Ten Reasons to Step Up from Metal Detection to X-ray Inspection

Bob Ries, Lead Product Manager,
Metal Detection and X-Ray Inspection, Thermo Fisher Scientific

Key Words

Food safety, foreign objects, glass, stone, radiation safety, product verification

Introduction

The basic principle of X-ray is well known today because of its use in the healthcare industry and airport security. What is not so well known by many food production and quality professionals is what X-ray can do to improve food safety compared to traditional metal detectors. Described in this paper are 10 compelling reasons to consider stepping up to the latest technology utilized in the Thermo Scientific™ NextGuard™ and Xpert™ X-ray inspection systems.

1. Detect contaminants by "seeing through" metalized film or foil packages

Shelf life and product appearance have always been important packaging deliverables. This is why the use of metallized film, foil and induction sealed packaging is growing fast. These materials provide improved moisture, oxygen and UV-light barriers which extend shelf life and can also improve aesthetics. However, the challenge is that materials containing metal create large "product effects" for metal detectors which requires these devices to operate at a degraded sensitivity level. On the other hand, X-ray systems have no problem "seeing" right through these thin packaging materials to detect very small contaminants.

Another common problem that X-ray can solve is false contaminant detection due to metal being embedded in recycled paperboard. The metal present is so small that in most cases X-ray systems can ignore it. A metal detector would reject the package, potentially causing confusion for the quality manager.

Food products in packages that contain foil and metalized film

2. Find small pieces of many types of metal; and other foreign object types

In an X-ray image, darkness represents density. When coupled with automatic image analysis, X-ray systems can find contaminants that are dense, have sharp edges or are a particular shape or size. These include glass fragments, stones or plastic and bone pieces.

An additional benefit, when compared to metal detectors, is most metals (ferrous, non-ferrous and stainless steel) react in the same way because their densities are very similar. So unlike metal detectors, you don't have to trade-off detection capability by metal type. Aluminum, which has a density similar to glass, is also usually detectable. Very small diameter wires that are several millimeters in length can be found due to their shape.

Finally, in many cases, X-ray is more sensitive than a metal detector due to its advanced image generation and detection software. For instance, in a typical metal detector application with a wet or conductive product where 2.5-3.5 mm stainless steel can be detected, X-ray frequently can detect 1.5 mm or less thus improving food safety and brand protection.

Granola bar with glass, cookies with metal contaminants and coffee beans with ceramic "rocks"

3. Set up/test new products in minutes utilizing an intuitive, graphical interface

Setting metal detector frequency and gain, and learning the product phase angle (what reactive and resistive signals to ignore), is anything but intuitive. Even when this is simplified, understanding and making adjustments due to variable product effects or environment "noise" can take very specialized knowledge.
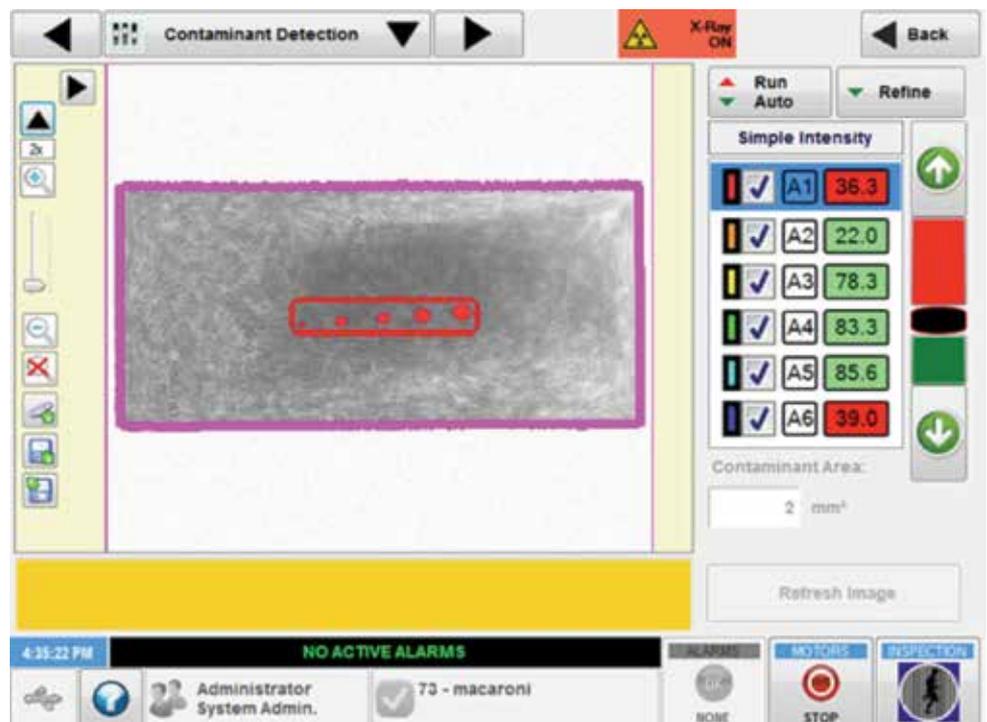
NextGuard set-up/adjustment of detection parameters

