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Food Safety:

What food processors need to know

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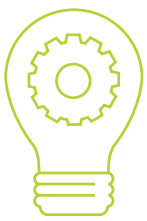

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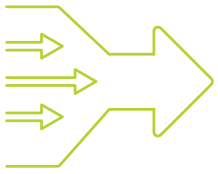


Simplification

“Food manufacturing and processing companies are under tremendous pressure. They must meet the high standards of consumers, retailers, and regulatory authorities in regards to productivity, safety, quality, and compliance. In order to fulfill these wide-ranging requirements, food manufacturers and processors depend on effective processing technology.”

Johannes von Stein, Vice President Sales Food

Dear readers,

As the world population grows and global living standards rise, the food industry is confronted with a number of challenges and opportunities. Expectations are higher than ever. Food products must not only taste good, but must also fulfil demanding requirements for safety, quality, and availability. In order to adequately meet these demands, food production is reliant on new technologies, automation, and digitalization.

Improved food safety is one of the crowning achievements of the modern food industry. Comprehensive quality management systems make it possible to uphold the strictest food safety standards at all times. Through risk analyses and systematic controls, food industry businesses take seriously their responsibility to ensure the safety and quality of their products.

Industrial food production also faces issues of resource scarcity. Sustainable management solutions will be key to the long-term economic success of food industry businesses. Losses in the production process involve costs and waste, presenting problems with both economic and ethical consequences.

Last but not least, the food industry is among the most regulated industries in the world. Manufacturers and processors must comply with a multitude of laws, rules, regulations, ordinances, and guidelines in order to produce and market foods in different regions.

This e-book is meant to offer a comprehensive overview of the varying and influential factors shaping the future of food manufacturing and processing.

We hope you find many valuable and interesting pieces of information inside.

The Sesotec Team

01. What is Food Safety?

Food safety refers to routines in the preparation, handling and storage of food meant to prevent foodborne illness and injury. From farm to factory to fork, food products may encounter any number of health hazards during their journey through the supply chain. Safe food handling practices and procedures are thus implemented at every stage of the food production life cycle in order to curb these risks and prevent harm to consumers.

As a scientific discipline, food safety draws from a wide range of academic fields, including chemistry, microbiology and engineering. These diverse schools of thought converge to ensure that food processing safety is carried out wherever food products are sourced, manufactured, prepared, stored, or sold. In this sense, food safety is a systemic approach to hygiene and accountability that concerns every aspect of the global food industry.

The following article defines food safety in manufacturing and explains the importance of food safety for the global food chain. Following a brief overview of the different regulatory bodies tasked with evaluating food safety around the world, the article outlines the key principles of effective food safety regulation, the history of food safety and the consequences of unsafe food handling practices and procedures for companies and consumers.

Food safety regulations in a globalised world

Food products are among the most-traded commodities in the world. As markets become increasingly globalised with each passing year, and as the world's population continues to grow, the global food supply chain will only continue to increase in scale and complexity. Precisely because of these megatrends influencing the mass production and distribution of food, food safety compliance has never been more important.

Every country has different regulatory bodies that preside over the definition and enforcement of domestic food safety standards. In order to sell or manufacture food products in any given country, domestic and international businesses alike are subject to the food safety legislation and enforcement measures of that nation. In the European Union, for example, food safety legislation is detailed in Regulation (EC) 852. In the United States, the Food Safety Modernization Act outlines the legal requirements for food safety.

Around the world, the majority of laws about food safety are based on two concepts: HACCP and GMP.

HACCP – Hazard Analysis and Critical Control Points is a systemic, risk-based approach to preventing the biological, chemical and physical contamination of food in production, packaging and distribution environments. The HACCP concept is designed to counter health hazards by identifying potential food safety problems before they happen, rather than inspect food products for hazards after the fact. The HACCP concept entails controlling for contaminants at a number of key junctures in the food production process and strict adherence to hygiene practices throughout.

GMP – Good Manufacturing Practices are internationally recognised quality assurance guidelines for the production of food, beverages, cosmetics, pharmaceuticals, dietary supplements and medical devices. These guidelines lay out the protocols which manufacturers must implement to assure that their products are consistently high-quality from batch to batch and safe for human use, including mandatory product inspection at critical control points.

There are also several privately-owned international organisations that provide comprehensive guidelines for auditing food manufacturers on the basis of food safety and hygiene. These international standards facilitate the global food trade by helping food industry players from different countries to ensure that food quality and safety standards are met in a way that transcends borders.

In addition to complying with the food safety laws of the countries in which they are active, global market leaders in the food industry often pursue certification with a number of private food regulators. They may furthermore demand that the upstream and downstream suppliers they work with provide proof of the same certifications.

Internationally recognised food safety organisations and certification programs include:

IFS Food 6.1 – The IFS Food Standard is part of the Global Food Safety Initiative and is an international standard for performing audits of food manufacturing processes. Their compliance audits concern both the factory floor and administrative duties, with regulations on topics ranging from the installation of food defence and inspection equipment to thorough bookkeeping.

BRCGS – The British Retail Consortium Global Standards (formerly BRC) are a set of international consumer protection certifications that provide safety criteria for global food retailers, food manufacturers, packaging manufacturers and food service organisations. Their certification for food manufacturers includes an assessment of the equipment used to detect and remove physical contaminants.

SQF – The Safe Quality Food Institute provides detailed safety programs tailored to the specific concerns of different food industry players. The various SQF codes are segmented to address the unique conditions of each stage of the food production life cycle, from agriculture to packaging, from manufacturing to retail. Each SQF program is internationally recognised.

