FOOD-SAFE DRAINAGE FOR FOOD & BEVERAGE MANUFACTURING

DRAINAGE DESIGN CONSIDERATIONS FOR NEW AND RETROFIT FACILITIES

FOODSAFE DRAINS

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TABLE OF CONTENTS

INTRODUCTION

WHY DRAINAGE MATTERS

Adopting food safety best practices is important in all aspects of food and beverage manufacturing, and achieving the highest level of evidence-based food safety is imperative. Properly designed and selected drainage is a critical component to food plant infrastructure and requires as much consideration as any other piece of equipment on your production floor.

FOODBORNE PATHOGENS & DRAINAGE

The CDC estimates that Salmonella and Listeria are responsible for roughly 20,000 illnesses, and over 600 deaths in the United States every year. The last 20 years have seen several highly publicized outbreaks of foodborne illnesses. The majority of outbreaks can be traced back to food production facilities, and it is worth noting that it is very common for positive microbial tests in food and beverage manufacturing facilities to be found in drainage and the surrounding floor space.

Recently, a small food manufacturer was fined more than $275,000 for a “drainage failure”. The court heard that “poor drainage meant waste water from raw meat areas flowed back into the cooked meat production room,” contaminating production.

Furthermore, research published in ‘Applied and Environmental Biology’ states:

“Floor drains in food processing facilities are a particularly important niche for the persistence of listeria and can be a point of contamination in the processing plant environment and possibly in food products. Drainage is a critical component affecting the hygienic performance of food production. Effective drainage helps mitigate hazards from the external environment and is central to the safe and hygienic operation internally.” Applied and Environmental Biology, Volume 72.

A THOUGHTFUL APPROACH

Drainage has an integral role to play in food safety and therefore in public safety at large. Drainage cannot, however, be considered in isolation. It is, as the Hazard Analysis and Critical Control Points (HACCP) program states, essential that drainage, cleaning processes, and flooring are considered together, as they all directly impact each other's performance.

APPLYING BEST PRACTICES

Ultimately, the best outcome is achieved by thoroughly planning processes and consistent execution. This document was written to assist you in considering and adopting best practices pertaining to drainage and its specifications.

THIS DOCUMENT:

1. Gives expert advice on drainage specifications, key pointers regarding cleaning, and essential information regarding flooring specifications — all of which are based on the principles of HACCP and best practice recommendations.

2. Breaks down the potential risks associated with improperly designed drainage systems, as well as the 'Hidden Costs' that can be incurred through improper implementation.

3. Explains the five key design features to look for when specifying food-safe drainage for your facility, as well as features to consider when attempting to future-proof your build against a changing food production environment.

DRAINS AND ORGANIZATIONAL RISK

When planning facility infrastructure, whether a greenfield project or brownfield, it is important to consider both the short and long term costs associated. Failing to examine this or focusing on only one of these factors runs the risk of increased construction/installation difficulties in the short term, and increases a slew of potential long term costs that can negatively impact your bottom line.

SHORT-TERM COSTS

There are a variety of factors that can affect the upfront costs associated with choosing a drainage system for your production facility:

Product Purchase & Materials

The main initial cost that most people will consider when assessing any new equipment or infrastructure, is the price of the product itself. This cost can be affected by many different factors such as country of origin, product quality, and materials used. Although this is potentially one of the costs that gets focused on the most during initial evaluation, it often ends up as one of the least significant elements of the total cost of ownership when taken as a whole.

Installation

Depending on whether the project is a net new build or retrofit can greatly affect the total cost of a drainage product's installation. A brownfield project will require the demolition and removal of existing systems, or a channel to be cut into the concrete for the drain to be installed, if no pre-existing drain is present. Other factors can also play a part, such as the drain's ease of installation, along with the potential costs of any unique installation equipment.

