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Eliminating hygienic hazards

Smart planning and utilization of sanitary plant design principles can save processors time, money, embarrassment and even their businesses.

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A M King helped convert an existing 80,000-sq.ft. facility into a USDA-certified facility for the production of foods for the retail grocery industry. The food preparation area is cooled to 45°F utilizing a Freon refrigeration system. Source: A M King.

By now, say the name Blue Bell, and the first thought in most people's minds isn't ice cream. The company just went through one of the biggest recalls in recent times due to potential contamination from *Listeria monocytogenes*. According to the Centers for Disease Control and Prevention, 10 cases of Listeriosis related to this outbreak were confirmed in four states; three deaths were reported.

Listeria is a robust pathogen that can resist the damaging effects of processes such as drying and freezing. Typically, facilities employ aggressive sanitation programs to prevent it from contaminating the environment. However, it can be introduced into a plant in a number of ways, including ingredients and people coming into the building. Once in, Listeria can survive and thrive in a number of areas, some of which may not be accessible to sanitation crews, possibly making their actions futile.

"The best cleaning practices in the world cannot be expected to overcome design or infrastructure failings," states Bill Sokolowsky, business development manager for Burns & McDonnell Engineering Company. "Clean all you want, but an open wound lends itself to infection, unless constant cleaning is the regimen."

A well-developed sanitary design plan can make all the difference in the level of cleaning at a facility

A fast-curing, pure polyurea coating designed for food processing plants is a spray applied to any required thickness and shaped into the modified wall and ceiling design. Source: VersaFlex.

and could potentially help prevent pathogen contamination and outbreaks. The best plans require efficiently, effectively and consistently sanitizing the entire facility with the ultimate goal of eliminating potential cross-contamination and the harborage and proliferation of pests and microorganisms.

Zones of control

Increased governmental regulations for food and beverage processors, as well as more demanding consumers, are making food safety and the elimination of food contamination in plants perhaps more crucial than ever. The spotlight is on sanitation. "But, if a food or beverage plant doesn't follow a sanitary design strategy from the beginning, it can never be cleaned to a microbial level," says Joe Bove, vice president of design for Stellar.

During the design, construction or renovation of a food processing facility, a number of sanitary principles should be taken into consideration. Bove was part of the American Meat Institute's facility design task force, which developed 11 sanitary design principles to reduce food safety hazards:

- Distinct hygienic zones established in the facility
- Personnel and material flows controlled to reduce hazards
- Water accumulation controlled inside the facility
- Room temperature and humidity controlled
- Room airflow and room air-quality controlled
- Site elements to facilitate sanitary conditions
- Building envelope that facilitates sanitary conditions
- Interior spatial design to promote sanitation
- Building components and construction that facilitate sanitary conditions
- Utility systems designed to prevent contamination
- Sanitation integrated into facility design.

A number of these principles deal with one of the most important elements in designing a facility—control. Physically separating areas and processes, such as keeping raw products from those that are cooked, can minimize the risk of contamination. In addition, Randolph Wilson, director of process engineering for Gray Construction, suggests there should be a hygienic "separation between process and non-process areas to allow personnel to change from 'street clothing' to appropriate [work] clothing."

Stuart Jernigan, A M King director of preconstruction, agrees that one of the most common sources of cross-contamination is poor workforce and product flow design. However, other common sources are invisible: air quality and pressure.

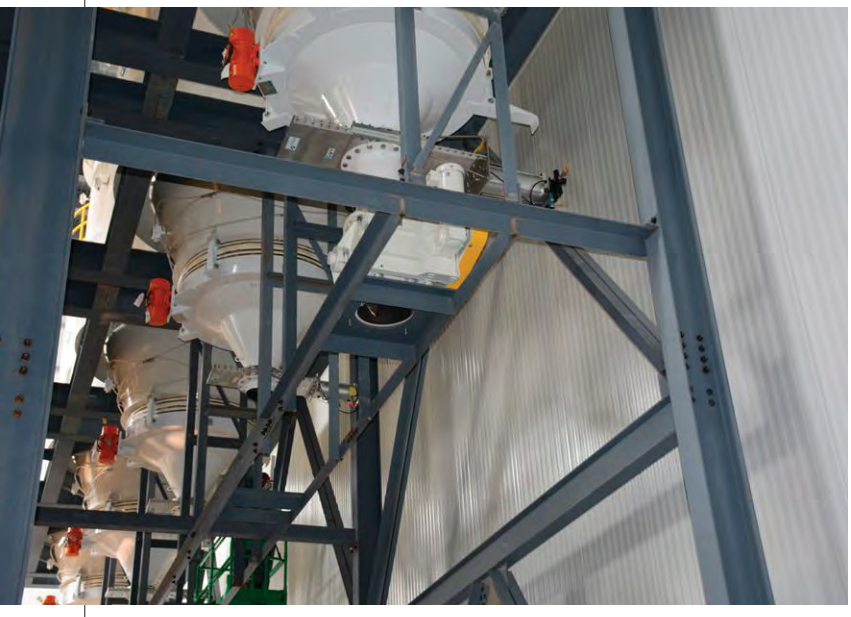
"Proper air quality and pressure imbalances between raw and ready-to-eat areas are critical to the prevention of airborne food contamination," Jernigan says. He adds that in ready-to-eat processing areas, air units with high-efficiency filters should be used. "Units utilizing variable frequency drives controlled by pressure sensors can help maintain the proper air pressures when doors are frequently opened and closed."