Each of these private food safety organisations have built their certification programs around ISO 22000, an international norm for food safety management systems:

ISO 22000 – The International Organisation for Standardisation details a proactive management plan for food safety relevant for any organisation along the food supply chain. ISO 22000 includes an interactive communication strategy between upstream and downstream industry players and a comprehensive system for management. Furthermore, the norm encompasses a model for how to implement a customised HACCP concept depending on the industry, product and facilities. For instance, should a risk of metal contamination be identified, ISO 22000 may recommend the installation of a metal detector with a rejection mechanism to manage the hazard.

Who is responsible for enforcing food safety standards?

While the international regulatory bodies listed above provide guidance, certification and auditing services for global food manufacturers, they are not responsible for the active enforcement of food safety laws.

Every nation defines and establishes its own laws and enforcement practices for food safety regulation and these regulations may vary from country to country, and domestically from region to region. Bringing a food product to a foreign market requires compliance with the food safety and consumer protection laws of that nation and its regional governmental authorities.

Generally speaking, international food safety standards are designed to facilitate compliance with food safety laws in major markets, simplifying the process of receiving approval from foreign governmental regulators.

The history of food safety

Foodborne illness has threatened human health since the dawn of time. In fact, many food preparation methods we still use today, such as cooking, canning, smoking and fermentation, can be understood as primitive food safety measures, developed as a means of keeping people from getting sick.

Today, we benefit from centuries of scientific and technological progress that have made an abundance of safe food and drink products something that many of us take for granted. But the concept of food safety as we know it today, and the rigor with which it is enforced, is a relatively new development in human history that is intimately tied to changes in the way we live and eat.

In 1905, American author Upton Sinclair published his novel The Jungle, which featured horrific depictions of Chicago's meatpacking industry. The ensuing public outrage led the U.S. government to pass the Meat Inspection Act the following year, establishing the first sanitary standards for slaughtering and butchering. This law marked the first time that food processing facilities were subject to regular audits and inspections by governmental authorities and some of the very first laws for food safety in manufacturing.

Across Europe and North America, the industrial revolution ushered in the establishment of many regulatory bodies and foundational laws concerning food safety and inspection. As food production became increasingly mechanised and profit incentives climbed, laws were passed to prevent the intentional sale of food products that were misbranded, contaminated, or otherwise tampered with. It was during this era that ingredients and additives became subject to regulation.

In the decades following World War II, electric refrigerators entered middle class homes across Europe and North America, changing the way that everyday people purchased and stored food. The era of home refrigeration sparked the rapid expansion of industrial food production, as well as a growing need for stricter food regulations. It was in this changing food landscape that Mars Incorporated became the first major food manufacturer to install metal detectors in their facilities in 1947.

The shift from reactive to proactive food safety principles began when HACCP was born in 1959. Recognising that testing finished products was not an effective means of ensuring food quality and safety, scientists at NASA collaborated with the Pillsbury Company, an American manufacturer of baked goods and baking mixes, to create a risk-based system that identified “critical failure areas” in production that posed health risks. With Pillsbury leading the way, this system of hazard analysis and control was adopted by a number of leading food manufacturers in the United States.

By the mid-1980s, scientists around the world agreed that the proactive nature of HACCP provided a more effective means of controlling for food safety hazards than traditional inspection methods. The following decades saw the establishment of international regulatory bodies and third-party audit firms designed to implement and enforce preventative compliance in an increasingly globalised food industry. It is upon this groundwork that modern food safety regulations and practices are built.

The seven principles of a safe food supply chain

While HACCP lays out the steps necessary to proactively ensure food quality safety in individual food production environments, a healthy supply chain also demands action on a collective level. The European Union identifies seven overarching food safety principles necessary for the entire food supply chain to operate for the public good.

1. **Corporate responsibility** – Every company involved in the food supply chain is required to do their due diligence to ensure the quality and safety of a food product within the bounds of their responsibility. This includes implementing in-house controls according to HACCP. In addition, corporations assume liability for any damages their products may cause.

2. **Traceability** – All food business operators in the EU are responsible for documenting where their materials are sourced and where they are sent. This documentation helps regulatory bodies quickly identify the source of contamination should a recall become necessary.

3. **Official food controls** – Governmental authorities within the federal states are responsible for enforcing EU food law requirements through risk-oriented reviews, targeted sample collection and regular inspections.

4. **The precautionary principle** – Competent authorities are permitted to take precautionary measures if they believe the effect will minimise food safety risks. These precautionary measures will be reviewed on an ongoing basis as scientific data becomes available.

5. **Independent scientific risk assessment** – A governmental institution that operates independently of political, social and economic influences is responsible for scientifically investigating and assessing the risks that food products may pose to human health. In the EU, this institution is known as the European Food Safety Authority.

6. **Separation of risk assessment and risk management** – Due to possible conflicts of interest, a clear distinction is made between those responsible for scientific risk assessment and those responsible for risk management.

7. **Transparent risk communication** – The public must be promptly informed of imminent and potential food safety hazards. Circulating information about food safety problems is only possible if scientists, policymakers and food business operators communicate transparently.

The importance of food safety and the consequences of non-compliance

Food safety is highly important both financially and ethically. The consequences of failing to comply with food safety standards are manifold. In addition to being incredibly costly for companies who must recall their products, overhaul their processes and manage the public relations crisis, inadequate food safety in manufacturing carries a significant human cost.

The cost of food recalls for companies

Failing to implement an effective food safety protocol can lead to contaminated products entering the food chain. Once the defective product has been discovered, food businesses are subject to dramatic disruptions in their operations as they manage and assume the cost for product recalls.

Food recalls cost companies an average of $10 million USD in direct, immediately measurable costs alone. But the long-term effect that a product recall can have on consumer trust is perhaps even more costly. Some 21 percent of consumers say they would never again purchase anything from manufacturer who had to recall one of their food products.

The human cost of unsafe food

The importance of food safety to modern human life would be difficult to understate. Food safety problems are a leading cause of more than 200 preventable diseases worldwide. Each year, one in ten people will suffer from foodborne illness or injury. An estimated 420,000 people die every year as a result of eating contaminated food and more than a quarter of these victims are small children.

