Plant automation drives demand for inspection technology

The greater use of automation in meat and poultry processing is enhancing the threat of foreign matter contamination and making it increasingly crucial for operators to leverage potent inspection systems.

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Meat and poultry plants are accelerating their use of automation. Processors seeking to enhance operating efficiencies while compensating for reductions in available labour are leveraging more innovative technologies for functions ranging from the cutting and mixing of raw meat to robotics and the packaging of final products.

While newer machine designs are enabling operators to produce higher quality meat products faster, this increase in automation also brings additional challenges and requires highly effective detection systems.

Automation brings added risk

Not only does the greater use of production technologies increase the probability of having machine components, such as bolts and brackets, fall into meat during processing, but also smaller labour forces reduce the chances that workers will spot foreign matter in products or even prevent incidents from occurring.

Plant employees who are cutting into meat and poultry by hand, for instance, typically can better detect when the blade is touching bone and are able to adjust their movements before creating bone fragments.

"The processing machinery does not know when things are going wrong in such a way," Michael Ahern, National Sales Manager for Anritsu Infivis Inc. told International Food and Meat Topics. "There is a greater risk of foreign material getting into a product anytime operators add automation to their production lines."

The recent push for automation is replacing functions that are easy for humans to execute. When once plant workers had to cut a chicken by hand, there are now very sophisticated machines to take the chicken apart. While such machines can be expensive, labour shortages are making the technologies more cost effective for processors. Indeed, additional processors are investing in robotics because of the shortage of skilled workers and the expense of attracting and retaining labour.

As of May 2021, there were approximately 86,450 individuals working as slaughterers and meat packers, reports the US Department of Labor's US Bureau of Labor Statistics, but the employment levels still are falling short of demand.

Inspection systems are becoming increasingly valuable by enabling detection of smaller objects while having a range of price points and capabilities to support processors of all sizes. That is important, as worker shortages, which have been made worse by the COVID-19 pandemic, are likely to be ongoing.

"The pandemic will continue to spur the move toward automation because of the reluctance of plant employees to be working close together on processing lines. That means there are fewer hands and eyes examining products," Micheal added.

A system for every situation

X-ray machines and metal detectors remain the two prevalent inspection technologies.

X-ray devices transmit energy in the form of a short wavelength X-ray beam through the product, and a detector on the opposing side measures the amount of absorption of the X-ray beam passing through to create a density graph of the product.

Elements denser than the product will be seen as dark spots including metal, glass, calcified bone, stone, and cement. Other objects, including wood, paper, fabrics, and plastics, are the same density of the products so they are difficult to detect.

Metal detectors, on the other hand, have been used in foods plants for decades and operation is based on a magnetic field within a tunnel. Metal objects within the field interfere with the magnetic field indicating an unwanted inclusion. Performance of the metal detector does vary depending on the size of the aperture and the product.

While metal detectors do their job effectively, they have limitations on product type and packaging. In addition, operators are looking to find non-metal contaminants, all of which makes X-ray technology more attractive.

Over the past ten years there have been significant gains in the technology.

The launch of newer designs is also resulting in increasingly cost-efficient inspection systems, and that includes previous generation models that are dropping in price. When technologies get better, the older, but still effective, equipment becomes less expensive. It is making it easier for smaller producers to get into X-ray inspection and allowing processors, ranging from family-owned

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companies to the largest international conglomerates, to find equipment that aligns with their budgets and needs.

Modern X-ray systems can better detect less dense contaminants, such as bone and glass as well as plastics impregnated with X-ray detectable materials. The top-tier X-ray systems can often detect metals ranging in size between 0.5mm to 0.8mm and that performance level also proves that lower density contaminants are detected at smaller sizes as well.

Nevertheless, processors will benefit from using both X-ray and metal detectors on their lines, as there still will be instances in which a metal detector will find matter that an X-ray system cannot.

Such detection may include clusters of metal particles that are typically too small for X-ray to locate, and thinner material, including aluminum foil.

There is a school of thought that X-ray devices are most effective when inspecting products that are uniform in size and shape, evolving technologies are enabling processors to better detect foreign matter in non-uniform products as well.