Production Downtime

One of the largest hurdles for any kind of retrofit application is the concept of production downtime. The cost of reducing or shutting down production can carry a substantial cost, even for minimal periods of time. Add to this the potential cost associated with re-starting the production process, and it becomes vital that production shut-down is kept to a minimum.

LONG-TERM / HIDDEN COSTS

While the initial cost of a system is the usually the factor that determines whether or not it is chosen for a facility, it can short sighted to not consider the potentially much larger long term costs including:

Cleaning & Maintenance

Every day it is used, your drainage system incurs a cost to clean and maintain. This cost can take the form of actual materials used in its upkeep, or simply in the cost of labor and time that the cleaning process takes. A drainage system that is designed and manufactured in a way that supports quick and efficient cleaning can make the difference between a simple daily task for your team, and an expensive frustrating chore.

Drainage Durability & Failure

Although a basic consideration, the durability and longevity of your drainage system can affect more than just how soon it will need to be replaced. A structural failure of your drainage system puts your processes at risk, yes, but it also poses a potential threat to employee safety. Damaged drainage systems can be the cause of slips, trips, and falls, along with the potential for worker injuries and compensation claims. The best way to avoid this risk is to choose a properly designed and load rated system that fully meets the requirements of your production.

Contamination & Failed Audit

The largest potential risk to any facility is that of bacterial contamination. If caught by an inspector during an audit, this can result in fines, stopped production, or even facility closure. If the contamination goes undetected and tainted product is shipped, this could mean lawsuits and a loss of consumer trust. One of the most common places that bacterial threats are identified in production facilities is within the drainage system, so ensuring that you have a properly certified food safe drainage system can make all the difference.

HISTORY OF FOOD FACILITY DRAINAGE SYSTEMS

1960–1970

Concrete Drainage Era

In the 1960s, food and beverage plants used concrete drainage systems due to their rudimentary designs and little or no upfront costs. However, concrete drain systems were difficult to clean, posed risks to staff, machinery, and increased harbor points for bacteria.

Pain points:

- Heavy metal grates were difficult for plant personnel to move, which led to injuries.
- Concrete cracked due to weight, temperature changes, or chemical exposure.
- With cracking, concrete drainage harbored bacteria and was challenging to remove.
- The rough concrete surface trapped debris.

Concrete drains were a major drawback for food plants as the 1960s gave way to the 1970s and new regulations. In 1969, the United States Food and Drug Administration (FDA) began sanitation programs specifically for shellfish, as well as milk, and the food-service industry as a whole. And, in 1970, the United States Centers for Disease Control (CDC) began keeping records on foodborne illness-related deaths, which was the unofficial starting point for data on modern foodborne illness outbreaks.

With excessive crew cleaning times and a more significant emphasis on food safety, the industry began seeking more modern designs like manufactured sloped trench drains.

1970–1990

Manufactured Trench Drains

As advancements were made with plastic and metal fabrication, sloped trench drains were adopted in great numbers during the 1970s and 1980s. The smoother and non-porous properties of plastic and metal featured fewer harbor points for microbes.

Trench drains offered high-flow capacity due to wide channels, which is important with frequent washdowns or food processes generating high volumes of liquid byproducts. Moreover, higher volume capacity with trench designs reduced the risk of standing water and harbor points for bacteria and reduced slippery surfaces.

Most of all, maintenance crews had easier access to cleaning due to the open channel design, with a rounded body and steel construction. The drawbacks to trench drains included heavy grating during cleaning and damaged grating, which became a tripping or safety hazard for staff.

Floor drainage systems at food and beverage facilities have evolved, but companies didn't consider long-term costs early on, such as excessive cleaning time. Over the years, companies have faced challenges updating older facilities and have not updated their drainage systems. With this, food companies have not been able to reduce cleaning times and experienced production downtime due to older technology. However, more companies are employing a holistic approach to facility and production design, which includes drainage, cleaning processes, and flooring.

