

Control of foreign bodies and contamination within the meat supply chain

Throughout the meat supply chain there exist contamination risks and, as these supply chains become longer and more complex, technology is playing a vital role in minimising the real and potentially costly threat of contaminated product reaching the end consumer. It also enables full transparency to determine liability in the event of a complaint or incident.

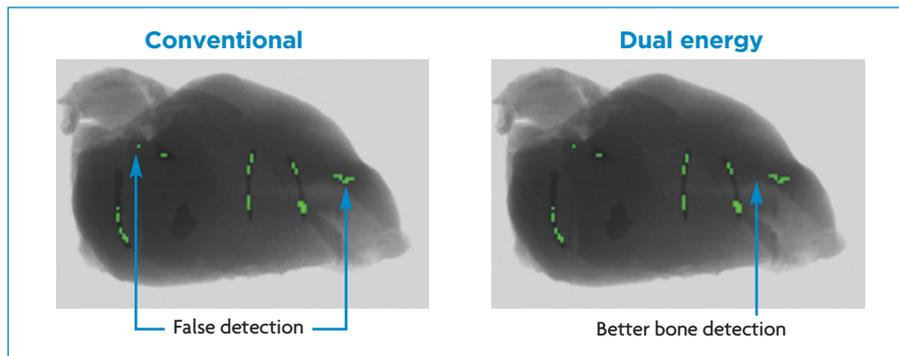
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This article examines the role that X-ray plays in helping to eliminate physical contamination risks, product recalls and the potential for brand damage and business loss.

A perennial problem

'Foreign body' is a term that applies to anything physical, chemical or biological that is found in food and renders it unfit for human consumption. Physical contamination generally refers to any contamination that is not microbial and includes a diverse range of items from metal, plastics, and glass through to hair, insect parts, bones, paper and paint.

While many recalls affecting meat are due to poor labelling or bacterial contamination, a piece of plastic found in mince beef prompted an investigation by a leading



Chicken example: conventional vs dual energy.

supermarket chain in the UK last year and small balls of plastic resulted in a recall of 4,500lb of chicken nuggets in the US in March. A failed bearing prompted a recall of more than 75,000lb of fresh beef products because of the risk of it being contaminated by metal, while wire found in a sukijaki beef product prompted the recall of more than 48,000 ready-to-eat frozen beef and pork products. Glass fragments resulted in a recall of more than 200,000lb of chicken pizzas and lasagnes in the US in March. These are just a few examples, but they often involve high volumes of product.

Indeed, the Food Safety Inspection Service has requested millions of dollars from Congress to improve its meat inspection capabilities. Of the 18 meat recalls in the US already identified in 2016, 33% were attributed to foreign matter contamination.

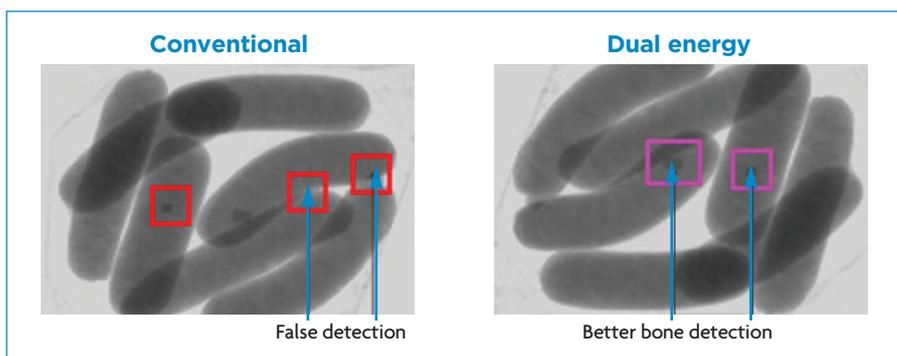
Around the world, the cost of recalls runs

into millions, especially when you factor in labour, production, logistics and disposal costs. They also impact on reputation not just for the supplier but, in the case of own-label brands, the retailer, resulting in potential loss of custom and damage to brand reputation.

Physical hazards in finished products can arise from several sources, such as contaminated raw materials, poorly designed or maintained facilities and equipment, faulty procedures during processing and improper employee training and practices. Food hygiene legislation emphasises every food business operator's responsibility to produce food safely by applying good hygienic practices and food safety management procedures based on hazard analysis and critical control point (HACCP) principles.

In common with other food businesses, all meat plant operators have an obligation to keep supplier and customer records. Indeed, traceability has become a major factor in reassuring customers that the meat products that reach the table have been handled and processed responsibly.

Sausage example: conventional vs dual energy.



Advancing the performance of quality control systems

The range of options for X-ray inspection systems is growing year on year, offering entry level solutions for smaller companies through to sophisticated solutions for high volume and complex final meal delivery.

Different products and processes require dedicated solutions. While regulation and

compliance are important, the main driver for investing in X-ray inspection systems is to reassure the customer, often the supermarket, that the supplier is doing everything it can to protect its customers' brand reputation by ensuring that it delivers a consistently high quality product, day after day, month after month, year after year.

It demonstrates a commitment to quality and, for many businesses, is the foundation on which long-term relationships are built. And, if things do go wrong, full traceability and data mean that investigations can start promptly and remedies found, helping to maintain customer satisfaction and ultimately, brand equity.