Thermo Scientific X-ray systems take a totally different approach. Utilizing set-up wizards, simply tell the system about your package size and line rate. Let it set the X-ray power levels based on product density and speed, pass a few sample "good" packages through the machine to calibrate the detection algorithms and set reject delay and duration.

Because X-ray systems generate images of your product throughout this process, you get immediate and easy to understand feedback, helping to optimize set-up. It is also very easy to test the system with varying contaminant types. If something seems incorrect, you can zoom into the image for closer analysis, while adjusting the detection level to determine impact. This means a relative novice user can set up their first product in 5-10 minutes and an experienced user can do it in a fraction of that time.

A final benefit of this visual interface is that you can save and export images of contaminated products for off-line review. For full traceability, these images are also tagged with the product name, date, time and reason the product was rejected.

4. Don't worry about compensation of difficult, changing product effects

With metal detectors, products that are wet, salty and conductive are hard to ignore. They react similarly to metal when traveling through the metal detector, sometimes hiding a true metal contaminant. Additionally, partially frozen or hot products can change their characteristics over the course of the production day. This usually results in false rejects, or means you have to track and change the product effect, or worse yet, compromise detection by reducing the sensitivity settings.

These problems are eliminated with X-ray systems because they don't care about the electrical "state" of the product or its temperature. During setup run a large enough sample of products with varying shapes and thicknesses so that the system adjusts to the worst case. If, for some reason, something does change over time, you can quickly view the most recent rejected images and make adjustments. With the NextGuard X-ray system, it is even possible to adjust, evaluate and change detection levels on the fly, while inspection continues in the background.

5. Compact, complete design means installation is done in hours

The Thermo Scientific NextGuard and Xpert platforms are all available as complete systems including inspection, material handling and rejection. They can be unpacked, powered up and installed immediately. In many cases, their small size makes fitting them into a production line easy. In special situations, they can be customized for your factory or can be placed on casters to simplify cleaning and line configuration.

NextGuard without reject system (1m wide) and Xpert with reject (1.5m wide)

With start-up assistance, a factory-trained Thermo Fisher Scientfic service engineer connects power and air to the system and typically within a few hours the unit is inspecting product. The quality assurance department can then certify the system with the necessary test samples and your engineers and operators can be trained on-line for basic setup and operation. The service technician also performs a full radiation safety check (to your local regulations) and provides documentation for your records.

6. Detailed production statistics and image storage are standard

In most production environments, keeping complete records (type of product, batch number, quantity, contaminants, etc.) is daunting with metal detectors. Proprietary networking solutions lock you in to a particular vendor and available low-level protocols require custom programming and setup. A third option, manual, paper-based systems, is less than ideal in a food processing environment.

With Thermo Scientific X-ray systems, complete production statistics are saved right on the system for many months. They can easily be viewed and transferred to any PC via a USB memory stick or network connection. The data saved provides more detail than most users require. It even includes a log of which operators were running the system, what changes may have been made and if there were any system errors or alarms. Unlike metal detectors, rejected product images can also be saved for root cause analysis and recordkeeping, should there be a quarantine or recall event.