In addition to the immediate human cost, inadequate food safety comes with a greater ripple effect that impedes socioeconomic progress, especially in the developing world. The World Health Organisation states that food safety, nutrition and food security are inextricably linked. A lack of safe food creates a “vicious cycle of disease and malnutrition” which overburdens public health services, disrupts social and economic progress and detracts from the quality of life.

02. How the growing world population will shape the future of the food industry

Over the course of this century, the global food industry will face many unprecedented challenges, from climate change to geopolitical disruption. But one global megatrend in particular will have a tremendous impact on the global supply chains and production processes behind food manufacturing. With population growth projected to reach more than nine billion inhabitants, how must industrial food production adapt in order to feed the world of 2050? The food safety experts at Sesotec explain why automated technologies are necessary to keep food products safe and plentiful in a changing world.

In as little as three decades time, the United Nations estimates that 9.7 billion people will inhabit the planet. This rapid expansion of the global population will change many aspects of life around the world, particularly the ways we live, work, and eat.

The Food and Agricultural Organisation of the United Nations forecasts that worldwide food production will need to increase by at least 70 per cent in order to adequately feed the projected global population of 2050. A great challenge to achieving the industrial output necessary to feed 9.7 billion is the question of how to balance the shrinking availability of resources with heightened consumer expectations.

If food products are to remain safe, nutritious, affordable, and plentiful in the face of massive population growth, the global food industry must continue to adopt innovative solutions.

Food production and population growth: the past, present, and future

Over the course of the last century, the market for industrial food production has expanded alongside the growing world population and climbing global prosperity. As household incomes and standards of living have risen the world over, food manufacturers, aided by technological innovations, have been able to supply the rapidly increasing demand for a wide assortment of high-quality foods.

Huge strides in food manufacturing technology have made it possible to produce higher volumes of safe and nutritious food, even as the amount of land available for agricultural and industrial development has declined.

The sheer diversity of food products available today, as well as the 'round-the-clock nature of their availability, is unprecedented in human history. This is especially true in industrial nations. In Germany, for instance, the average customer can choose between more than 170,000 different food products each day (BVE, "Germany – Partner of the World 2018", pg. 28).

But with formidable demographic and environmental changes on the horizon, the present state of industrial food manufacturing will be insufficient to maintain current levels of diversity, quality, and availability in food products by 2050. Furthermore, rapid population growth will place tremendous stress on the natural resources needed for bountiful food production. In turn, the technology that has driven productivity growth in the food industry up until this point must continue to evolve and rise to these new challenges.

Increasing food production in the face of limited resources

In diverse sectors of the global food supply chain, automation is already helping to make great improvements in terms of efficiency and sustainability. From agriculture to processing to packaging, smart systems are processing huge volumes of data in real time in order to make better use of available resources and achieve ideal results.

Within the food manufacturing sector, ramping up output requires tightening controls on food safety and product quality. Automated inspection technology is making it possible to increase global food production without compromising on the safety or quality of food products. Computerised food inspection machines, ranging from optical sensors to metal detectors to x-rays, can be programmed with information about product characteristics and processing conditions in order to perform with incredible accuracy.

By implementing a sophisticated network of automated inspection equipment at key junctures in the production process, contaminants and defects can be identified and removed immediately and reliably. Automated inspection technology also makes it possible to detect contaminants early, thus reducing the food waste caused by product recalls and cross-contamination.

Population growth and heightened stakes for food safety

Globalised trade is only forecasted to increase alongside the world population. This means that any defective food products entering the market can have widespread and disastrous consequences for public health and corporate trust.

In the coming decades, food manufacturers will need to practise extreme diligence to ensure that their upstream and downstream partners are operating with integrity and complying with food safety protocol.

Robust inspection technology is key in this endeavour, as it can help manufacturers and international regulatory bodies trace contaminants directly to their source. In this way, advanced food safety equipment will have a crucial role to play in promoting transparency in the food industry and keeping the public informed about threats of contamination.

