

private eyes for product inspection

Bakers and snack makers harness data from cutting-edge technology for more than just food safety

by Dan Malovany

When it comes to metal detection, rejection is a good thing. However, no longer are these systems just the gatekeeper of food safety. With the rise in machine learning and enhancements in technology, product inspection systems have gone from providing detection to being detectives on high-speed bakery and snack lines.

In addition to gathering data, they're supplying evidence that's offering new clues uncovering those hidden problems on a production line that can compromise the integrity of a product.

"The metal detector is not the end to identifying your problems. It's just the beginning," said Eric Garr, regional sales manager, Fortress Technology.

"Investigating where that metal is coming from could point to a bigger problem. If you use the information that it gives you and investigate, it might point out a catastrophic failure before it's become catastrophic."

In some cases, recent developments in software and machine learning have allowed metal detectors, X-ray and vision systems to keep pace with the onslaught of food safety regulations and quality control requirements over the past few years. At the same time, the early stages of artificial intelligence (AI) have the potential to transform product inspection even further.

"Technology has advanced at an incredible pace during this past decade, and with advances

Quality assurance systems inspect thousands of baked goods a minute on a high-speed line.

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Top: Going forward, using artificial intelligence will have a dramatic impact on the effectiveness of vision systems to detect foreign matter on the surfaces of products.

Bottom: Advanced technology of X-ray machines provides high sensitivity and accuracy of low-density and tiny foreign object contaminant detection.



in AI, technologies likely will revolutionize the way the food industry inspects food at an even greater pace," observed Todd Grube, product manager for inspection systems at Heat and Control. "The engine that drives the marketplace is customer expectations. Today's consumers are more interested in healthier living because of the link between diet and overall well-being. Coupled with the technological ability to improve quality control, governing entities have refined food safety regulations to become more stringent to reflect this trend. Expect X-ray and metal detector manufacturers to continue to improve their equipment to detect smaller pieces of metal and foreign materials without false detections."

Hanno Antoni, product line manager, vision systems, for Mettler-Toledo, said the pace of product inspection technology has accelerated because of faster processors, better sensors and the increasing push for AI that are enabling real-time analysis and lower false-reject rates. Moreover, the increasing adoption of the cloud and the Industrial Internet of Things has enhanced these systems' ability to provide centralized monitoring of quality assurance as retailers push for bakeries to provide better traceability.

Simply put, product inspection technology has become better at safeguarding the integrity of snacks and baked goods.

"The bottom line is today we can capture more data and analyze it faster," said Josh Becker, bakery and confection segment manager at Harpak-Ulma. "A faster analysis of data means a quicker response to addressing the food safe-

ty concern. Everything now can be tracked and traced on the production line and even after the products leave the bakery."

Detecting new paths to safety

Today's metal detectors, X-ray and vision systems make it easier for bakeries and snack producers to comply with burgeoning food safety requirements.

For instance, Garr pointed out that the increased use of digitized recordkeeping automatically documents when employees test a metal detector to verify that it's performing properly.

"Performance verifications are historically done manually, which also includes the recordkeeping that goes with it," he said. "Digitizing records can ensure that they are recorded properly."

He added that the latest metal detectors alert operators to perform the test, then record the date, time and results.

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"Food manufacturers can use communication adapters to then take all that data to their own systems — or use our company's own reporting software — to generate reports on an hourly or shift basis, and those reports can then be automatically emailed out to the quality control department," Garr said.

He said Fortress Technology offers the HALO automatic testing system that checks metal detectors for ferrous, non-ferrous and stainless steel contaminants without stopping production.

"It takes that human element away and fully automates performance verifications, ensuring that the metal detectors are tested correctly," Garr explained. "They're tested using best practices while digitizing those records to ensure that they're always available and can be used at any time, whether an auditor requests them, or you have a food safety incident and need to look at what's been happening on that metal detector."

More sensitive and dependable technology now enables bakeries to use X-ray systems on higher speed lines than in the past while improving the effectiveness of metal detection.