1990–2000

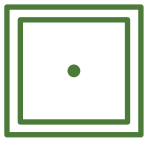
Area Drains

With the introduction of area or point drain designs, food operators achieved increased cleaning efficiencies and addressed food safety issues simultaneously. For food safety, long linear drains gave way to area drainage systems that channeled water away from food processing areas in a more concentrated way, which reduced harbor points for bacteria. The drains' rounded body and stainless steel construction continuously removed water and reduced standing water concerns.

Besides continuous draining, spot or area designs allowed drains to be strategically placed in specific areas and offered flexibility with facility design. Moreover, plant designers combined sloped concrete floors with area drains for a more cost-effective solution in larger facilities.

However, food producers also encountered design issues with sloping floors and durability. With multiple drains and sloped flooring, heavy forklifts and increased traffic, along with new machinery, added stress points and led to damaged flooring.

2000–2020



Slot Drains

As food safety requirements increased, slot drains offered a considerable step forward with material advantages, easier cleaning, and improved hygiene. The slot drain design led to a revolution in facility safety for food products, staff and the consumer all at once.

Slot drains made from food-grade stainless steel offered improved hygiene compared to other drains, due to no gaps or crevices for debris and bacteria to accumulate. Moreover, the smaller design delivered easier cleaning compared to larger traditional drain grates. The smooth channel allowed for unobstructed cleaning and reduced harboring of germs.

During this time, regulators increased scrutiny and new requirements for food safety, namely the Hazard Analysis Critical Control Point (HACCP) regulations. With HACCP, slot drains became a favorite in hygienically sensitive production areas, and continue to be the best drainage option for preventing bacterial threats.

HISTORY OF FOOD FACILITY DRAINAGE SYSTEMS

2020 – PRESENT

The Whole Facility Approach

With food construction building activity reaching new heights in the 2020s, facility managers and designers are evaluating how different drain technologies can be integrated into larger production facility designs. In this modern food facility era, drains, engineers, and designers need to identify specific use cases and requirements for each area of the facility. Once identified, designers can choose the best drain for the job based on those requirements.

Using this approach, companies can integrate both lower-cost approaches while also identifying the importance of food safety for new buildings and retrofits.

DRAINAGE DESIGN

ESSENTIAL SPECIFICATION CRITERIA

A properly specified drainage system will positively impact hygienic performance, food/ beverage safety, employee health and safety, and operational costs, making it vital to consider drainage during the initial stages of a plant build or retrofit. If considered as an afterthought, food and beverage producers risk having to rectify or repair drainage issues during later stages of the build or shortly after completion. This is not a quick, cheap, or easy process and involves the removal of production equipment and floors, resulting in a considerable disruption to the manufacturing process. This will inevitably have a significant impact on plant capacity.

When specifying drainage, there are three key areas to consider:

1. Is the drainage system fit for your process?
2. Is it designed to be food-safe?
3. Is the system easily cleanable?

IS THE DRAINAGE SYSTEM FIT FOR YOUR PROCESS?

There are five key areas to consider to ensure a drainage system is the proper option for your process:

1 **Area of Application**
- Safety requirement/risk level
- Factory and equipment layout
- Fluid type to be drained

2 **Drain Design**
- Manufactured to food-safe ANSI 3-A 14159-1, BS EN 1672, and BS EN ISO 14159 standards

3 **Cleaning protocols & wastewater capacity**
- Clean-in-place (CIP) considerations

4 **Installation & Cleaning**
- Floor/Drainage connection
- Thermal shock loads
- Chemical attack

5 **Maintenance requirements**
- Easy to inspect

AREA OF APPLICATION:

YOUR FACILITY & FOOD SAFETY

What type of drainage is required in low-, medium-, and high-risk areas? (refer to the table below)