Consumer culture in a world of 9.7 billion

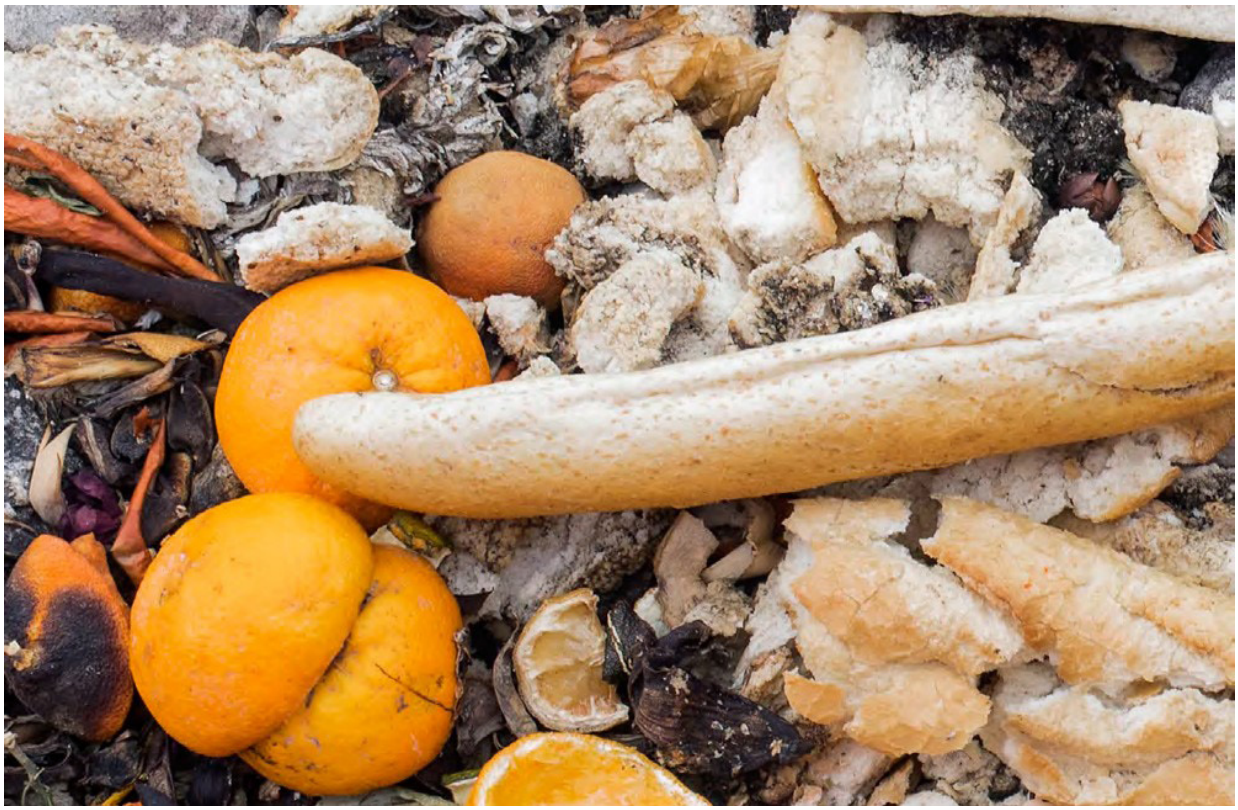
Technological advancements such as these are necessary in the pursuit to feed the world population of 2050. But beyond simply supplying the world with enough calories, food industry productivity will need to improve even further if products are to adequately address changing consumer expectations. The world of 2050 will not only be more multicultural than ever before, it will also be more concerned with issues of health, ethics, and sustainability.

Mass migration and demographic change are causing urban areas to grow and become increasingly diverse. As cities around the globe become more multi-ethnic with each passing year, new markets emerge alongside new challenges. In order to meet the needs of growing populations with varied dietary preferences and restrictions, food industry companies will need to tailor their manufacturing practices and expand their product portfolios to suit diverse tastes and religious affiliations, even in formerly homogenous markets.

Furthermore, living in a world populated with 9.7 billion others will inevitably lead to shifts in the way that everyday people think about resources, health, and the products they consume. Dramatic changes in consumer attitudes are already apparent and influencing the market in meaningful ways. A 2019 survey of consumers in Europe, Asia, and North America revealed that 49 and 37 per cent of those surveyed cited health and environmental impact, respectively, as major considerations when making purchases.

03. How better food safety technology can help minimise waste

Each year, nearly one trillion dollars' worth of food produced for human consumption goes uneaten. Of the tremendous amount of food wasted globally, roughly a fifth is wasted during processing and production. Industrial food manufacturers have both financial and ethical imperatives to reduce food waste within their facilities – but balancing these pursuits with rigorous food safety protocols proves to be challenging. Innovative food safety technologies can help to reduce pre-consumer food waste, boost profits and improve the overall quality and safety of industrial food products.



From farm to factory to fork, nearly 1.3 billion tons and 1 trillion USD worth of food products slip through the cracks of the global food supply chain each year. According to studies by the United Nations, roughly a third of all food products end up discarded, constituting a tremendous waste of natural resources, labour and capital, and amounting to a major source of needless greenhouse gas emissions.

In a supply chain that grows more intricate with each passing year, the problem of global food waste is not attributable to any single player in the food production life cycle alone. Food waste happens at every stage of food production and consumption, and the volume of waste differs dramatically by region. In industrial nations, the largest volume of food is wasted at the hands of end-consumers. In developing nations, however, the FAO cites a lack of infrastructure to facilitate coordination between farmers, manufacturers and distributors as the most significant source of food waste.

Share of Food Waste in Germany by Value Chain Sector - 2015 (Source: bmel.de pg. 4)

Stage in food production life cycle	Food wasted in million tons	Share of total food waste
Agriculture and primary production	1.36	12%
Food processing and manufacturing	2.17	18%
Distribution and marketplace	0.49	4%
Food service industry	1.69	14%
End-consumer	6.14	52%

In developed nations, nearly a fifth of food wastage happens during manufacturing and production. Beyond the environmental impact of food processing waste, there is a sizable financial incentive for manufacturers to reduce food waste within their facilities. In the face of narrowing profit margins and a rising pressure to ramp up productivity in order to feed a growing global population, reducing industrial food waste may be a necessity in order to remain competitive in a changing market.

Causes of food processing waste

There are many causes of industrial food waste, some of which are avoidable while others are virtually inevitable. In terms of preventable and recurring waste, inefficient working procedures and inadequate employee training are amongst the major drivers of wasted food in manufacturing environments. A study by researchers at Brunel University London and Ghent University found that roughly 11 per cent of all food processing waste was due to routine human errors. However irregular and monumental product losses can also occur in the face of unforeseen power outages, natural disasters or unplanned downtime due to equipment failure.

