Sanitation for Cereal Product Processing Plants Begins with a Plan

- Effective sanitation programs are critical for food product safety, protecting the health of consumers and businesses alike.
- Sources of contamination in cereal food production include physical, chemical, and microbial, as well as cross-contamination.
- A variety of wet and dry cleaning methods are reviewed.

J. Dirksen
Ecolab
St. Paul, MN, U.S.A.

Effective sanitation programs are critical for food product safety. Establishing a proper sanitation program is both required by law and a good business practice to help protect the health and safety of consumers.

As defined by the World Health Organization (WHO), sanitation includes "all precautions and measures which are necessary in production, processing, storage and distribution, in order to assure an unobjectionable, sound and palatable product which is suited for human consumption." Major regulations include the U.S. Food and Drug Administration's (FDA) Good Manufacturing Practices (GMPs) (1), which requires production of foods that are safe and suitable for human consumption and that have been processed, packaged, stored, and distributed under sanitary conditions. While sanitation programs help ensure that food manufacturers produce foods and beverages that are safe to eat and drink, they must also address the safety of the employees who work with the products manufactured and the environment in which sanitation products are discharged.

doi:10.1094/CFW-56-4-0148

It seems intuitive that companies would want their products to meet and maintain standards for quality and consistency because products are an expression of a brand and the positive aspects it represents. Recent industry research into consumer behaviors and preferences supports this, finding that survey respondents were willing to pay a premium of 12% for safe foods (2).

Substandard sanitation can harm a manufacturer's reputation by resulting in product recalls, lawsuits, fines, and, in some cases, business closings. Protecting the health and safety of consumers by ensuring quality products helps protect the health of a company's reputation and business as well.

An Effective Sanitation Program Starts with a Sanitation Plan

To prevent contamination at all critical points, processors must start with a plan that addresses where and how contamination in the manufacturing environment could occur, how frequently and in what manner equipment should be cleaned, what processes employees must follow to prevent contamination, and documentation that these processes are in place and being followed.

Just as in other types of food processing environments, manufacturers in cereal production must have processes in place to prevent contamination from a variety of sources, including those not readily visible. In cereal processing plants, contaminants may be physical, chemical, or microbial. Physical contaminants can include pieces of plastic or metal that enter the food product during processing or airborne particles such as dust or soot. Chemical contamination can occur from cleaning chemical residues, pest control products, greases and lubricants used for equipment maintenance, and other sources. Sources of microbial contamination include raw materials, the environment, plant personnel, and water.

Although having a plan in place can help ensure food safety, a sanitation plan only works if it is followed. To ensure this occurs, the plan must be endorsed, prioritized, and clearly communicated by plant management. All plant operators must understand the importance of the program's goal and the practical impact of the program in ensuring food safety.

A sanitation plan has several key elements, which include

- **Sanitary Design**—Processing equipment and environmental surfaces (floors, walls, and ceilings) must be designed for effective cleaning.
- **Standard Sanitation Operating Procedures (SSOPs)**—The SSOPs describe the sanitation program for each piece of equipment. They include safety information such as appropriate PPE (personal protection equipment) and describe the specific sanitation chemicals to be used for each application, including concentration, application time, and rinsing requirements. SSOPs should be developed jointly by the food manufacturer and sanitation chemical vendor to assure that the information and procedures are appropriate and specific to the equipment.
- **Master Sanitation Schedule**—A master sanitation schedule describes the frequency of cleaning for each piece of processing equipment and provides a guide for required products and procedures to assist with planning for equipment downtime for cleaning.
- **Employee Training**—Timely and thorough training of plant employees is critical to a successful sanitation program. Training should include why to clean as well as what, when, and how to clean. It must also address safety in chemical handling, understanding of the chemical MSDS (material safety data sheet), appropriate dispensing and application equipment, and a basic understanding of the different chemicals used as part of the sanitation program.

- **Monitoring Sanitation Results**—Cleaning and sanitizing must be consistently monitored for effectiveness. In many cases, visual observation is the simplest and most effective way to determine whether any residues are present after cleaning. However, visual observation cannot verify whether a surface is contaminated with microbes or chemical residue. To check for microbial contamination, ATP (adenosine triphosphate) swab testing provides immediate results on the cleanliness of a surface. Micro-swabs can also be used to identify particular microorganisms on the surface.
- **Documentation**—Sanitation records both provide the required documentation for regulatory inspection and can serve as a valuable troubleshooting guide when investigating quality issues.