WET MANUFACTURING PROCESSING / WET CLEANING

ENVIRONMENT	HIGH RISK	MEDIUM TO LOW RISK	LOW RISK
Wet manufacturing processing/ wet cleaning	• Design must adhere to food contact surfaces EN1672 and EN ISO 14159 standards • Ladder grating Sanitizing agents and cleaning protocol consideration • Anti-slip surface • CIP capability • High flow rates and wastewater • Load rating requirements • Equipment placement • Floor slope	• Design must adhere to food contact surfaces EN1672 and EN ISO 14159 standards • Ladder or mesh grating Sanitizing agents and cleaning protocol consideration • Anti-slip surface • CIP capability • High flow rates and wastewater • Load rating requirements • Equipment placement • Floor slope	• Ladder or mesh grating • Anti-slip surface • CIP capability • Medium/high flow rates • Load rating requirements • Equipment placement • Floor slope

DRY PROCESSING / WET CLEANING

ENVIRONMENT	HIGH RISK	MEDIUM TO LOW RISK	LOW RISK
Dry processing/ wet cleaning	• Design must adhere to food contact surfaces EN1672 and EN ISO 14159 standards • Ladder grating • Sanitizing agents and cleaning protocol must be considered • Medium-grade anti-slip surface • CIP capability • Medium flow rates and wastewater • Load rating requirements • Equipment placement • Floor slope	• Design must adhere to food contact surfaces EN1672 and EN ISO 14159 standards • Ladder grating • Sanitizing agents and cleaning protocol must be considered • Medium-grade anti-slip surface • CIP capability • Medium flow rates and wastewater • Load rating requirements • Equipment placement • Floor slope	• Ladder or mesh grating • Anti-slip surface • CIP capability • Medium/high flow rates • Load rating requirements • Equipment placement • Floor slope

AREA OF APPLICATION:

YOUR FACILITY & FOOD SAFETY

What type of drainage is required in low-, medium-, and high-risk areas? (refer to the table below)