According to Wilson, proper airflow design should ensure that the highest environmental pressure in a facility is at the point where finished product production areas are positive to the adjacent areas. Conversely, the lowest pressure in a facility should be in the raw food storage and/or preparation areas.

Controlling temperature and moisture in processing areas is another key element of hygienically designed plants. Achieving the right temperature for the room's function and level of humidity can prevent bacteria harborage, says Bove. Additionally, mixing dry environments with wet processing can not only pose a microbiological risk, it also can make cleaning difficult.

Water management

Ironic as it seems, sometimes the greatest source of bacterial growth is one of the tools used for cleaning—water. Because wet processing facilities use so much water during production and in cleaning,



Mixed and ground dry ingredients are batched into one of six bins that feed the extrusion process at the new Champion Petfoods facility in Kentucky. Source: Gray Construction.

managing water accumulation is an important element of sanitary design.

In the PROCESS EXPO 2015 session, "Controlling *Listeria monocytogenes*: Sanitation and sanitary design in frozen food facilities," Kelly Stevens, quality manager for General Mills, pointed out the best places to look for Listeria, which include drains, leaks, water sources, COP areas, mops and buckets. She stressed that plant design must include properly sloped floors that angle down to the drain, which is placed at the lowest point, to eliminate water ponding. Also, according to Stevens, clean-in-place output should connect directly to a drain and not have to travel.

"Drainage is very important because standing water is a serious source of bacterial growth," says Doug Commette, director of marketing for VersaFlex, a supplier of polyurea coatings, liners and joint sealants. VersaFlex works with Fixxus Rehabilitation Systems to "reshape" areas in processing plants by filling in flat areas and converting right angles to sloped cove bases. "Eliminating all the angles, construction gaps and flat areas eliminates the places for water to stand and bacteria to hide that normal cleaning can't address."

The drains themselves should not be overlooked, warns Tyler B. Johnson, U.S. Water district manager, because "drains that are not cleanable put food at risk for contamination."

Greg Peterson, U.S. water district representative, notes that older food plants were not designed for post-production cleanup, and the combination of high-pressure water sprays and old drains can be a Listeria nightmare. "High-pressure sprays can aerosolize Listeria, *E. coli* and anything else on the floors and/or in drains and onto clean equipment."

Consequently, hygienic hose practices are important to bear in mind while designing a sanitary plant. Stevens says keeping hoses off the floor is crucial as hose nozzles can harbor microorganisms. The nozzles also should be tested often.

Additionally, controlling the temperature and moisture in areas can help prevent condensation, another potential contamination source. Controlling ice and frost in freezers is also important, since Listeria can survive the freezing process.

Building envelope and interior spatial design

One of the biggest threats to a sanitary food plant is a poor construction design. Moreover, a large percentage of food and beverage processing is done in aging facilities, further complicating sanitation efforts and creating additional microbial contamination potential.

"Whether it's poor design or an aging infrastructure in need of more frequent maintenance, food and beverage companies are at risk," says Commette. "Walls and ceilings are commonly made of steel and concrete and then painted or covered with a fiberglass or epoxy."

Plus, many of these plants contain right angles on steel I-beams, wall corners, wall-to-floor joints, flat areas, and gaps and cracks in construction. These areas can allow water, dirt and, potentially, bacteria to collect, because they are not easily accessible and, thus, not easily cleanable. Consequently, right angles should be made into cove-type junctions to reduce areas of collection and make them easier to clean.