Thermo SCIENTIFIC

Statistics Report

3/9/2015 4:47:22 PM

REPORT ON COMMAND - NOT CLEARED

Line	XYZ		
Product	73	macaroni	

	Short Term/Batch Counters	Long Term Counters
Start Date	3/9/2015 4:33:54 PM	3/9/2015 4:33:54 PM
End Date		
Accepted Count	103	103
Rejected Count	50	50
Total Processed	153	153

Reject Events		50
3/9/2015 4:35:42 PM	Simple Intensity = Fail, Area Contaminant Measure = Fail,	
3/9/2015 4:35:41 PM	Simple Intensity = Fail, Gradient = Fail, Morphology 1 = Fail, Morphology 2 = Fail,	
3/9/2015 4:35:38 PM	Simple Intensity = Fail, Area Contaminant Measure = Fail,	
3/9/2015 4:35:37 PM	Simple Intensity = Fail, Gradient = Fail, Morphology 1 = Fail, Morphology 2 = Fail,	
3/9/2015 4:35:34 PM	Simple Intensity = Fail, Area Contaminant Measure = Fail,	
3/9/2015 4:35:34 PM (222)	Simple Intensity = Fail, Gradient = Fail, Morphology 1 = Fail, Morphology 2 = Fail,	
3/9/2015 4:35:31 PM	Simple Intensity = Fail, Area Contaminant Measure = Fail,	
3/9/2015 4:35:30 PM	Simple Intensity = Fail, Gradient = Fail, Morphology 1 = Fail, Morphology 2 = Fail,	
3/9/2015 4:35:27 PM	Simple Intensity = Fail, Area Contaminant Measure = Fail	

Water-tight USB port and sample PDF statistics report

7. X-ray systems are as safe to use as metal detectors

In their early years, X-ray systems producing ionizing radiation were perceived as a potential health hazard. For this reason, organizations around the world like the U.S. Food and Drug Administration (FDA) stepped in to set standards (e.g., CFR 21 part 1020) on what safety-related measures and tests are necessary to sell and install an X-ray inspection machine.

Now there are thousands of machines inspecting food every day around the world and all of them have been certified to very stringent standards, many of which are country specific. Thermo Scientific X-ray systems have passed all of these tests and they are installed in more than 30

countries. Also, since X-rays are generated electrically and are typically very low power (< 200 W), there are no worrisome radioactive sources that are difficult to manage and dispose. Additionally, there is no long lasting impact or change to the food products being inspected.
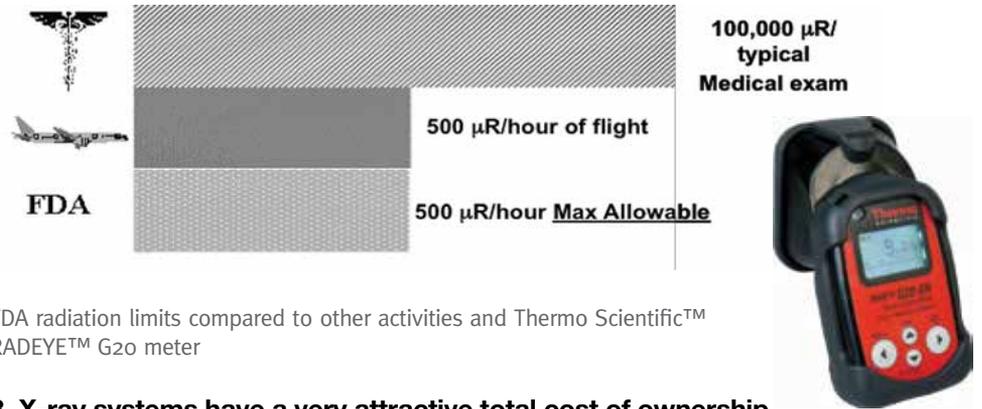
FDA radiation limits compared to other activities and Thermo Scientific™ RADEYE™ G20 meter

8. X-ray systems have a very attractive total cost of ownership

Years ago, an X-ray system cost five to 10 times more than a metal detector. Over the course of five years or more, you had to buy many expensive parts such as tubes, detectors and high-voltage power supplies. Those days are over.

