White Paper

Bulk Flow X-ray Inspection: Providing Protection for High-Value, Unpackaged Food Production

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Key Words

X-ray, nuts, almonds, bulk ingredients, product inspection

Nuts, seeds, dried fruits and dozens of other fresh, bulk food products are fetching sky-high prices of late due to demand and supply issues caused by the drought in California. That is causing their growers and producers to revisit their processing operations as they clean, sort and package these products.

What's needed are reliable ways to maximize production while eliminating contaminants. This requires extra diligence, including the use of advanced inspection equipment to remove foreign objects. Gone are days of error prone human inspection or wasteful processes such as discarding partially clean products to avoid further inspection costs.

The overarching requirement: Avoid waste. When almonds and other nuts are so valuable that thieves are stealing truckloads of them, you don't want to be robbing yourself with inefficient production techniques.

It's a complex matter that requires a disciplined, thoughtful approach. Among the areas worth exploring is how your operation can effectively remove unwanted material from your products from the very beginning of the processing chain through the final packaged products – and with minimal waste of these ever-more-valuable food items.

The Growing Food Safety Environment

It's hardly news that we live in a lawsuit-happy world. Consumers have long been quick to hire lawyers when they find stray objects in their groceries or at restaurants. Even though many of the lawsuits are unfounded, they can be expensive to defend against.

In years past, it took a fairly major food-safety problem to make the news. Because consumers were hearing about issues primarily from newspapers, radio and television, the number of incidents that got public attention – while significant – was relatively low.

That all changed with the Internet and social media. Now each time someone spots an item that looks funny, it can instantly be shared with hundreds, thousands, even millions of people. And it's not just some written description – a photo can be snapped with a smartphone and uploaded in seconds, along with the label of the company that produced it.

So as a food producer, you now face not only legal threats, but threats to your reputation. You may find your business partners quick to protect their own reputations and to distance themselves from your organization.

The best way to manage a potential food safety problem is to solve it before it occurs.

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Are you relying on 19th-century technology to protect yourself from 21st-century threats?

For centuries, food producers have used simple techniques to sort out physical contaminants from bulk agricultural products. A screen, for example, allows bigger items to stay on one side while smaller ones fall to the other side. Separating magnets and gravity have been exploited as well to remove ferrous metals and dense materials, respectively. The original detection equipment – trained workers – can visually inspect for just about anything, but can be costly and less accurate than machines as they tire.

More recent inventions can have limitations, too. Optical sorters can only detect and reject objects that look different than the product being inspected. High-sensitivity food-grade metal detectors only find metal.

This is why advanced bulk flow X-ray inspection systems are being used to augment other inspection techniques.

What an X-ray inspection system can do for you

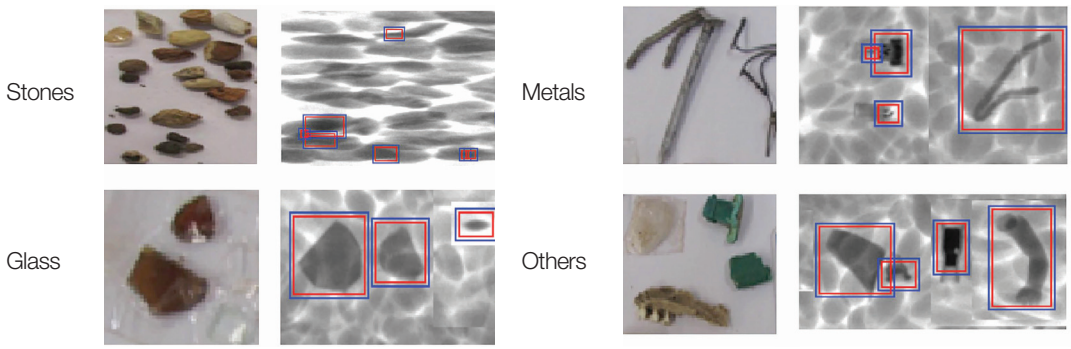
A special-use X-ray system designed to inspect bulk ingredients can find a range of objects potentially missed by other technologies. For bulk food inspection, X-ray machines are particularly useful because:

