

WHITE PAPERS

FOOD PROCESSING: DESIGN-BUILD



INSURANCE REQUIREMENTS, WASTE PIPING, WASTEWATER TREATMENT AND SANITARY DESIGN

As design-build experts in the food processing industry, we're committed to implementing the industry's best practices in our projects. We also understand the importance of working closely with a plant's owners to fully understand their current and future needs and goals. This allows us to better control the budget and ensure the project moves along smoothly without any unexpected consequences. Here, we discuss many of the issues necessary to address in the planning stages of a new greenfield plant, expansion or renovation.

FOOD PROCESSING PLANT DESIGN AND FACTORY MUTUAL (FM) REQUIREMENTS: WHAT YOU NEED TO KNOW

As a food processing design-build firm, it's the first question we ask our clients—are you planning to insure through Factory Mutual Insurance Company (FM Global)? As the preferred insurer for most commercial and industrial projects, Factory Mutual has rigorous specifications and standards so it's important to address those requirements during the initial food processing design phase, whether you're planning new construction or an expansion.

FIVE KEY FM REQUIREMENTS THAT SHOULD BE ADDRESSED EARLY IN THE PLANNING PROCESS INCLUDE

1. **Structural** – the FM Research guidelines are more stringent than the building code requirements. The roof assembly should be FM approved and must be designed to withstand wind uplift pressures and roof snow load. Roof assembly, from the roof membrane to the insulation to the roof decking, should be securely fastened to meet the roof wind rating. Exterior insulated metal panel (IMP) walls should be FM approved materials and fastened to meet the wind design pressures.
2. **Refrigeration machine room** – if the facility contains ammonia or any hazardous combustible materials, the refrigeration room requires proper ventilation, ammonia detection and explosion venting. In the event of an explosion, venting allows hazardous fumes to escape properly without damaging other areas and equipment and putting employees at unnecessary risk.
3. **Fire protection** – in warehouses and storage areas, FM dictates the maximum height that product can be stacked depending on the type of product being stored in the facility.
4. **Compartmentalization** – especially in larger facilities, FM requires that a maximum foreseeable loss (MFL) fire wall be installed to separate facility rooms depending on their function and product. For example, production rooms must be separated by a MFL fire wall from rooms housing finished products. MFL fire walls must have four-hour fire resistance and adequate strength for lateral stability to limit damage and loss in case of fire.
5. **Electrical** – all electrical conduit should be intrinsically safe electrical within a fire-rated wall so air can't pass through from one side of the wall to another, especially if ammonia is present.

Overall, early communication is the key to meeting FM standards. It's critical to engage the local FM representative in the early planning stages to address all of these areas before any design or construction begins.

FOOD PROCESSING PLANT DESIGN: DESIGNING THE MOST EFFICIENT WASTE-PIPING SYSTEM

There are numerous factors to consider when designing a wastewater piping system for a food manufacturing plant. Where will drains be located? What types of piping materials will be used? Can the system be designed to accommodate future physical growth of the facility? Yet the most important factor of a waste-piping system is efficiency – efficiency in location, layout, materials and installation. Here's what you need to know:

- Use appropriate materials – the types of cleaning chemicals used and the temperature of water used for wash downs will drive which piping material you select. Polypropylene stands up best to harsh cleaning chemicals, but is not suitable for higher temperatures. Stainless steel holds up well to both high temperatures and chemicals, but is the most costly. Cast iron, though not the most chemically-resistant, is well-suited to high temperatures and is the most economical choice.
- Architects determine drainage locations – food processing plant architects are best equipped to determine proper drain locations based on equipment layout, floor slopes, and USDA guidelines with guidance from the mechanical engineers. Once they've determined the best location, mechanical engineers can lay out and size the piping system.
- Efficient layout – efficiency is really the key to a dependable waste-piping system. It's important to design the system using the most efficient routing possible, thereby minimizing the number of code-required vents. This translates into reduced labor and material costs and an overall lowered, installed cost.
- Consider barriers in the layout – the layout of the building, floor levels, and the location of the dock area, toilet areas, and process areas can create obstacles for designing an efficient system. The floor height and drainage needs of these areas must be taken into account in the initial design of the waste-piping system.
- Use sanitary drains – more plants are moving away from trough drains to round floor drains. Troughs can collect bacteria because of bends and corners. Round floor drains minimize the potential for bacteria harborage with a circular, seamless design
- Ensure proper venting – a proper venting system is crucial to allow air to replace water as it moves through the pipe to keep it flowing freely.