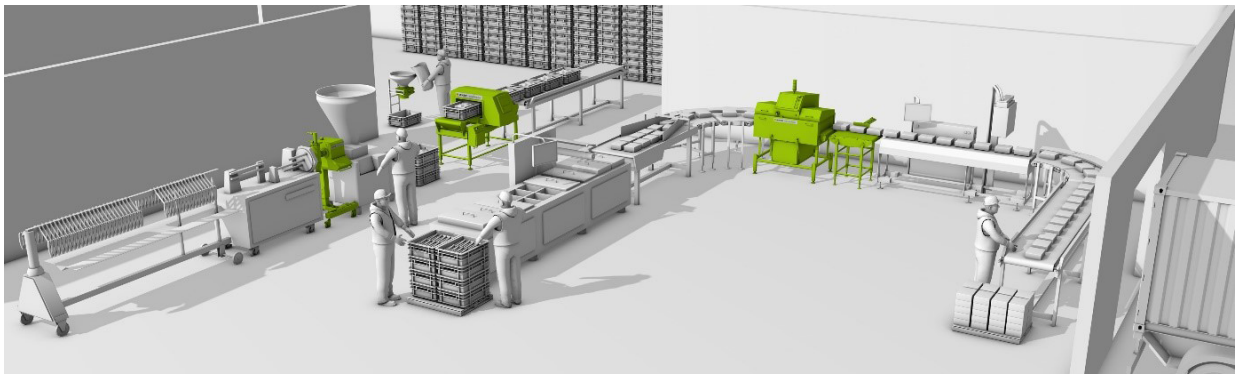
But paradoxically, food safety protocol is another major contributor to the problem of pre-consumer food waste. In order to ensure that no contaminated or otherwise defective products end up on consumers' plates, global food safety standards are designed to diminish risk at every turn. This means that even the slightest detectable chance of contamination within a product results in its rejection from the production line.

The role of food safety technology in reducing pre-consumer food waste

While a zero-tolerance approach to food safety risks is crucial to protecting consumers from foodborne illness and injury, unoptimised inspection systems may be wasting a disproportionately high amount of food. Between traceability issues, product recalls and false rejects, inferior food safety technology may be contributing to food waste problems.
Innovative contaminant detection and inspection technology makes it possible to both maintain compliance with rigorous food safety standards and minimise the volume of food discarded during manufacturing. Here is how improving the food safety devices within a manufacturing facility can help reduce food processing waste:

1. **Early detection of contaminated products**

   End-of-line product inspection is a necessary feature in any food manufacturing facility, ensuring that packaged products are safe to continue their journey along the supply chain. But relying on end-of-line inspection alone to control for physical contamination in food products has several downsides. One of these downsides is a higher volume of food waste. Food products may become physically contaminated at any juncture in the production line. It may even be the case that raw ingredients arrive at the facilities already harbouring physical contaminants. If there are no controls in place to screen for contaminants until the final stage of production, a contaminated food product may have made a complete journey through the manufacturing process before being identified and rejected. In this scenario, it is not just the contaminated product that is being thrown out, but also all the additional ingredients, energy and resources that went into its processing up until that point.



   Product purity is best ensured when food manufacturing facilities implement a sophisticated, multi-tiered food safety concept in which food products are inspected at several critical control points along the production line. By integrating advanced detection technology at strategic processing junctures, such as at raw-ingredient intake and after mechanical processes like pulverisation, physical contaminants can be identified and rejected at the source. This not only provides more precise data in regards to tracing contaminants, but it also saves companies from investing resources into products that will only be rejected later and prevents foreign bodies from dispersing and contaminating further product batches.

2. **Avoiding the waste associated with food recalls**
Food product recalls are on the rise worldwide. In the United Kingdom alone, food recalls across all product categories increased 40 per cent over the course of the 2018 calendar year. An unfortunate but often necessary measure, food recalls are imperative in order to prevent illness and injury. But in terms of food waste, the tradeoff is enormous. When food products are recalled, it is not just the contaminated products that get thrown out. Rightly preferring to err on the side of caution, companies and consumers toss out a tremendous of volume of food that may actually be safe to consume. A single contaminated specimen entering the market could theoretically lead to the waste of thousands of pounds of perfectly edible food products.

No food manufacturer wants to recall a food product. Beyond the lost resources and high costs of pulling products from store shelves, recalls wreak serious damage to a company's reputation. Reliable food safety technology is key to preventing consumer injury, food wastage and the PR crisis that follows in the wake of a product recall.

3. **Reducing false rejects caused by product effect**
   Amongst the most complex challenges in metal contaminant detection is the phenomenon of “product effect.” Some common food products such as fresh fish, meat and dairy have a moisture- and salt-content that creates the right conditions for the product to have a certain electrical conductivity. This can lead these perfectly safe products to trigger the rejection mechanism on industrial metal detectors meant to control for the presence of foreign bodies in food.

International food safety standards demand that any food rejected by a contaminant detector is discarded, even if a false reject due product effect is suspected. A metal detector that is not properly configured to adjust for product effect can lead to a high rate of false rejects, resulting in unnecessary food waste. Industrial metal detectors used to inspect foods with high moisture and saline levels must be equipped with intelligent software that is flexible enough to accommodate such adjustments.

The most advanced industrial metal detectors use artificial intelligence in order to differentiate between metal contaminants and the product effect generated by meat, fish and dairy products. These innovative, AI-integrated metal detectors can both reduce the food waste associated with false rejects and improve the overall accuracy of product inspection.

In other cases, it may be necessary to employ x-ray inspection technology instead of metal detectors in order to prevent excessive food waste due to false rejects.

04. How food safety standards impact production

Ensuring food safety and product quality is a demanding, ongoing undertaking that affects every level of the food supply chain. A significant portion of the food industry's total expenditure is dedicated to reducing the risk that contaminated or otherwise unsafe foods pose to consumers. These preventative measures are both time- and resource-intensive, but constitute an essential part of doing business in the food industry. An effective food safety management system is crucial for manufacturers looking to prevent catastrophic recalls, scale productivity and gain new business in a globalised market.

Ensuring food safety is the overarching concern that connects food industry players from all parts of the food supply chain. Food safety standards are omnipresent in the manufacture and production of food products and a substantial portion of a food producer's expenditure is dedicated to their food safety management system.

In manufacturing, food safety management systems are designed to address two types of food safety standards: legal food safety requirements as defined by governmental agencies and food safety certifications obtained from private, third-party auditing firms.