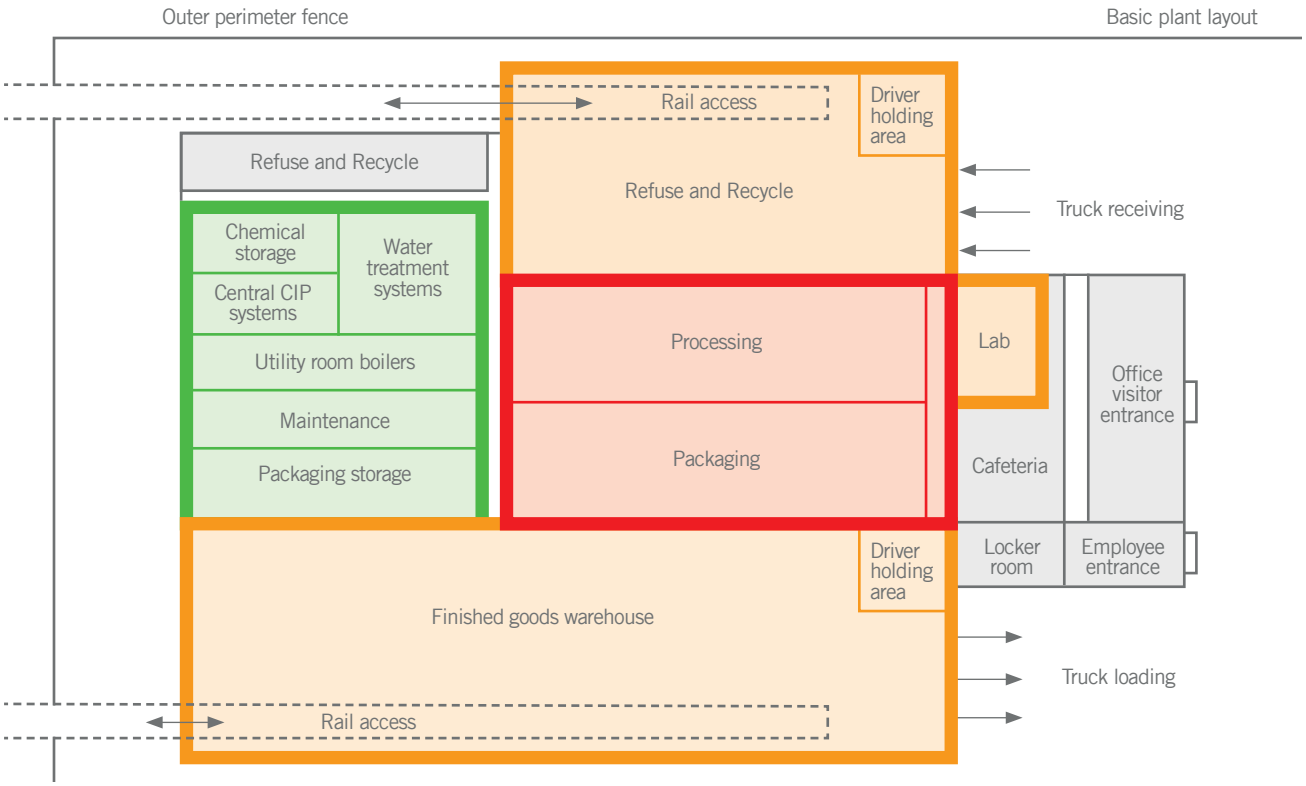
RECOMMENDED FOODSAFE DRAIN

ENVIRONMENT	HIGH RISK	MEDIUM TO LOW RISK	LOW RISK
Recommended FoodSafe Drain	• Slot Drain NSF Certified 10,000 or NSF 6,000 series • Area drains • Trench drain • All with CIP accessories	• Slot Drain NSF Certified 10,000 or other series • Area drains • Trench drain • CIP capabilities a consideration	• Slot Drain series • Anti-slip surface • Area drains • Trench drain • CIP capabilities a consideration

KEY SPECIFICATION CONSIDERATIONS

1. Is linear or point drainage more appropriate?
2. What falls are required in the floor?
3. What hydraulic capacity is required? Consider both sanitation flow and waste water flow.
4. Does your application require grade 304 or 316 steel drainage?
5. Is your choice of drainage and flooring future-proof?
6. Does the drainage system layout work in the context of the equipment being used?

TYPICAL FOOD PLANT LAYOUT



HIGH RISK
– Processing
– Packaging

MEDIUM RISK
– Warehouse
– Laboratory
– Waste and refuse

LOW RISK
– Shipping
– Storage
– Utility/maintenance

FACILITY USAGE & CHARACTERISTICS

FOOD RISK FOR BACTERIA

	LOW RISK	MEDIUM RISK	HIGHER RISK
FACILITY AREAS	• Storage • Maintenance • Utility • Shipping	• Warehouse • Laboratory • Waste and refuse rooms	• Processing rooms • Packaging rooms
CHARACTERISTICS	• Lower traffic • Infrequent wash-down • No equipment • Less concern for floor slopes • Lower concern for bacteria	• Medium traffic • Infrequent wash-down • Racking and equipment • Some concern for floor slopes • Lower concern for bacteria	• High traffic • Frequent wash-down • Equipment and forklift • A significant concern for floor slopes • Higher concern for bacteria

Manufacturing process flow

Water flow direction

As a rule, we recommend your drainage systems move waste, liquids, and solids away from your manufacturing process flow in the opposite direction.

IS YOUR DRAINAGE DESIGNED FOOD SAFE?

Drainage systems should be designed in accordance with best practices and should apply the standards reserved for food contact surfaces EN1672 and EN ISO 14159. FoodSafe Drains' drainage systems comply with both.

THE FOODSAFE WAY

Channels have completely drainable basins and slope within all areas

To optimize FoodSafe performance, drainage channels have completely drainable basins, with engineered positive slopes to prevent the build-up of stagnant water, odours, microbial growth, and potential chemical hazards.