"As production capacities and line speeds rise and the resolutions of X-ray sensors increase, faster microprocessors are required in order to analyze the image and to determine if the product meets compa-

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ny requirements before going on to inspect the next package," Grube said. "While there are no images involved with a metal detector, a microprocessor is used to analyze the various signals from the product as it passes through the metal detector's electromagnetic field."

The performance of vision inspection technology has also evolved significantly over the past 15 years, noted Andrew McGhie, global business development director of inspection systems, KPM Analytics.

He mentioned that many vision systems rely on preprogrammed product quality tolerances for attributes such as size, shape, bake color and other basic measurements. They may also use some early AI algorithms to check shapes and defects but only in the most basic way. However, new AI-based vision inspection technology has quickly risen to prominence over the past five years to provide more sophisticated product quality checks and improve bakeries' ability to detect unwanted foreign materials on their product surfaces.

"AI vision inspection systems are trained on images of real products, and over time, they can recognize patterns and texture variations that a human inspector may not be able to achieve with any reliability, let alone a rule-based system," he said. "This advanced inspection type has really changed the game for baking and snack food companies, not just for quality assurance, but to amplify their food safety programs."

To enhance food safety, McGhie said, vision systems detect "soft" foreign materials such as plastic film, rubber gasket fragments and personal protective equipment, like a piece of plastic glove, that are not detected by metal detectors or are difficult for an X-ray to reliably flag. Inline vision systems can also ensure compliance with government and customer requirements by securely storing foreign material detection records that can later be shared during audits or quality reviews.

Garr described AI as "the future" of product inspection, but currently, it all depends on how it's applied to ensure food safety.

"People are using it in different ways, and there are a lot of buzzwords that go on to the marketing materials, but AI has helped us to speed up the

development of software and hardware in our systems to develop the next generation of capabilities," he said. "It's allowing us to better automate the setups of systems and ensure they're optimal. We really see it as a tool that will help when it comes to maintenance and tracking production trends identifying when setup can be further optimized."

He added that AI can combine and analyze the data from several different types of inspection equipment, such as X-ray, metal detection, checkweighers and vision systems, to identify issues that might not have been apparent in the past.

"Any of the data from any of those singular pieces of this whole system may not show a problem. It may not be a detection or rejection event for any one of them, but if you look at the data altogether, AI is really good at sifting through large sets of it," Garr explained. "AI might identify something that isn't right and decide to reject it. It might not be metal, it might not be a dense contaminant, it might not be the weight of the package, but looking at all those things together, AI may say, 'This just doesn't look like the rest of the production. We may want to take a closer look at this product or package.'"



X-ray systems can provide multiple inspections of baked goods simultaneously.

Automatic system testing and recordkeeping ensure that metal detectors, X-ray and other systems are always working properly.





Combining technology such as a checkweigher with a vision system will enhance both quality assurance and food safety.

Investigating new technology

Government regulations are only some of the hurdles when it comes to guaranteeing quality assurance and food safety.

"While regulations remain important, much of today's innovation is being driven by retailer expectations, brand protection concerns, traceability requirements and the need to operate more efficiently," noted Christy Draus, head of marketing, Eagle PI.

To meet these challenges, several recent technological advancements have enhanced product inspection capabilities and food safety in general. Take multi-simultaneous frequency technology, which enables users to select two frequencies within a single operational mode for metal detection.

"This capability helps minimize false rejects caused by the product effect, which can trigger signals and complicate metal detection," said Noor Rifai, product line manager, metal detection, at Mettler-Toledo. "By combining multi-simultaneous frequency with signal suppression, users can effectively eliminate false rejects, thereby improving productivity and protecting brand integrity."

Grube pointed out CEIA's multi-spectrum metal detectors use several frequencies both simultaneously and continuously to optimize sensitivity to all metal contaminants and reduce product waste by minimizing product effect errors.

"They provide a unique detection capability and extreme sensitivity of magnetic, non-magnetic, and even stainless-steel metal contaminants and are also available in a US Department of Agriculture-approved design," he observed.

Moreover, technology such as photon counting within X-ray inspection systems has evolved to de-

Teaming up technology to ensure better food safety

No system is foolproof when it comes to guaranteeing food safety on today's high-speed production lines, but pairing multiple technologies together can create a powerful process for inspecting products from both the inside and outside.

