Protecting brand, reputation and consumer confidence

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In a highly regulated environment food manufacturers face many challenges ensuring maximum food safety and protecting high value multi-national brands.

Contamination risks exist at most stages of production including microbiological, chemical, packaging, contamination from process equipment and physical contamination.

The costs of failing a customer site audit, having a product recall or damage to brand reputation can be enormous.

This article focuses on physical or foreign body contamination, outlining some of the removal and detection mechanisms available and how they can contribute to a robust HACCP plan.

Physical contamination can occur from many sources, incoming raw materials, poorly maintained machinery, poorly maintained lighting, storage containers, human factors and pests such as insects or rodents.

Foreign body prevention

Today, most food producers have recognised that the best way to control hazards is to prevent them entering in the first place.

Robust prevention procedures include stringent vendor audits to ensure any incoming ingredients are from suppliers who adhere to strict food hygiene standards. Regular machinery maintenance and replacement cycles also help to prevent contamination from faulty or worn machinery. A proactive pest control system is also important to minimise the entry of insects or rodents into the process. In addition, employee training, safety wear and strict codes of practice are important to prevent user error which may lead to food contamination.

Removal and detection

Prevention procedures eliminate most problems but foreign bodies do still enter or are created within the process. Metal, plastic, paper, wood fragments are present in many processes. An HACCP plan identifying critical points in the process and fitting with the correct removal or detection device can reduce contamination to virtually zero.

Liquid filter.

There are a range of foreign body removal and detection systems available. Generally they can be installed in-line at critical control points without reducing production efficiency. Before specifying an effective foreign body removal system there are several considerations:

- Device location – is it in a critical location where contamination could have occurred? Is it accessible for cleaning and inspection?
- Product flow characteristics – can the device installed deal effectively with the speed of flow required without negatively impacting output?
- Particle size – consider the typical particle size needed to be removed as this will influence the device required.
- ATEX approval – does the product have full ATEX certification to operate in potentially explosive environments?

It is vital that these simple criteria are considered to ensure effective detection and removal systems, and to show due diligence if an incident was to occur. Auditors and other independent bodies are keen to establish that systems are not just present but are of the correct specification.

The range of separation and detection devices available includes vibratory sieves and screens, liquid filters, magnetic separators, metal detectors and X-ray machines.

Sieving system.

Vibratory sieves and screens

Vibratory sieves and screens are widely used at the start of the process to verify the integrity of ingredients, screen out contamination and oversized product. They are usually used for powders or granules and include one or more mesh screens. Ingredients can be gravity or pneumatically fed through the mesh.

Typically the mesh will remove any contaminants of 20 microns or larger. There are many different types of sieve design to suit the specific applications.

To enhance the screening process sieves can be fitted with a magnetic grid which will remove ferrous contaminants right down to sub-micron size.

Sieves are excellent for primary foreign body removal but it is important other methods are also employed to remove smaller particles and remove matter created in process.

Liquid filters

Automated in-line filters, cartridges and cross flow membrane filtration devices are available for removing contaminants from liquid. Typically these devices filter out contaminants down to 5 micron particle size.

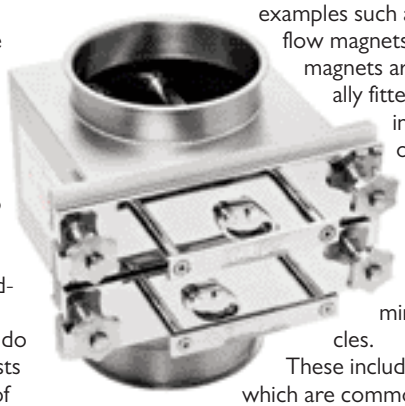
Magnetic separators

Magnetic separators are now common in most production lines. They are generally located at goods intake points, before and after process machinery or at the end of the process line. They attract and remove contamination without the need to stop or slow the process.

Magnetic separators are ideal for large throughputs of ingredients when continuous production is critical. This method of foreign body removal is much more effective as each magnet location only has to remove the contamination generated between itself and the previous magnet. This allows quality personnel to easily and accurately pinpoint the area of concern and investigate the cause of the contamination.

This acts as an early warning system and highlights wear and deterioration in critical machinery.

Separation systems are much more effective and reduce product wastage as the magnets only remove contamination and do not eject good product. They also eliminate the possibility of contamination finding its way into finished product.



Easy clean grid.

Manually cleaned units do not have any running costs and due to the stability of the magnetic material will last indefinitely if cared for correctly.

