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Where did that foreign body come from?

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In the food and beverage industry, foreign body investigations need not be nasty affairs.

Earlier this year, Mars had a foreign body incident that caused the company to voluntarily recall a selection of Snickers, Mars, Milky Way and Celebrations chocolates across 55 countries. This was initiated after just one consumer in Germany reported finding a piece of red plastic in a Snickers bar. After Mars established that the plastic piece came from a protective cover used in the manufacturing process at its Veghel plant in The Netherlands, the company made the precautionary decision to recall all of the 'at risk' product manufactured in the plant. Industry pundits are estimating that the recall will have a significant financial cost attached, certainly running into tens of millions of dollars. The cost comes directly from the recall process, the loss of writing off products and from lost sales in the short and medium term, compounded because the brand damage is occurring in the chocolate boom time in the lead-up to Easter.

Large-scale recalls like this are not good for any company's bottom line or brand image, but in smaller companies the loss of direct revenue, the cost of crisis management, the damage to brand reputation and communications costs are enough to force them into receivership.

You would only instigate this scale of recall if, like Mars, you were satisfied that the problem was genuine, originated in your plant and posed a risk to consumer safety, wouldn't you?

In truth, you can only answer yes to this question if you are absolutely sure of your facts.

'Zero tolerance' is now the norm

Despite the industry's best efforts, it is probably inevitable that foreign particles and matter will periodically be found in food products.

Most raw foods and ingredients originate in a natural environment — a farm, an orchard, a market garden… As the food is picked or harvested, foreign objects such as stones or glass can end up comingled and transported into the processing plant. Additionally, objects found in manufacturing facilities can also find their way into the processing stream.

Lastly, fragments of bones, pits or shells that are removed during processing can end up hidden in the final products.

Also, the very processing of the food involves a large number of mechanical devices — there are knives, rollers, conveyors, gears and a plethora of other bibs and bobs required in production. And one thing all mechanical devices have in common is that they eventually wear out and have the potential to be the source of a foreign body incident.

HACCP and GMP plans are designed to minimise the risks of contamination incidents, but control of materials in production environments still presents a major challenge. Consideration needs to be given to the equipment design and certification and design standards which exist to promote hygienic performance (eg, the standards and protocols from EHEDG6, 3-A7 and NSF International8). Adoption of these will mean that your equipment has been designed and constructed to reduce the potential for product contamination or failure.

Added to this, online systems including metal detectors and X-ray inspection can detect and then prevent many foreign objects from reaching the consumer, but even these can never be a 100% guarantee that a product will be contaminant-free.

Prevention and elimination of foreign bodies

A foreign body incident is not limited to consumers finding something in their food or drink.

A much more positive scenario is when your in-house, online detection systems uncover contaminants. This is a better scenario because the problem has been found and then hopefully solved without the product leaving your plant — so there is no expensive recall and no damage to your brand through unwanted media attention.

A foreign body find in these circumstances can indicate lapses in your quality control systems or be the first indication that a serious contamination incident has already happened.

Whether the contaminant came from an in-house lapse or externally, it is essential that the source of the foreign body be found quickly and conclusively. If the problem is internal, isolating the contaminant source quickly will limit productivity losses and line shutdown time.

Is the foreign body contaminant complaint genuine?

This isn't a silly question. A 2013 study by Glass Technology Services in the UK found that 70% of fragments reported by consumers and submitted for analysis originated from items that are commonly found in the home. It is a sad fact that sometimes consumers fake contamination complaints in the hope of financial gain, notoriety or revenge for a perceived slight.

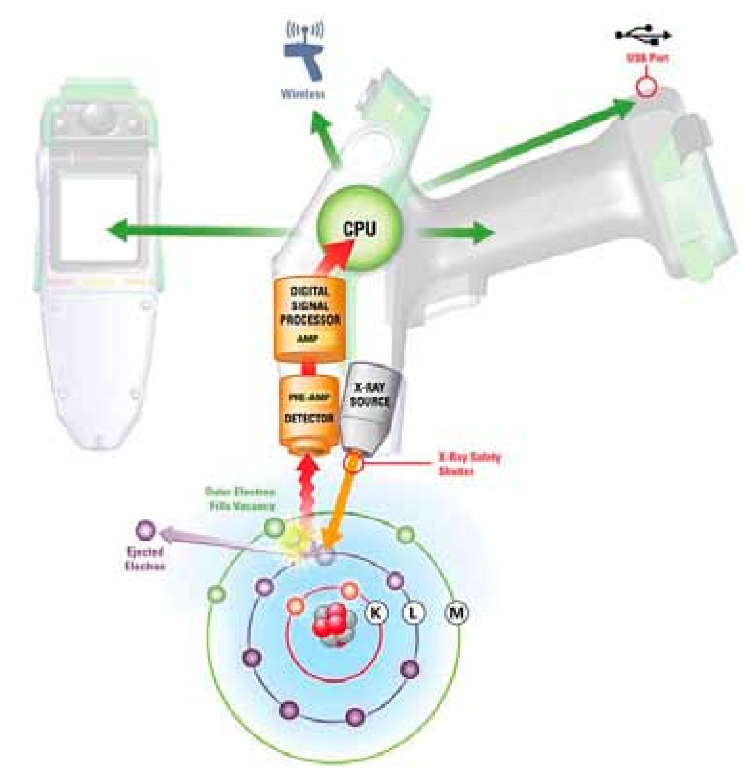
If manufacturers can establish with surety where the foreign body came from, they can instigate the most appropriate response in a very timely manner.