Lap joints and welded butt joints have been eliminated

Lap joints can't be welded hygienically. When you weld a lap joint, you create a void, which will harbor bacteria. FoodSafe Drains are free of lap joints and welded butt joints.

All corners are rounded

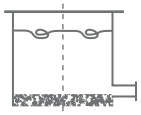
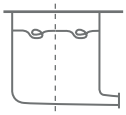
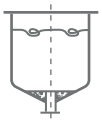
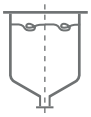
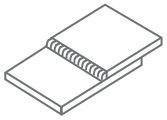
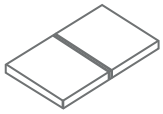
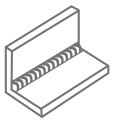
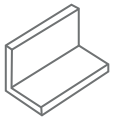
Sharp corners are harder to clean, particularly if they're situated at a right angle or bend in the drainage system. This can lead to bacterial build-up, compromising the food safety of your operation. To ensure every part of the drainage surface is easily accessible and meets best practice guidelines, FoodSafe Drains feature rounded corners with minimum radii of 3mm.

We weld on flat areas, not corners

FoodSafe Drains products are welded on a flat area to ensure that the weld is smooth, eliminating crevices that can harbor bacteria.

FoodSafe Drains steel drain products are passivated

Passivation is a chemical treatment process used to fully restore the all-important oxide layer that naturally occurs on stainless steel, which is destroyed on welded joints. Without this layer, stainless steel ceases to be corrosion-resistant, negatively affecting the product's lifespan and creating a safety hazard. Therefore, we ensure that all welded areas of your stainless steel drainage system receive passivation treatment.

AVOID	RECOMMEND
Hygiene risk according to BS EN 1672 and BS EN ISO 14159	Acceptable according to BS EN 16172 and BS EN ISO 14159
 No drainable design ✗	 Drainable design ✓
 No drainable design ✗	 Drainable design ✓
 Continuously welded lap joint ✗	 Continuously welded butt ✓
 Welded corners ✗	 Round internal corner ✓
 Welded in corners ✗	 Welded in smooth area ✓

CLEANING PROTOCOLS & DRAINAGE

Cleaning practices have an important impact on food safety, employee safety, and operational cost. Your cleaning protocol also needs to be carefully considered to ensure compatibility with your facility's drainage.

There are three key factors to consider when it comes to cleaning and drainage:

- How robust is your cleaning protocol?
- Are your cleaning products and equipment hygienically designed?
- Is your drainage designed to make cleaning a quick, easy, and effective process?

1 HOW ROBUST IS YOUR CLEANING PROTOCOL?

At the most basic level, and as part of your HACCP process, your protocol should state:

- What needs to be cleaned
- How frequently it must be cleaned
- How cleaning will physically be conducted (with what chemicals and what equipment)
- How you will measure cleanliness
  (e.g. by taking swabs from the drainage and conducting drainage performance audits)

When looking at how cleaning, flooring, and drainage interact, the types of chemicals used and their compatibility with your specified drainage must also be carefully considered in order to reduce the chance of damage and subsequent microbial growth.

2 ARE YOUR CLEANING PRODUCTS AND EQUIPMENT DESIGNED WITH FOOD SAFETY IN MIND?

- Cleaning equipment should be hygienically designed to minimize the risk of bacterial contamination and ensure compliance with relevant legislation.
- Council Directive 93/43/EEC (June 1993) on the hygiene of foodstuffs states that:
  - "All articles, fittings and equipment with which food comes into contact shall be kept clean and:

  (a) be so constructed, be of such materials and be kept in such good order, repair and condition as to minimize any risk of contamination of the food

  (b) with the exception of non-returnable containers and packaging, be so constructed, be of such materials and be kept in such good order, repair and condition as to enable them to be kept thoroughly cleaned and, where necessary, disinfected, sufficient for the purposes intended

3 IS YOUR DRAINAGE DESIGNED TO MAKE CLEANING QUICK, EASY, AND EFFECTIVE?

By making drainage easy to access and clean:

- Cleaning will be routinely completed (not ignored)
- Cleaning time and operational costs will be reduced
- Food safety risks will be reduced

As a material, stainless steel can be easily cleaned, but the cleanability of your stainless steel drainage system is entirely dependent on proper design. Adopting the design principle best practices already outlined in this document will help to ensure this.

