for protein removal is sodium hypochlorite. This same compound is also used as a sanitizer. Because of the chemistry of chlorine, it has no sanitizer activity when used in a detergent, so do not be mislead by those who claim that their products will clean and sanitize in one step.

Fillers - Fillers are used in detergents to provide bulk and for ease of use or safety.

Other Additives - Detergent manufacturers will add other compounds to yield specific effects. In industrial operations, a common additive may be a corrosion inhibitor to protect “soft” metals such as aluminum.

So, now, let’s find something that will work in our plant. The type of soil that one wishes to remove is dependent upon the products being manufactured. In baking and snack operations, one could face a wide range of different cleaning issues. Although the focus thus far has been on food contact surfaces, cleaning programs should also include procedures for walls, floors, drains and even the trash containers. These programs must be conducted on a regular basis to assure that surfaces remain clean and sanitary. There is no need to create a situation which would encourage biofilm formation, which creates another and bigger headache. The two tables (Courtesy of GW International / Klenzade) demonstrate the comparative efficacy of alkaline and acid detergents. It can be used as a guideline to in selecting a detergent.

As an example, let’s assume that our factory manufactures fried pies and cinnamon buns. Pies would be filled with fruit mixes, chocolate and vanilla. Such a facility would have dough mixers, formers, fillers, cutters, blend tanks for fillers, pumps, a deep-fat fryer and some hand utensils, plus belts and conveyors. The factory is located in an area of the country where the water has twenty (20) grains of hardness per gallon. The factory does not have a system to soften water so any cleaners that are used must have a softener built in. The tanks where the fillers are blended and the lines to the pie filler are designed to be cleaned-in-place.

Tanks and Lines - These are designed to be cleaned in place. The first step will be to use water to remove excess product. Since the fruit fillings are high in sugar and contain very little fat, the water will flush much of the materials away. For actual cleaning, a detergent with a “softener” or sequestering agent must be used. Because there are two basic types of fillings, one with fat and one that is

predominantly sugar, two cleaners should be used. Due to the hardness of the water, and acid cleaning or rinse should be used on a regular schedule to assure that there is no buildup of scale.

Dough Mixers - The dough contains flour, fat, salt, sugar and some other ingredients. The systems will need to be flushed and then cleaned with an appropriate detergent containing an emulsifier to assure that the fat will be properly removed.

Belts and Conveyors - These units have large surface areas. This is the type of application where a foam cleaner will work well. The foam will need to be applied and rinsed at intervals established by the supplier.

Fryer - The first step in cleaning a fryer is to drain the systems and flush with water. Even though many systems are equipped with filters or some type of system to remove particles, there will still be pieces of food in the vat. The unit is then filled with water and a strong caustic. The fryer is then turned on and the unit "boiled out". If the operator has maintained oil quality, the unit will (hopefully) not have too much polymer buildup. If this is the case, that may require hand scrubbing with "white pads". After the boil-out, the caustic solution will need to be neutralized and properly disposed of. The next step is usually a rinse with a mild acid solution, followed by a water rinse. Be sure that the fryer is allowed to drain after cleaning. If water is allowed to remain in the lines or in the fryer itself, the new oil may not be damaged by the remaining water, but the introduction of water into the fryer after it is running can result in an explosion.

Utensils - The best way to clean utensils is to designate a sink as the clean-up area. Rinse the utensils and fill with hot water and detergent. Have workers with gloves scrub the utensils to assure that they are clean. Rinse and either dip in sanitizer or place the washed utensils in boiling water for ten minutes. Be sure that there is a space where they can both dry and be protected against contamination. You could also install a special tank for doing COP as described earlier.

Drains - Drains should be flushed with water on a daily basis. They should also be cleaned and sanitized at least once a week. A heavy duty detergent with strong grease-cutting abilities should be used.

SUMMARY

Cleaning is one of the basic prerequisites for food safety and, therefore, a HACCP program. Food processors must properly clean their equipment before they can sanitize. An improperly cleaned surface cannot be sanitized. Of all the cleaning steps, the most important is the pre-rinse or flushing. The gross soil must be removed prior to delivery of the cleaner. Cleaners are simply not designed to handle heavy, visible soil. Selection of cleaners should be placed in

the hands of experts, which is why food safety professionals recommend that processors work with competent suppliers of chemical suppliers who provide not only the chemicals, but support their products. Once a cleaning regimen has been established, follow the program to the letter. Cleaners are designed within certain set parameters. If the process is too short, the surface will not be clean. If the process is too long, the surface will not be clean. This is especially true with foam cleaners. Leaving them on a surface longer than recommended will result in soil re-depositing on the surface, which will creates an even worse problem. The bottom line is:

If a surface is not clean it will be dirty and you cannot sanitize a dirty surface!

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ALKALINE DETERGENTS

Comparative Ability

A – Excellent
G – Good
C – No Ability
D – Negative Performance

	INGREDIENTS	SAPONIFICATION	EMULSIFICATION	PROTEIN CONTROL	PENETRATIOn	SUSPENSIoN	WATER CONDITIONING	RINSEABILITY	FOAM	NON CORROSIVE	NON IRRITATING
Basic Alkalis	Caustic	A	C	B	C	C	D	D	C	D	DD
	Silicates	B	B	C	C	B	D	D	C	B	D
	Carbonates	C	C	C	C	C	D	C	C	C	C
	Tri-Sodium Phosphate	C	B	C	C	C	C	C	C	C	D
Complex Phosphates	Tri-Sodium Phosphate	C	B	C	C	B	A	A	C	A	A
	Sodium TriPoly Phosphate	C	A	C	C	A	AA	A	C	A	A
	Sodium Polyphosphate	C	A	C	C	A	AAA	A	C	A	A
	Gluconates	C	C	C	C	C	B	C	C	A	A
Organic Materials	EDTA	C	C	C	C	C	AA	C	C	A	A
	Phosphates	C	C	C	C	C	AA	A	C	A	A
	Polymers	C	B	C	C	A	A	B	C	A	A
	Wetting Agents	C	AA	C	AA	A	C	AA	A	A	A
	Chlorine Source	C	C	A	C	c	C	C	C	B	B

ACID DETERGENTS

Comparative Ability

A – Excellent
G – Good
C – No Ability
D – Negative Performance

INGREDIENTS	MINERAL/SCALE REMOVAL	EMULSIFICATION	PENETRATION	SUSPENSION	RINSEABILITY	FOAM	NONCORROSIVE TO SS	NON CORROSIVE SOFT METALS	NON IRRITATING	PASSIVATION
Mineral Acids	AA	C	C	C	C	C	DD	DDD	DD	DD
	AA	C	C	C	C	C	DD	DDD	DD	DD
	A	C	C	C	C	C	B	D	B	B
	A	C	C	C	C	C	A	DDD	D	AA
	A	C	C	C	C	C	A	DD	C	A
Organic Acids	A	C	C	C	C	C	A	D	B	A
	B	C	C	C	C	C	A	D	A	B
	B	C	C	C	C	C	A	D	A	B
	B	A	A	A	A	A	A		A	C