Having a sanitation plan in place provides the framework for how to maintain cleanliness and prevent contamination. Below are some recommendations that will help you understand the sources of potential contamination and their impacts, as well as soils specific to cereal processing and effective methods for cleaning them.

Soils from Cereal Grain Processing

Cereal grain product soils include varying amounts of protein, oils (or fats), carbohydrates, and minerals. Depending on the type of cereal and product to be processed, the ratio of these different soil types will vary; therefore, the sanitation program must be designed to suit the specific environment.

In general, fats and oils are cleaned with alkaline or caustic products, while proteins are effectively cleaned with alkali and an oxidizing agent. Frequently, the oxidizer is chlorine, although various peroxide-based products can also be used.

Carbohydrates can be more complicated to clean because they include a variety of materials, such as sugars, starches, and gums. Simple sugars can be cleaned with hot water and alkali, but complex starches and gums frequently require stronger cleaning solutions. Minerals typically are removed with acid detergents.

Microbial Contamination

Many different types of microorganisms can contaminate food products, but those most specific to cereals include bacteria, yeasts, and molds. Pathogenic organisms can cause illness or, in the worst case, can be fatal. Spoilage organisms can also cause off-flavors or off-odors and can shorten the shelf life of foods.

Microbial contaminants can enter the plant from a variety of sources, but most commonly are introduced through the water supply, drains, air, personnel, and raw materials. Because microorganisms have the ability to form biofilm (a buildup of microorganisms on a substrate that can attract other inert or food-related particulates) on surfaces, they are difficult to remove and may require special cleaning regimens.

Allergens

Another primary cause of food recalls each year is the presence or suspected presence of allergens in products that should not contain and are not labeled as containing an allergenic ingredient. Food allergens are specific components of foods that can induce adverse allergic reactions involving the body's immune system in those people sensitive to the allergen. These incidents are generally due to possible cross-contamination of allergens as a result of product residue from a food containing an allergen (e.g., a product containing peanuts) coming in contact with a food that should not contain an allergen (e.g., a product that does not contain peanuts), which can occur if the same processing line is used for both types of foods.

Food allergens are all proteins, and surprisingly, just eight major foods account for 90% of all severe allergic reactions suffered by humans. One of these eight foods is wheat and wheat by-products.

Allergen cross-contamination can occur when product contact surfaces and non-product contact surfaces are not cleaned correctly. Dry cleaning in particular poses challenges for complete allergen removal, but there are cleaning programs that remove all protein residues and prevent allergen contamination.

After cleaning, visual inspection and ATP bioluminescence-based monitoring programs can help verify that equipment has been effectively cleaned. Specific ATP systems have sufficient sensitivity to record trace levels of soil, providing confidence that the soil and related allergens have been removed.

Dry Versus Wet Cleaning

Because of the dry nature of the ingredients being processed, some areas of cereal food processing plants require dry cleaning, while others require wet cleaning. The decision to use one method or the other frequently depends on the type of processing involved; the basic rule is if the environment is dry, keep it dry.

The purpose of dry cleaning instead of wet cleaning is to minimize humidity or moisture that could cause growth of microorganisms in the area. If wet cleaning is used in a dry processing area of the plant, any excess moisture should be removed as quickly as possible using a squeegee and/or vacuum to clean the floor drain.

For dry production, determine which areas should remain dry and which areas will have wet activities. Next, isolate dry areas to limit employee movement and dedicate employees, tools, parts, and forklifts for those areas. Finally, identify traffic patterns in and out of each line to determine how supplies are moved and isolate each so that routes are established for dry and wet ingredients. The recommended steps for dry cleaning include the following:

- Sweep or wipe gross soils off equipment and floors. Pick up gross soil and remove.
- Remove trash containers from the area.
- Remove tools or unused equipment from the area.
- Check and clean drip pans and drain lines from air conditioners or dehumidifiers.
- Monitor and investigate all water use, and minimize or eliminate water ingress into dry areas wherever possible.
- Inspect and replace air filters if necessary.
- Vacuum cracks and crevices in equipment, floors, and walls.
- Wipe food contact surfaces and the framework of equipment with EPA-registered, food contact-surface sanitizing wipes. Use sanitizing wipes on switches, seals, and related environmental surfaces.
- If dry floors cannot be maintained, use an EPA-registered, solid or powdered quaternary sanitizer to help reduce potential bacteria levels as directed by the product label. Clean and sanitize drains daily.