CONSIDERATIONS FOR ON-SITE WASTEWATER TREATMENT

Reducing the costs of wastewater treatment spent at an outside facility is leading many food processing plants to consider treating their wastewater on-site. In addition to treatment costs based on volume, municipalities typically impose a surcharge if the characteristics of the wastewater stream exceed the municipality's typical domestic strength. It becomes an ROI issue and fairly easy for plants to justify.

CONSIDERATIONS FOR TREATING WASTEWATER ON-SITE

1. The starting point for a plant considering treatment on-site is to gather as much data as possible with a clear understanding of flows relative to the municipal ordinance, contract and sewer use fees. A significant factor to consider is if there is co-mingling of sanitary waste with process waste. This will determine what treatment options may be viable for you. Realistic cost projections (capital and operating) are crucial to effective evaluation of various levels of treatment.
2. It's important to plan for flexibility and adaptability and build them into the initial design. If you're considering expanding the plant or changing your product mix in the future, the wastewater treatment system should be designed to fit those anticipated needs.
3. Consider reuse options. Wastewater is most often treated and reused for irrigation. It can also be treated and reused for refrigeration systems (i.e., condensers) or other non-potable uses.
4. Depending on the waste stream, sometimes it is viable to treat it anaerobically to yield a usable byproduct, such as methane. This can be used in a generator to create power or it can be piped back to the facility's boiler to generate steam for the plant. Plants that produce high-strength waste – beverage plants, juice plants, dairy production, meat packing – can treat wastewater to generate gas to run basic functions within the plant.

FLOORING IN FOOD PROCESSING PLANTS: ISSUES TO CONSIDER WHEN SELECTING A FLOORING SYSTEM

One of the most critical decisions made in food manufacturing facility design is what type of flooring to install in the facility. A flooring system in a food processing plant is essentially designed to do two things:

1. Protect the concrete surface to maintain the floor's structural integrity, allowing it to withstand heavy equipment usage.
2. Provide a sanitary environment for washdowns, forming a chemical-resistant barrier and protecting moisture from getting into the concrete, which can harbor bacteria.

HERE ARE SOME KEY QUESTIONS YOU SHOULD CONSIDER BEFORE SELECTING A FLOORING SYSTEM

1. What has been your past experience with flooring, materials and manufacturers? What are the flooring systems your industry is typically using? It's important to consider both good and bad experiences you've experienced with floor toppings and with specific manufacturers.
2. What are the specific uses of each room? Will the room require hot water washdowns? Is there a possibility for thermal shock in the room? For cold conditioned rooms, how low will the temperature get? What type of foot traffic is expected in the room? Is steam used for sanitation in the room? The answers to these questions will determine the specific flooring required to stand up to the conditions within each room.

3. What washdown chemicals will be used on each room's floor, but more important, what specific strengths of those chemicals do you use? Once you know the chemicals and strengths, it's critical that your design-build team speak with flooring manufacturers to determine how their product stands up to these chemicals.
4. Are you committed to performing regular maintenance on the flooring selected? Floors and floor joints need to be checked often for gouges, chips, flaking and cracks. These are all considered a breach in the flooring and require immediate repair.
5. What areas of the plant will be subject to foot traffic and must be treated for employee safety issues? An aggregate layer applied to most flooring will prevent slippage, but also can impact the ease of sanitation of the flooring system.

BEST PRACTICES FOR SANITARY DESIGN IN FOOD PROCESSING PLANTS

Over the years, the role of food plant architects has expanded greatly, requiring designers to become true experts in sanitary design. As a result, some best practices have emerged in the food processing design-build industry to ensure food safety and prevent problems, and added expenses, down the road.

In 2008, the American Meat Institute (AMI) formed a task force and set forth three broad principles of sanitary design, which have led to these six best practices in design-build for food processing plants.

ZONES OF CONTROL

1. The design and construction of any food processing facility should include a complete separation of production areas that house uncooked (raw) from cooked, ready-to-eat (RTE) products
2. Construction should also incorporate segregated welfare areas for employees who handle raw products from those who handle RTE products including locker rooms, cafeterias, and support areas.

TEMPERATURE AND MOISTURE CONTROL

3. Food processing plant design should begin with a clear understanding of each room's function to ensure sufficient room temperatures based on the intended use of the spaces
4. Installing reliable mechanical systems to control humidity within the plant is critical to eliminating potential food safety and bacteria harborage issues.

ABILITY TO CLEAN AND MAINTAIN THE FACILITY

5. Materials used in the construction of a food processing plant should be selected for both durability and cleanability, including the ability to resist harsh cleaning chemicals and temperature variations.
6. The design should include ample space above, around and under physical constraints, such as process equipment, with separate levels established for proper cleaning and maintenance of the building and the process equipment.

Stellar's team of process engineering experts have designed, specified and installed processing and packaging lines for many of the world's largest food companies.

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