Legally speaking, food manufacturers are only required to comply with the food safety legislation of the countries in which they do business. By comparison, obtaining additional, internationally recognised food safety certifications from third-party auditing firms is optional.

The challenges of food safety management for manufacturers

Ensuring food safety is an intensive and continuous process. Implementing and maintaining an effective food safety management system invariably demands the investment of nontrivial amounts of time and money.

All international food regulations are built around an HACCP concept: they identify potential food safety hazards and critical control points and specify proactive means by which to control for and prevent these hazards. The more potential hazards inherent to a food manufacturing process, the more robust the food safety audit and controls must be.

The exact amount of resources a manufacturer should expect to invest in food safety management depends largely on the foodstuffs produced and the scope of production. Food manufacturing facilities that run highly complex operations consisting of hundreds of employees and dozens of distinct processing steps should expect to invest more time and resources into achieving compliance.

Time invested in food safety

Not all working hours in a food manufacturing facility are spent on production. An important number of working hours are devoted to tasks related to food safety. These activities include, among others:

- **Employee education**

  All employees who come into contact with food products over the course of their workday must be trained in food safety protocol. In addition to certifying new hires, employees need to partake in recertification sessions on a regular basis.

- **Documentation and recordkeeping**

  From equipment cleaning protocol to the materials used in food-contact applications, most every aspect of the food production process must be documented.

- **Inspections**

  From raw ingredient intake to in-process inspection to final quality checks, food products are inspected many times on their journey through the supply chain. Distinct quality control measures are carried out at each individual stage.

- **Hygiene and cleaning**

  Facilities and all food-contact equipment therein must be sanitised at regular intervals. All employees working in food-contact roles must also take time to ensure they are following proper hygiene protocols.

- **Audits**

  A requirement for obtaining food safety certification from a third-party agency, audits can span several months and include extensive preparation, consulting, on-site visits and fol low-up communication.

- **Validation and verification**

  It is not enough to simply implement a food safety management system; food manufacturers must also regularly prove that their system works. Validation concerns collecting evidence that the chosen food safety methods are effective for the application, while verification concerns confirming that implemented processes are working as expected.

Money invested in food safety

Ensuring food safety in a manufacturing environment also requires financial investment. Some of the costs involved in a robust food safety management system include:

- **Certification**

  Obtaining and renewing certification with third-party auditors involves several upfront costs. For an initial on-site audit, food manufacturers should expect to spend between €5,000 and €10,000, not including additional travel costs. After receiving certification, there are also yearly membership fees.

- **Food Safety Systems Manager salaries**

  Many larger food production businesses have a dedicated role or team responsible for the management of food safety activities.

- **Food safety technology**

  From advanced contaminant detection equipment, to automatic temperature controls, to hygienically designed processing equipment, a large portion of the total cost of food safety goes towards investing in the proper technology to reliably reduce risk.

- **Equipment maintenance and servicing**

  Food processing and inspection equipment must be regularly serviced in order to prevent malfunctions and unplanned downtime. Should machinery deteriorate, foreign objects may contaminate food products. Computerised food safety technology, such as contaminant detection equipment, must also undergo software updates.

Food safety as an economic imperative

Despite the hefty upfront and ongoing costs of achieving and maintaining compliance, food safety remains crucial to the economic viability of a food manufacturing business.

Because food law (and the rigor with which it is enforced) can vary from region to region, global market leaders within the food industry demand that all upstream and downstream partners with whom they work provide evidence as to the effectiveness of their food safety system.

In addition to granting access to lucrative international markets, a robust food safety management system can provide highly precise data that can be leveraged to improve productivity and prevent recalls.

Preventing recalls

Though ensuring food safety is a time- and resource-intensive endeavour, the effort and costs involved are negligible compared to fallout of product recalls. Globalization and digitalization have amplified the corporate consequences of contaminated food products entering the market. Not only is executing a recall more costly and difficult when goods have been shipped across the globe, but the news of recalls can now spread faster and further via social media and other digital channels. Product recalls are truly disastrous for food industry businesses. In addition to the hefty price tag of organizing and executing a recall, companies may also incur untold losses due to the resulting decline in consumer trust. Both can be devastating to the ongoing economic viability of a company. A third-party food safety audit can help illuminate the blind spots in a production line. These blind spots, if neglected, could lead to a contaminated product making its way onto consumers' plates. Through continued investment in advanced food safety technology and more robust and transparent food safety management policies, food manufacturers can continuously shrink the likelihood of a recall.

Efficiency gains

Improving a facility's food safety management system can do more for a manufacturer than simply win them the certification necessary to access international markets. By implementing a modern and robust food safety concept, manufacturers can also reap rewards in terms of production efficiency. For many food manufacturers, obtaining an internationally-recognised certification in food safety involves implementing a meticulous protocol for ongoing documentation and updating the food safety technology within their facilities. Where intelligent inspection equipment meets rigorous documentation, there is valuable data to be gleaned. By improving and expanding contaminant detection equipment and record-keeping practices, food manufacturers can win cost-saving insights into their production processes, reduce excessive food waste and quickly trace food safety threats right to the source. An effective food safety management system can also help manufacturers to rapidly ramp up production in times of crisis. Should production output need to quickly multiply in order to deliver basic foodstuffs to a public in need, a robust and reliable food safety management system can be scaled up to accommodate a higher output without compromising on quality.

What is the purpose of a food safety management system?

Because food safety is a series of preventative procedures, it can sometimes be challenging to ascertain what a food industry business can gain financially from their implementation. How does one assign an exact monetary value to food safety failures that may have happened, but didn't?

The purpose of a food safety management system is to ensure that a food production facility is using state-of-the-art technology, science and protocol to minimise the risk of contaminated products reaching consumers. From preventing to recalls, to navigating the global supply chain, to increasing productivity: when food manufacturers modernise their production facilities according to international standards, they become better prepared to handle the economic challenges of the modern food industry.