For example, if drainage channels do not feature curved corners with radii of at least 3mm, it is impossible for cleaning brushes to reach every part of the drainage channel's surface and for corners to be cleaned. Having a flush connection between drainage sections ensures hot water wash-downs aid in removing unwanted debris within the drains.

FUTURE DRAINAGE DESIGN CONSIDERATIONS

As times and technologies change, so too must the infrastructure of our production facilities. In the same way that food processing has gone through a period of industrialization in the last century, we are now entering a new era of advancement: automation. Both in terms of AI and robotics, food processing is changing right now as an industry, and the infrastructure of your plant should take this into account, especially if you are looking to be future-proof.

Automated Workers

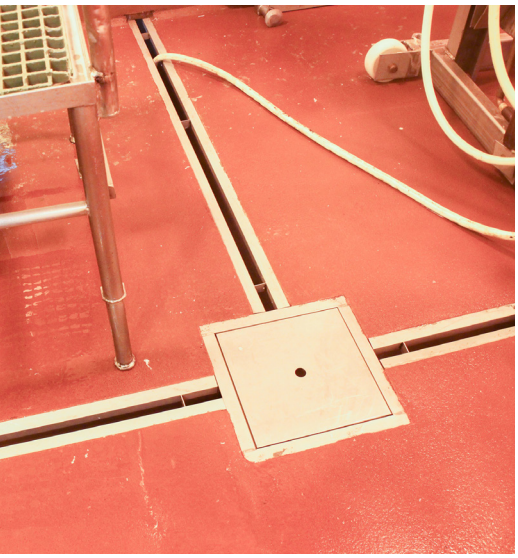
With robotics and automation continuing to develop, alongside the recent strides in AI technology, it is becoming more and more common to see machines taking the place of workers inside of food production facilities. These automated workers can be more efficient and precise than a human employee, but they come with a number of challenges and considerations as well. In regards to drainage and flooring design, the main accommodation that has to be considered is the machine's method of movement. Whether treads or wheels, your drains and floors must be compatible with your machinery, or there is potential for damage to your drainage, your automated workers, or both.