What can you do?

Rapid and accurate foreign body identification is the first step. Then you need to ascertain where and when a foreign object in food was introduced — your actions will be vastly different if you establish it originated post purchase rather than within the processing and packaging in your plant.

If you have any doubts about the source of the contaminant, you may have to instigate a costly and damaging recall. So anything that helps you to establish the source of the foreign body will be a huge bonus.

X-ray fluorescence technology (XRF) lets users identify the elemental composition of foreign bodies and



now, new handheld XRF analysers are moving this technique from the lab to the production line or field. The elemental composition of foreign bodies (down to around 0.5 mm) can be determined very easily with reliable, low-cost, lab-quality information — giving users a 'fingerprint' of the contaminant.

Fingerprint the plant

Even more importantly, the non-destructive technique can be used to establish a 'fingerprint' library of all of the items on the production line.

Once the user has established this library it can serve as a reference to identify the source of a foreign body. If a cutting blade is shearing and leaving metal fragments in your product, you can take a fingerprint of the elemental composition of the fragment, compare this to your library and determine that the blade needs to be replaced.

If your in-house metal detector picks up the contaminant and you identify the source very quickly using XRF, you can implement remedial action immediately. This will minimise downtime and product loss and the risk of contaminated product reaching the consumer.

In one example, a customer has saved hundreds of thousands of dollars through having invested in the fingerprint library of their most critical and problematic lines. In addition to engineering improvements, this has also minimised cost to the food company by holding manufacturing equipment suppliers accountable, having attributed failures to substandard materials such as lower grades of steel.

Equally challenging is internal misdiagnosis of foreign body sources; common without the use of XRF. Many contaminants could not have come from your plant or equipment; these can be quickly detected and you can avoid a large-scale recall or time- and money-consuming shutdown.

More detail about XRF technology

XRF can identify a variety of contaminants such as metals, glass, stones, bones, rubber and hard plastics. One of the major advantages of XRF is that measurements can be carried out on solid samples, avoiding sample digestion-dissolution, and results are available almost instantly.

XRF is a non-destructive analytical technique used to determine the elemental composition of materials. XRF analysers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source. Each of the elements present in a sample produces a set of characteristic fluorescent X-rays ('a fingerprint') that is unique for that specific element, which is why XRF spectroscopy is so good for qualitative and quantitative analysis of material composition.

To understand how this information can be used, consider scrap metal. Recyclers need to positively identify numerous alloy grades, rapidly analyse their chemical composition at material transfer points and guarantee the quality of their product to their customers. Metal alloys are designed for specific functions that are not interchangeable; small variations in composition can result in significantly different mechanical properties. Luckily, handheld XRF analysers can easily separate these grades and even create your own unique signatures for future identification purposes.

The X-ray fluorescence process

A solid or a liquid sample is irradiated with high-energy X-rays from a controlled X-ray tube.

When an atom in the sample is struck with an X-ray of sufficient energy (greater than the atom's K or L shell binding energy), an electron from one of the atom's inner orbital shells is dislodged.

The atom regains stability, filling the vacancy left in the inner orbital shell with an electron from one of the atom's higher energy orbital shells.

The electron drops to the lower energy state by releasing a fluorescent X-ray. The energy of this X-ray is equal to the specific difference in energy between two quantum states of the electron. The measurement of this energy is the basis of XRF analysis.

Interpretation of XRF spectra

Most atoms have several electron orbitals (K shell, L shell, M shell, for example). When X-ray energy causes electrons to transfer in and out of these shell levels, XRF peaks with varying intensities are created and will be present in the spectrum, a graphical representation of X-ray intensity peaks as a function of energy peaks. The peak energy identifies the element and the peak height/intensity is generally indicative of its concentration.

Modern software solutions enable rapid element identification and quantification. Additional matching algorithms enable a library to be compared against a contaminant creating a 'hit list' of likely candidates.

Energy dispersive X-ray fluorescence (EDXRF)

EDXRF is the technology commonly used in portable analysers. EDXRF is designed to analyse groups of elements simultaneously in order to rapidly determine those elements present in the sample and their relative concentrations — in other words, the elemental chemistry of the sample.