05. Legal requierments and important standards in the food industry and their differences

Food safety is a defining aspect of the global food industry. On the one hand, there are legal regulations specific to individual countries, and on the other, there are private, third-party certifications such as IFS, BRCGS, SQF, and FSSC 2200. Retail chains require their suppliers to meet certain food safety standards to ensure that food safety and quality are guaranteed. In this way, standards are the entry tickets to many markets.

The most important requirement in the food industry is that every product meant for human consumption must be pure and safe. A significant amount of expenditure in any food industry business is spent on protecting consumers from contaminated or unsafe foods. These preventative measures are both time- and resource-intensive, but constitute an essential part of doing business in the food industry.

Ensuring food safety and product quality is a demanding, ongoing undertaking that affects every level of the food supply chain. In order to prevent recalls and improve productivity, food processors and manufacturers need an effective food safety management system.

This Whitepaper outlines the legal requirements for food safety in some of the world's major markets and compares them with the most common standards. This information is meant to help food industry companies choose the best standard for their business.

The Whitepaper covers the following topics:

1. Legal food safety requirements in the EU, USA, and China
2. Food safety standards
3. A comparison of GFSI-accepted standards (IFS, BRCGS, SQF, FSSC 22000)
4. Selecting a food safety standard

06. What HACCP means and how to implement it

Hazard Analysis Critical Control Points (HACCP) is the underlying concept upon which all internationally recognised food safety management programmes are built. For food processors and manufacturers, understanding HACCP is critical to implementing systems and procedures that minimise risk, keep the public safe and uphold a company's reputation.

This article from the food safety and physical contaminant detection experts at Sesotec explains what HACCP is, why the concept is so important in the food industry and what implementing an HACCP programme entails.

What is HACCP?

Sorting machines could be even more efficient if the composition of plastic products were to make recycling easier, something that has so far not been seen enough. Developers prefer to optimise their materials and products for the intended purpose, as this opens up more opportunities on the market. One example is black plastic bottles, whose modern appearance makes them popular among particular target groups. However, due to its light-absorbing properties, the material used to ma

HACCP stands for Hazard Analysis and Critical Control Points and refers to an internationally recognised methodology for reducing food safety risks in facilities that manufacture, process, or handle food products. HACCP involves identifying and assessing potential sources of food safety hazards in order to establish a procedure for proactively controlling for and reducing risk.

HACCP standards emphasise controlling for preventable and eliminable food safety risks by means of two key components:

- **Hazard analysis** refers to identifying and analysing the food safety risks present in a food handling plant's processes. In particular, hazard analysis centres on evaluating potential sources for microbiological, chemical and physical contamination.

- **Critical control points** refer to key junctures in a food handling process at which controls can be applied to prevent or eliminate food safety hazards, or to reduce risk to an acceptable level. (Read more about determining critical control points)

Why is HACCP important in the food industry?

As a proactive process control system, HACCP is crucial for identifying and preventing hazards in food production so as to better protect public health. Rather than simply controlling for major food risks after food products have been processed and packaged, an HACCP plan involves strictly monitoring each step of the food production process in order to prevent contamination hazards from occurring in the first place.

When is the implementation of an HACCP plan required?

Because of its effectiveness in preventing contamination hazards, the HACCP methodology is the basis for all internationally recognised food safety guidelines and many food safety laws. Obtaining food safety certification from any programme accredited by the Global Food Safety Initiative will invariably involve implementing and documenting an effective HACCP plan.
A few examples of international food safety certification programmes requiring the implementation of an HACCP plan are:

- **BRCGS (Brand Reputation Compliance Global Standards, formerly BRC)**
- **FSSC 22000 (Food Safety System Certification based on ISO 22000)**
- **IFS (International Featured Standards)**
- **SQF (Safe Quality Food)**

How to develop an HACCP plan

There are two phases of planning involved in the development of an HACCP plan. The preliminary phase of creating an HACCP plan involves understanding the specific conditions, products and processes in the facility. The second phase involves applying the HACCP framework in order to write an actionable plan that is customised to the needs of the facility.

Five preliminary steps in developing an HACCP plan

Before a food handling company can begin to write an HACCP plan, there are five preliminary steps to follow. Each of these preliminary HACCP planning steps will help the company obtain a comprehensive picture of risk and responsibility within the food handling facility.

1. **Assemble a dedicated HACCP team**

   Companies start by designating a team of individuals to be responsible for developing the HACCP plan. This team may consist entirely of employees or may also involve assistance in the form of consulting from outside food safety experts. The resources allocated to the HACCP team should also be decided during this preliminary stage.

2. **Describe the products and the processes**

   During this step, the HACCP team composes detailed descriptions of each food product made and process carried out in the plant. These descriptions should also include information such as where and how the product is to be used, how it is packaged and labelled, as well as shelf-life and temperature considerations.

3. **Develop a complete list of ingredients and raw materials**

   Listing and categorising all the ingredients and raw materials used in a food product or process can help companies zero in on risk areas. The list should include all ingredients, both primary and additive, as well as all raw materials, such as packaging or casing, that are processed in their facility.

4. **Develop a process flow diagram**

   Starting at raw goods receiving and finishing with outgoing shipments, every single processing step carried out within the plant should be depicted in a process flow diagram. This diagram serves as an accurate representation of how products are made in the plant and should be verified via a walkthrough of the facility.

5. **Ensure compliance with sanitation requirements**

   Adherence to proper hygiene requirements makes for a strong foundation for an HACCP plan. As a prerequisite, all legal regulations regarding sanitation must be upheld before an HACCP plan can be drafted.

Once the preliminary planning phase has been completed, the HACCP team can begin to draft a plan.