Wet Cleaning

Wet cleaning can include CIP (clean-in-place), COP (clean-out-of-place), foam, gel, or spray applications and manual cleaning using a choice of cleaning product and program depending on the type of cereal product being processed. The basic guideline for wet cleaning is to follow the "sanitation 4 × 4," which is described as follows:

- Four key components for successful cleaning include time + temperature + chemical action + mechanical action. This means that the application time, temperature, chemical concentration, and amount of mechanical force must be balanced to achieve a clean surface.

- Four key steps for successful cleaning include rinse + wash + rinse + sanitize. A prerinse is used to remove gross soil, followed by detergent cleaning, a rinse to remove detergent components, and, finally, sanitizing with an EPA-registered food contact-surface sanitizer.

CIP and COP Cleaning. Generally, caustic or chlorinated caustic detergent is used in CIP cleaning. The typical temperature for tank and line cleaning is 60°C (140°F), but depending on the type of soil, CIP temperatures may be as high as 80°C (176°F). If the food product or water supply has a high concentration of minerals, an acid rinse may be necessary to remove any residual scale.

COP cleaning typically involves the use of a soak tank to soak clean removable equipment or piping. Parts should be rinsed to remove gross soil prior to placement in the COP tank. An alkaline or chlorinated alkaline detergent typically is used in COP cleaning, and COP tanks can be designed with temperature control and pumping action to maintain mechanical action on the parts.

Foam and Spray Cleaning. Foam cleaning is an effective way to clean the exterior of equipment surfaces, as well as environmental surfaces such as floors and walls. Surfaces should first be rinsed with water to remove gross soils. Foam is applied using a foam hose and allowed to remain on the surfaces for 5–10 min. The surfaces are then rinsed with water. Food contact surfaces are sanitized with an EPA-registered food contact-surface sanitizer. Environmental surfaces such as floors and walls can be sanitized with a non-food contact sanitizer.

Personnel Hygiene

Last, but not least, is personnel hygiene, which helps prevent the spread of contaminants into the processing environment from the outside and also among different production areas. At the most basic level, employees must wash and sanitize their hands before entering production areas. Boots or shoes should be dry when entering dry processing or packaging areas. Boots should be scrubbed and sanitized with an EPA-registered sanitizer as directed by the product label at shift end and allowed to dry before the next shift or be scrubbed and dry before entering the processing area. Automated doorway sanitizing systems can help protect key traffic areas and reduce cross-contamination between different areas of a facility.

Conclusions

Cereal processing environments have a number of unique challenges that must be addressed to ensure that proper food and product safety procedures are followed. Although working with so many moving parts may seem overwhelming, starting with a basic sanitation plan can help break down the process into actionable parts. But remember—the most important part of having a sanitation plan is following it.

References

1. Food and Drug Administration. 21 CFR, Part 110: Current Good Manufacturing Practice in manufacturing, packing or holding human food. *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC, 2010.
2. Saulo, A. A., and Moskowitz, H. R. Uncovering the mind-sets of consumers towards food safety messages. *Food Qual. Prefer.* 22:422, 2011.

Joe Dirksen is the executive technical coordinator for Ecolab Inc., Food and Beverage Division. Dirksen has been associated with Ecolab for 31 years in a variety of technical, marketing, and sales positions, including product development chemist, international R&D manager, beverage marketing manager, and beverage corporate accounts. Dirksen has a B.A. degree in chemistry from St. John's University, Collegeville, MN, and an MBA degree from the University of St. Thomas, St. Paul, MN. Dirksen is a member of the International Society of Beverage Technologists (ISBT) and serves on the ISBT Board of Directors. He is a member of the Master Brewers Association of the Americas (MBAA) and regular presenter at the MBAA brewing and packaging courses. Dirksen also is a member of the American Society of Brewing Chemists (ASBC) and a Certified Food Safety Professional through the National Environmental Health Association. He has published numerous technical papers pertaining to sanitation for food and beverage production and has been awarded two patents pertaining to sanitation chemistry and applications. Dirksen can be reached at Joe.Dirksen@ecolab.com.