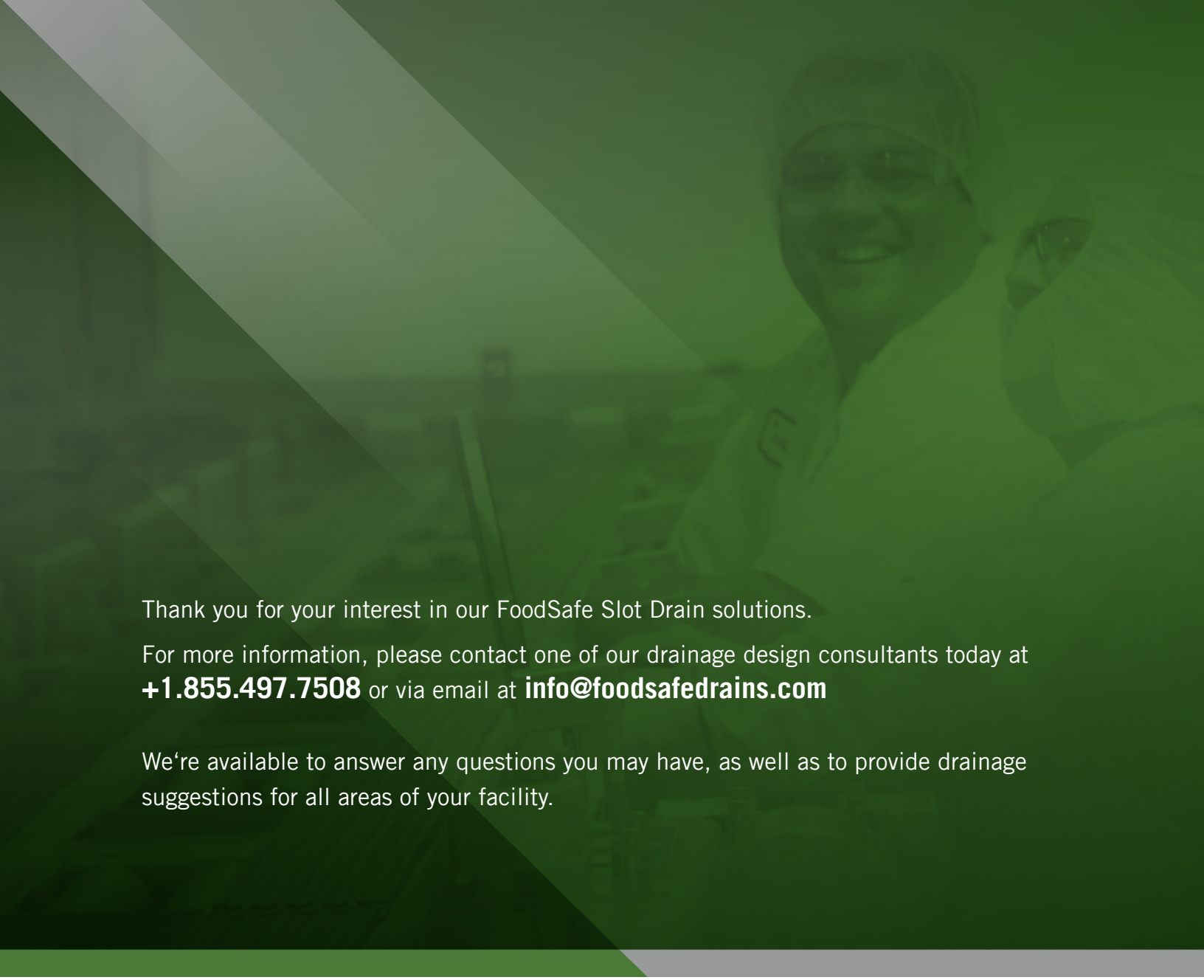
UV Cleaning

New ultraviolet technologies are changing what we had previously thought possible in terms of facility cleaning. Emerging tech would allow facility staff and sanitation workers to disinfect any surfaces in seconds, with a flash of UV rays. It's easy to imagine a device that is lowered into the drain which will be able to fully disinfect a system with ease. Considerations must be made for this however - the drain line will have to be made accessible for easy access, so this means no large machinery should be placed over the drain line, which might make drainage openings difficult to reach.

Vertical/Indoor Farming

It's not just food processing that is evolving, but the way we grow our food itself is seeing constant innovation as well. Advances in vertical farming and automation are seeing more and more of our produce growth moving to indoor facilities that can be more closely monitored and maintained. However, there are risks to these new processes, not least of which is bacterial contamination. Listeria and salmonella bacteria can grow extremely quickly in the presence of contaminated soil and standing water, so it is of vital importance that a sanitary designed, easy to clean drainage system is present in these facilities. Failing to integrate such a system risks contamination, recalls, and potential plant shut-down.





Thank you for your interest in our FoodSafe Slot Drain solutions.

For more information, please contact one of our drainage design consultants today at **+1.855.497.7508** or via email at **info@foodsafedrains.com**

We're available to answer any questions you may have, as well as to provide drainage suggestions for all areas of your facility.

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