A host of variables dictate device positioning

While it is easier to locate objects in chicken breasts of consistent sizes lying flat on a conveyor belt, upgrades are enabling better inspection of various-size chicken parts that processors might randomly deposit on a line.

"In the early days of X-ray, the more uniform the product, the better your inspection," Michael says. "But today's technology does not require that everything be perfect. We can deal with the natural variations of the production load and still find the contaminants."

The optimal locations for inspection devices on processing lines, and the technologies that are most effective, can vary in accordance with such factors as space availability; product temperature, as some devices are more effective on frozen meat and poultry; and the size of the product undergoing inspection.

Equipment selection and placement also will differ in accordance with a processor's inspection objectives, and can include the use of multiple technologies in different sections of the processing line to support functions ranging from bulk inspection of raw ingredients to case inspection prior to palletising.

Earlier placement, however, can help prevent damage to processing equipment by enabling operators to detect dense matter before the objects have contact with processing machinery.

In addition, inspecting products at the head of the process can help ensure that larger objects are not reduced into smaller, harder to detect pieces, while end-of-the-line inspection guards against the chance that foreign matter will elude monitoring.

"Placement becomes more critical when the primary goal is finding low-density contaminants like bones, glass, or stones," Michael notes. "Often this dictates upstream placement where product thickness is low and consistent and creates more ideal conditions for detecting the matter."

X-ray inspection systems can consist of single energy or dual energy technologies. Single energy X-ray is the traditional technology used by most facilities and excels at detecting metals, stone and glass and bones in certain applications.

Dual energy is an upgrade in technology that uses two energy levels to identify the difference between organic and inorganic material and is better able to detect low density matter as glass, stone, rubber, and bone. Commercially, dual energy is used to detect calcified bone in protein applications but mostly in the poultry industry.

Dual energy also can better 'tune out' product effect when detecting foreign matter and is ideal for inspecting products consisting of layers and overlapping pieces. Product effect refers to meat and poultry characteristics that can alter inspection device readings and cause false rejects.

Steps to minimise false rejects

Because false reject readings often result in product waste and mistrust of the detection system, it is critical that processors leverage devices that minimise occurrences. Indeed, frequent false reject readings may cause operators to question whether an accurate positive reading is legitimate.

"False rejects not only cost money, but the plant's quality department is more likely to say, 'here we go again' rather than 'I have a reject, let me find out what it is,'" Michael notes. "It is important to minimise false rejects because you want everyone in the plant to trust the detection technology."

Higher false reject rates are more likely to occur if the producer's inspection goal is too close to the detection device's performance limit.

For example, metal detectors are subject to performance changes based on product and plant temperatures so if the device is tuned to the edge of performance, they are subject to a high reject rate if the product temperature changes.

However, having performance headroom allows producers to run with much lower false reject rates and that is an advantage with X-ray technology. Such headroom is available with X-ray technology that can detect 0.6mm metal where the customer's specification is 0.8mm.

"Having a two-rank margin against the specification will reduce false reject rates and that can have a dramatic financial upside when there is less interruption of high-speed lines that are processing high value products," Michael adds.

The technology evolution adds ease and efficiencies

Along with greater detection capabilities, X-ray equipment and metal detectors are becoming easier for processors to implement. The auto setup routine is more intuitive and no longer requires technical skills or the services of an electrician or engineer.

Indeed, operators typically just perform such simple functions as inputting product information and the conveyor belt speed before running products through the devices multiple times to set the detection signal.

Systems can be operating within a couple minutes and common user interfaces on equipment from a single supplier can reduce the need to train workers to use different technologies within a plant, including X-ray systems, metal detectors and checkweighers.

The inspection equipment itself is already mostly automatic and requires very little input from operators.

The human-machine interfaces continue to become more usable and efficient by simplifying, and speeding product setup and easing adjustments.

Inspection technologies, meanwhile, will continue to evolve with advances to X-ray sensors set to provide even better detection of low-density contaminants, offering higher resolution imaging with more contrast, Michael says. In addition, improvements to single energy X-ray equipment are increasing efficiencies and reducing ownership costs.

Inspection technologies are also incorporating deep learning, a subset of machine learning that contains algorithms that are intended to work like the human brain to optimise detection. The goal is to find as many contaminants as are reasonable to find with X-ray systems. ■