Floors are an especially important consideration, since they are a common source of microorganisms, but don't forget the ceilings. "We need to look up," says General Mills' Stevens. "Look for harborage points, such as in gaps behind beams that can be hard to see and clean."

Equally as important to sanitary plant design is the condition of the surface above the ceiling—the roof. For example, bird populations must be controlled, because bird feces and nests on roofs can cause hygienic problems, especially if there are obstructions to drain flow on the roof.

"Common sense and industry practice have been to think of drainage as equipment and methodology for the floor," says Commette. "The greater challenge occurs when standing water is left elsewhere that normal drainage does not address, such as ceiling and roof structures, cracks in the walls or voids in the paint."

Sanitary design principles should be top of mind during the building of any new plant. "Ensuring food safety in a manufacturing process starts with careful consideration of sanitary details during the design process, the selection and specification of quality construction materials and attention to detail during construction," says Gray's Wilson. He advises that sanitary construction details should allow room for inspection and cleaning everywhere within processing areas. The design also should minimize horizontal surfaces to reduce the collection of contaminants and employ positive floor drainage to reduce ponding.

Designers working on a new site from scratch can take advantage of building information modeling (BIM) tools in 3-D formats that allow them to show processors hygienic interior elements, such as sanitary workflow, materials of construction and the best placement of equipment. "They also can use BIM data to determine how to best access equipment for cleaning, sanitation and maintenance," says Stellar's Bove.

Materials also should be carefully chosen according to the level of rigorous cleaning and aggressive detergents used. For example, since rust can be a significant issue in wet cleaning, most contractors advise using higher-grade stainless steel in these situations.

"Stainless steel resists cleaning chemicals and water," says Johnson. He adds that painted surfaces should be avoided, as they can chip and rust due to contact with high-caustic/chlorine combinations. In addition, he suggests using epoxy-coated and sealed floors, as well as plastic pallets for material transfer, instead of wood.

In recent years, suppliers have begun incorporating antimicrobial surfaces into or adding treatments to floors, walls or the equipment itself. For instance, antimicrobial resinous flooring systems have become common, especially in meat and produce facilities, says Jernigan. Additionally, new FDA-approved anti-stick coatings now are available to reduce the potential for raw materials to adhere to equipment surfaces.

"These [coatings] help improve pre- and post-operational performance by providing a better barrier against bacterial colonies and the formation of biofilms that are often resistant to chemicals and inferior sanitation practices," says Bove. (A biofilm is a group of microorganisms that stick to each other and attach to a surface, forming a layer that traps nutrients and can cause a significant threat to a facility's hygienic conditions.)

Upgrading plants

Many food and beverage processing plants are decades, or even a century or more, old. This can make it difficult for a processor to know when to give up the ghost and start fresh. Factors to consider include the cost to operate the plant, e.g., the amount

spent on sanitation and sanitation crews, as well as the price tag associated with a possible recall and loss of production, versus the cost of a new plant.

"Typically, when there are constant battles with pathogens, signs of corrosion and fatigue in steel members, recurring floor and wall maintenance issues and high energy and maintenance costs, it is time to review your current and future needs," says A M King's Jernigan.

According to General Mills' Stevens, if a processor can no longer produce safe food in a facility—no matter what actions have been taken—that is a good indication to start over. However, building new may not an option for some companies.

"Building a new plant to overcome the sanitation risks of an existing or older facility is a drastic measure," says Burns & McDonnell's Sokolowsky. "A more cost-effective approach may be to conduct an audit facilitated by a third party to identify and prioritize the risks. It is then a matter of assigning costs and schedules to systematically address and eliminate the issues."

Fortunately, many options are available for addressing facility hygiene issues. For instance, wall treatments, gap filling materials and resurfacing materials for a number of applications exist. As previously mentioned, Fixxus is one company that provides these types of solutions. Through structural rehabilitation, surface preparation, retrofit design modifications and the food-grade protective polyurea coating and topcoat provided by VersaFlex, the company provides essentially a liner to eliminate all existing chips, seams and gaps.

"Wall treatments are among the most popular [options]. However, they must be installed in a way so they do not create additional, less accessible voids," Sokolowsky says.

Even constructing new walls in an attempt to create separate production areas must be carefully considered. Stevens says she has seen walls constructed over existing drains, making an important feature in water accumulation control useless. "Sanitary design plus execution equals effective, efficient and sustainable sanitation," she says. ❖

For more information:

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