Magnetic design and performance has improved in the last 20 years thanks largely to the advances in magnetic materials. All magnetic separators today incorporate rare earth magnetic material, also known as neodymium iron boron. Rare earth magnets are six times more powerful than traditionally used ceramic materials, thus greatly improving contamination extraction rates.

Magnetic separators are capable of removing sub-micron size particles. In addition to ferrous contamination they also remove stainless steel fragments.

Most process lines are constructed from 316 grade stainless steel which in its natural state is non-magnetic. When stainless steel becomes work-hardened (sawn, filed, drilled) the fragmented pieces become magnetic and are removed from the process by the magnet.

Separators are continually evolving with advances in new and higher grades of rare earth material. Units with magnetic performance exceeding 11,000 Gauss (the unit of measure for magnetic intensity) are now readily available, although the industry standard is set at 9,000 Gauss.

A magnetic separator's performance reading and certification should be taken at the magnet's attractive face and not the surface of the base magnet as this is not where the contamination is attracted. Testing should be conducted every 12 months to ensure compliance.

Separators are designed for simplicity and efficiency. The magnet will attract and secure the offending pieces of contamination until the unit can be cleaned.

This is generally carried out between shift changeovers and line shutdowns. Standard units require operator intervention to inspect and clean them, however, a number of auto-cleaning units are available which are either controlled by PLC, the main control room or interface with machinery. This ensures regular cleaning and logging of contamination levels.

Magnetic separators can be utilised in most manufacturing processes including powders, granulates, liquids, syrups or pastes. There are numerous designs currently being supplied into the food industry.

For removing primary contaminants or larger fragments, such as nuts, bolts, nails, examples such as chute magnets, underflow magnets, bullet magnets, drum magnets are available. They are usually fitted in-line at raw material inlet points, discharge end of conveyors, vibratory feeders or in-line chute sections.

High intensity magnetic separators are available to remove secondary contamination i.e. minute particles.

These include a range of grid magnets which are commonly fitted in-line at each stage of manufacture.

Housed magnetic cartridges for use in pneumatic conveying lines or rotating grids to deal with products prone to 'caking' or 'bridging' are also available. There are also magnetic filters for liquid processing lines of all viscosities such as pastes, jams, juices and soups.

Metal detectors

Metal detectors have been around for over 60 years and are now integral in most HACCP plans.

In recent years an increase in competition has driven performance and reliability to new levels. Most systems now have in built microprocessors giving greater sensitivity, stability and vastly improving data analysis.

Typically, metal detectors are available in three main configurations, conveyor fed systems for inspecting packaged or solid goods, gravity fed systems for inspecting free-flow materials such as powders and grain, and pipeline systems for liquid processing lines.

They are located at critical control points either to inspect incoming raw materials or a final check for the finished product. They consist of a search head, control panel, feed or transport system and reject mechanism.

When using or selecting a metal detector it is very important to assess the usage and operating environment to ensure optimum performance. Many different factors affect metal detector performance and it is advisable to consult with the metal detector supplier before installing.

Detector aperture size, orientation and size of the product, and the speed of the feed system all have effects.

In addition, environmental factors such as floor vibration, temperature, unstable power sources or nearby equipment, such as motors or radios, which exert electromagnetic fields may have an effect. Metal items located nearby can also impact reliability. Food composition affects sensitivity, for example salt can increase conductivity and cause false rejects.

Product packaging composition also needs to be taken into account. Most systems can be programmed for distinct product compositions or packaging.

Metal detection systems are limited in that they can only detect particles typically down to 0.5mm, thus it is important that they are used in conjunction with a magnetic separator.

X-ray machines

X-ray systems are widely used in-line to identify both ferrous and non-ferrous physical contaminants such as bone, glass and rubber. They are usually positioned at the end of the line as a final check.

Generally, their performance is not affected by the same environmental factors affecting a metal detector. However, performance can be limited depending on the density of the product being inspected and certain items such as hair, thin glass, submicron metal particles and paper can go undetected. As with metal detectors, there are many types of X-ray system available to suit any product, including packaged products, liquids or granules.

Summary

In an ever changing environment with increased scrutiny being placed on food safety a foreign object detection program is vital for processing lines. In the first instance prevention procedures to stop foreign bodies entering the process must be thorough and robust.

In addition, a range of removal and detection systems at multiple locations is vital in minimising risks of damage to machinery, product recalls and product loss. ■

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The new Artemis metal detector.