The seven steps of an HACCP plan

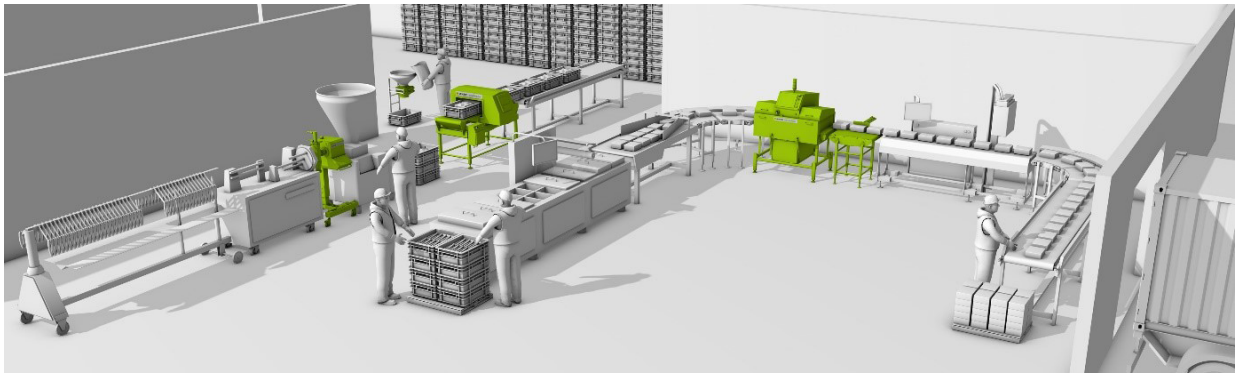
There are seven key principles that comprise the HACCP framework, each of which must feature in the written HACCP plan.

1. **Conduct a hazard analysis**

   Hazard analysis is a procedure in which all processes carried out in a food handling facility are examined for their potential to introduce contamination hazards. Hazard analyses take place in two steps. First, all potential hazards are identified. Second, these hazards are evaluated to assess the level of food safety risk they pose. For example, a company may identify two potential sources of metallic contaminants in their products: 1) raw materials arrive at the facility already harbouring metal particles and 2) machine wear and tear during processing. The company may then determine there is a higher level of risk in the former process and a lower level of risk in the latter.

2. **Identify the critical control points**

   A critical control point (CCP) is an intermediary step or procedure at which a control is necessary to prevent, eliminate, or reduce the risk of a food safety hazard to an acceptable level. Typically, a decision tree is used to identify CCPs. Generally speaking, the more processing steps carried out in a particular food handling facility, the more CCPs will be necessary to adequately control for contamination hazards.



   For example, a company may determine that raw material intake is a CCP, requiring that all incoming goods are scanned for metallic contaminants before they are processed.
   The company may also determine post-packaging and pre-shipment as another CCP in order to catch any metallic contaminants that entered the product during processing.

3. **Establish critical limits**

   A critical limit is the maximum acceptable level of a particular food safety parameter which indicates an unacceptably high risk to food safety if surpassed. Critical limits are typically expressed as values like time, temperature, pH, water activity, electrical conductivity, etc.

4. **Establish monitoring procedures for critical limits at CCPs**

Procedures will be established for the consistent monitoring of critical limits at every CCP. These procedures will describe when and how frequently the measurements will be taken, who is responsible for performing or monitoring them and what kind of methods or devices will be used. For example, this stage may involve creating a procedure for monitoring an end-of-line metal detector that inspects packaged products.
The sensitivity of the metal detector should be determined here, as well as the parties responsible for monitoring the performance of the device at specific intervals.

5. **Establish corrective actions**

Corrective actions refer to the established procedures which must be followed should any parameter at a critical control point deviate from the determined critical limits. First and foremost, the corrective actions should prevent the potentially hazardous food from entering the food chain. But secondarily, the corrective actions should also serve to rectify the cause of the hazard, thus preventing the situation from reoccurring. For example, this stage may stipulate that all units rejected by the metal detector are immediately removed from the production line and undergo a separate, closer inspection procedure in an effort to trace the contaminants back to the source of the hazard.

6. **Verification**

The efficacy of the HACCP plan should be tested and verified through measures such as process audits, final product inspections and random sample testing. For instance, the verification step of an HACCP plan may involve regularly calibrating contaminant detection equipment for accuracy in order to ensure foreign bodies are being detected and rejected reliably.

7. **Recordkeeping**

All of the steps outlined above should be documented in detail and archived on an ongoing basis in order to prove that all food products were produced safely. For instance, sophisticated contaminant detection equipment includes software that automatically generates and archives reports about each inspected batch. These reports can then be downloaded on a regular basis and stored centrally with all other food safety records.

Conclusion

Global megatrends such as the growing world population and rising living standards will make a lasting impact on the way the world eats. No aspect of the food industry, from global supply chains, to food cultures, to international business management, will remain unchanged.

In order to meet the growing demand for food in the face of shrinking resources, productivity must rise. All stakeholders in the value chain must take action within their own sphere of influence to produce food safely while sustainably minimizing food waste. Public health and environmental sustainability must always be top priorities.

Innovative, highly accurate inspection technology is essential if these goals are to be met. First and foremost, inspection technology protects consumer health by ensuring that food products comply with regulatory requirements. But by increasing efficiency and minimizing food waste, it also has an important role to play in improving the productivity and sustainability of food production as a whole.

About Sesotec
A circular economy must not only be sustainable and environmentally friendly, but also profitable for the companies that manufacture, process, and recycle plastics. To this end, the purity of the raw materials and sorting streams plays a decisive role.
Using intelligent technologies and services, we help businesses in the plastics sector operate with circularity and efficiency. In this way, profitability, sustainability, and environmental protection go hand in hand.

Learn more about Sesotec's solutions for safe food and saving food **here**.


Preserve valuable resources and protect the planet. We make sure that sustainable and high-quality production pays off.
For people, for the environment, and for industry.

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