While vision systems spot foreign materials on the surface, X-ray can identify thick plastic and other hidden hazards, while metal detection will kick out those products with fragments from machinery, conveyors and other places within a bakery or snack food plant.

"The fundamental reason to combine vision inspection with existing X-ray and metal detection systems is that no single technology exists that can detect everything on the line," noted Andrew McGhie, global business development director of inspection systems, KPM Analytics. "Each system has a distinct purpose, and the risks of foreign material contamination in a bakery are broad enough that relying on just one technology or inspection point will always leave gaps."

Christy Draus, head of marketing, Eagle PI, suggested that another effective approach is a layered inspection strategy that combines multiple technologies and inspection points throughout the production process.

"Depending on the product and risk assessment, manufacturers may deploy inspection systems at multiple points on the line to identify contaminants earlier, verify product quality attributes and confirm package integrity before distribution," she observed.

Draus added that inspection systems can now integrate with plant controls and data management platforms to improve traceability, simplify audits and provide greater visibility into the operation's performance.

McGhie stressed that pairing visual evidence with operational data, software programs and even artificial intelligence (AI) can go a long way toward identifying where and why issues in the process originate.

"By analyzing large sets of inspection data over time, AI models can uncover correlations among defects, tools and process conditions to support long-term reliability," he explained.



test lower density contaminants in "busy products" such as nuts.

"Additionally, the use of AI and machine learning has advanced to aid specifically with task-based detection such as looking for missing objects, counting and more," noted Kristina Djukic, product line manager, X-ray inspection, at Mettler-Toledo. "This is particularly valuable in complex scenarios such as overlapping products, mixed product types and random positioning on the line."

Grube said the Ishida IX-PD Series X-ray Inspection System, a photon-counting dual-energy X-ray machine, employs an alternative sensor and accompanying image processing technology to provide high sensitivity and accuracy of low-density and tiny foreign object contaminant detection.

Simply put, product inspection technology *has become better at safeguarding the integrity of snacks and baked goods.*

"This technology differentiates with high accuracy between product and foreign objects, reducing the rate of erroneous detection," he added.

Draus pointed out that today's X-ray systems can perform multiple inspections simultaneously, including contaminant detection, package integrity verification, mass measurement, fill-level inspection and component count checks.

"Eagle's dual-energy, photon-counting technology provides additional material information beyond traditional grayscale imaging, helping improve inspection performance in challenging bakery and snack applications," she said.

She added that Eagle's SimulTask PRO software enables bakers to perform multiple tasks

within a single inspection process.

"For example, bakery and snack producers can simultaneously inspect donuts for contaminants while verifying filling levels and shape consistency, identify missing snack bars in multipacks, detect voids in bread loaves and verify package integrity without compromising throughput," she said.

McGhie cited another emerging vision inspection capability, namely Short-wave Infrared (SWIR) Hyperspectral Imaging, which enables advanced foreign material detection on food products by inspecting within a non-visible spectrum.

"SWIR Hyperspectral offers the possibility to extract the chemical fingerprint of a product's surface to uncover multiple difficult-to-see foreign objects that could never be detected by the human eye," he said.

In addition to state and federal food safety rules, Garr said, US bakers and snack makers might keep an eye on new labeling regulations coming out of the United Kingdom.

"All the printing on the package for the lot codes, date codes and other information must not only be correct, but they must be legible," he said. "Otherwise, there's a risk of large fines."

He said Fortress Technology's vision system now pulls the records from the company's database and the product record on the line to ensure that the packaging has all the correct information.

"It inspects every package versus just checking a sample that some of our end-users might be currently running," Garr said.

Today's enhancements in new technology, especially within the software arena, are transforming product inspection from a reactive to a proactive process. By doing so, they're making bakers and snack producers better at detecting not only defective products, but also any issues with the production line. ●

Enhancements in software and microprocessors have enabled product inspection systems to keep up with the massive flow of buns, croissants and other baked goods in high-volume operations.