The NextGuard contaminant detection system has a low entry-level price, not much more than a metal detector on a high-quality conveyor. All Thermo Scientific X-ray systems are designed to run for 10,000 hours or more without any major service. Extended warranties are available at a reasonable cost and service contracts are offered to provide preventative maintenance, priority response and safety certifications.

All X-ray sources, even the low power ones typically used today, and detectors, are subject to wear over time due to heat and radiation effects. Replacement should be planned after three to five years of typical operation. To help predict when this is required, Thermo Scientific X-ray systems have built-in timers to tell you how many hours the sources have been operating. The systems also have detector diagnostics indicating when the signals generated are weakening and replacement should be considered. In many cases, remanufactured sources and detectors are available at significantly reduced costs. The total cost of X-ray ownership has never been more attractive.

9. Perform other quality inspections for just the cost of optional software

Once X-ray images are being captured for your products, it may become clear there are other quality problems—such as under filled bags or missing/ misformed products—that you would like to detect and reject. This can usually be accomplished by simply enabling or adding optional vision software designed for the task. A common add-on inspection is to use the total density of the image to estimate weight and find gross content errors. Other vision algorithms are available to measure objects or look for variations.
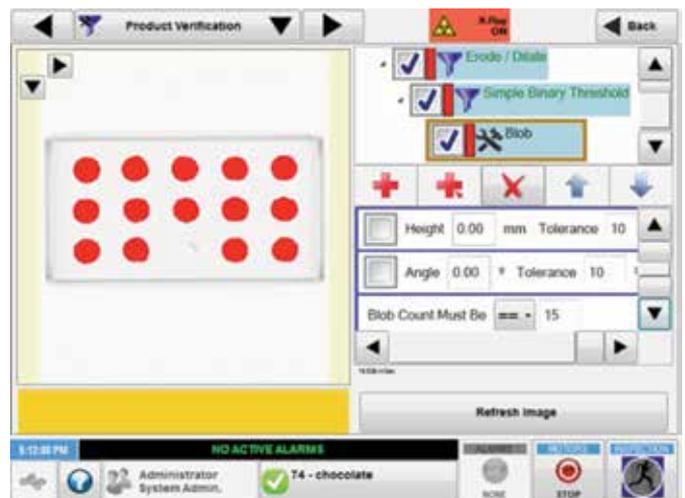
NextGuard product verification set-up showing counting application

The Thermo Scientific NextGuard system offers a unique, general purpose set of product verification tools that can be quickly experimented with to determine the feasibility of an inspection. Algorithms that transform or analyze the image can be connected in flexible ways with the

results clearly displayed on the screen in real time. This way, even with only some basic knowledge, users can try various things and quickly arrive at a result they like. Once an inspection sequence is running on line, reject images are saved so the magnitude of the quality problem can be determined and corrective actions in the production or packaging operations can be taken.

10. No need to worry about metal-free zones, ground loops, vibration or strange electromagnetic interference effects

Because X-ray systems use a totally different technique to inspect products and find foreign objects, all the arcane problems that can cause installation and use issues with metal detectors can be forgotten.

Although these problems are rare, when they do happen, getting to the bottom of them can be daunting. Even the best and most skilled technician can spend hours "chasing ghosts" and trying to determine what has changed that turns a stable metal detector into one with spurious false rejections.

X-ray systems only need power connections and relatively consistent density and texture products to operate reliably for days or weeks. Things like vibration, electromagnetic fields and even power variations have no effect. They also can be used in environments that range from almost frozen to too hot for an operator to be comfortable. They are usually rated for IP65 washdown and also can be designed at extra cost to survive caustic sanitation chemicals and high-pressure spray cleaning.

Conclusion

X-ray inspection has never been more attractive than today. There are many compelling reasons to step up from metal detection to improve food safety and quality while protecting your brand. Thermo Fisher can run samples of your products to show you exactly what X-ray contaminant detection and product verification might be able to do for you.

www.thermoscientific.com/xrayinspection

Thermo
S C I E N T I F I C

A Thermo Fisher Scientific Brand