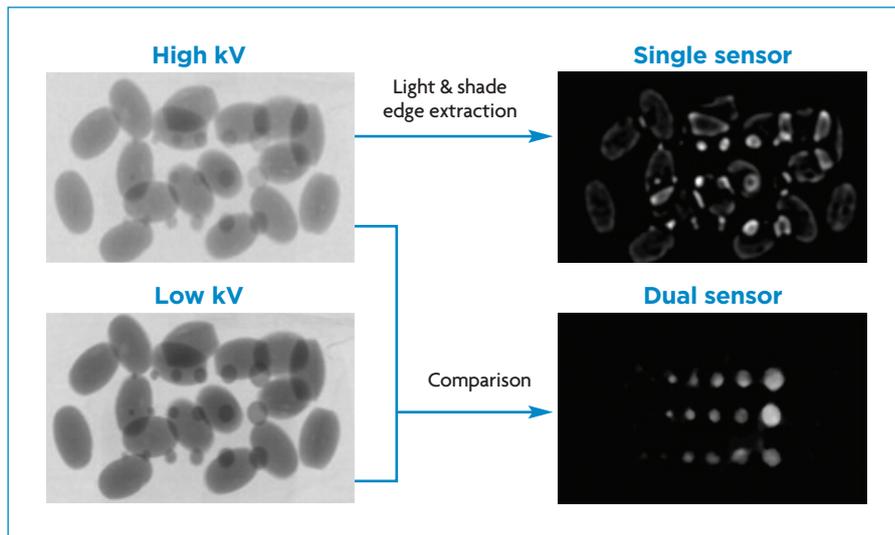
One advantage of X-ray over other inspection systems is its ability to monitor consistency of the product. Used as an end of line check, X-ray inspection can detect cracks in burgers, can identify broken sausage casings, can count the correct numbers of pieces in the pack, can ensure that clips on products are present and in the right place, can see if there is anything trapped in packaging seals and can even reject products that do not conform to weight parameters.

X-ray systems cannot see absolutely every physical contaminant that may be present in a product, such as paper, insects or hair. As a guide, X-ray systems can only see products with a density higher than water. That means that, generally speaking, if it floats, X-ray can not see it. Despite this, X-ray machines are proven to be more effective than metal detectors, vision systems and laser sorters at identifying and rejecting contaminated products at high speed. What they can see is dense plastics, rubber, metal, bone, shell, stones or glass, which critically, are the physical contaminants most likely to cause injury or harm if swallowed.

The introduction of Genetic Algorithm (GA) technology to image processing has taken the sensitivity of X-ray to a new level, improving detection rates by rapidly and automatically finding the optimal image settings to detect known, expected contaminants or impurities at very low levels.

For example, a 3mm glass ball without GA technology would only be spotted two out of 10 times for different parameters, but with GA processing, this would improve to 10 out of 10. It would also be able to see smaller balls of 2mm diameter. This saves manufacturers time and money by removing the need for them to send the product away to a laboratory. It also ensures that users have the best algorithm possible, since it was created on the actual product in the actual environment.

Numerous manufacturers of poultry products are benefitting from the advanced bone detection capabilities of specialist dual energy X-ray inspection systems. These machines use two X-ray line sensors simultaneously, which analyse different energies, to improve detection rates of



Single vs dual energy X-ray diagram. Conventional image processing technology finds contaminants by checking contrast variance on the image, where the high X-ray penetration area appears bright and the low X-ray penetration area appears dark. However this principle tends to cause false detection where the X-ray penetration rate is low, due to the effects of product overlapping or product edges.

low-density contaminants such as metal foil, thin glass, bone or shell.

Conventional image processing technology finds contaminants by checking contrast variance on the image, where high X-ray penetration area appears bright and the low X-ray penetration area appears dark. However the identification of low X-ray penetration areas, due to the effects of products overlapping, can lead to false rejects.

Energy analysis makes use of the principle that different products have different X-ray penetration characteristics at different energies, with the darkness of the image depending on the atomic mass. By cancelling the image of product characteristics, the contaminant is more easily identified and the number of false detections is reduced.

Four key production points

X-ray systems are typically installed at four key points in production and where works best will very much depend on the type of product and the amount of processing involved.

Often they will be installed to inspect loose bulk products such as chicken nuggets or on separated fillets prior to packing, or compacted cooked cut meat products. By removing contaminated product at the start of the process, X-ray inspection systems are helping to minimise waste in energy and packaging, as well as protecting process-line equipment from damage from bone, metal, stones and glass, thereby helping to reduce maintenance and down-time costs.

Meat usually undergoes some form of processing before it reaches the processor. It can be sold fresh, or frozen or be used as

an ingredient in ready meals or products such as pies, burgers, and sausages.

Where processing is more complex, risk factors increase and need to be managed more carefully.

Typical poultry processes can be easily accommodated by the X-ray system. In order to minimise waste, a trimming station will often be placed after the X-ray system so that when bones are identified, the product can be re-trimmed rather than discarded, ensuring optimal output and productivity.

With poultry and burgers, the fast food industry is becoming increasingly insistent that X-ray forms part of a supplier's quality control systems and that the system provides accurate records of all processed products leaving a facility.

In fact, X-ray images can be stored along with a unique number that appears on the pack, making it easy to trace the product and pull off all of the data and images should a complaint arise.

An in-depth audit of the process line helps to identify which system will deliver optimal results for a customer. Factors that could affect this include an assessment of sensitivity to determine the level of contaminant that can be seen, on-site and off-site testing, consideration of speed, size and weight of product feeding through the system and packaging options on the line.

Ultimately, X-ray is designed to give peace of mind to both suppliers and customers that a quality product has left the factory and all the documentation is there to prove it. A lot of customers are surprised to find that there are many additional cost-saving benefits in terms of minimising waste, performance and productivity, beyond the enhanced quality control that X-ray offers to support their own and their customers' brands. ■