- They can detect many of the contaminants likely to be found in the production line, non-metallic objects such as stones and glass in particular
- They can find contaminants that are visually similar to the food being inspected unlike optical detectors
- They are able to find metals that contain non-ferrous material better than metal detectors

X-ray systems work by comparing densities of materials. The denser the material, the easier it is for the machine to detect. We measure density as grams per cubic centimeter (gm/cm^3) and materials such as metals are quite dense – weighing well over 7 gm/cm^3. Even if the metal is lacking ferrous content, an X-ray machine will likely catch it based on its density.

But many of the materials likely to be in the process line are not metal. The density of items such as bone, shells, Teflon® and glass is such that an X-ray system has a good chance of detecting it. The key is the size of the foreign object relative to the amount of product being inspected by the X-ray beam.

Here's something surprising about this application: Rocks and stones vary so much in density that typically a company installing an X-ray machine at a production facility will test the density of rocks and stones in the field where the harvesting takes place. A field that lies near granite deposits will have far heavier rocks than one lying near a sandstone formation, for example.



These images show common physical contaminants and how they are identified in an X-ray image.

Of course, there are limitations. It's all but impossible for an X-ray inspection system to flag such items as hair, wood, insects and small plastic bits. But X-ray systems can detect metal items as small as 1-2 millimeters and glass and rock as small as 3-6 mm.

X-rays in action: How an advanced bulk flow inspection system works

Detection works best when it is designed into a plant's overall production system and the machine is configured to efficiently track and remove unwanted items.

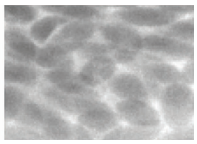
There are five elements that constitute a typical bulk flow X-ray system:

- **The infeed** – to place the product on the belt continuously and efficiently.
- **A metering system** – to ensure that product height is consistent prior to the X-ray beam.
- **Belt guides** – to keep the product flowing smoothly, free of jams and trapped food items.
- **Inspection software/hardware** – to detect unwanted material.
- **The rejection system** – to remove the least unwanted material as possible from the line.

A closer look at the details

To select a system that works for your operation, consider some of the following features:

- You should be able to accept product from the front, back or side in a flexible manner. In other words, the system should accommodate your requirements, not vice versa.
- The metering system should help ensure that the product isn't stacked too high on the belt because that would potentially allow hidden material to be out of the range of the detectors.
- The belt should have suitable guides so the product stays in the inspection area and doesn't get trapped under the belt, on the rollers or over the detector. (That would require frequent cleaning.)
- A multilane software and rejection system that monitors the flow through each lane and helps minimize the amount of food rejected, maximizing throughput.
- The system should include door and cover interlocks to assure that the X-ray source is turned off when undergoing maintenance, cleaning or repair.



The Thermo Scientific™ Xpert Bulk X-ray System

An example of using X-ray inspection to find contaminants among almonds

Thermo Fisher recently provided an X-ray system to an almond producer in California. The producer was already using other sorting methods but even so, their material still needed intensive hand labor to find and remove unwanted material. To gain efficiencies, recover more product and trim rework, the producer incorporated our bulk system at the end of the production line.

The machine was able to inspect more than 8,000 pounds of almonds per hour. (The machine's maximum is close to twice that amount.) The almonds were stacked at a half-inch depth on the belt, which allowed the machine to detect metal pieces as small as 1 and 2 millimeters and glass and stones as small as 3 to 4 millimeters in size.

By incorporating the X-ray machine, the producer saved thousands of dollars in labor, improved production output and gained consistency of detection. The Thermo Scientific X-ray system was reliable and rugged, reducing the cost of ownership and eliminating expensive downtime too.

Integrating X-ray inspection into the production process promotes food safety and quality and decreases the amount of scrap and rework. And while X-ray systems represent the best bang for the buck of all inspection devices, they are best used in combination with other inspection techniques. No one approach is perfect. An experienced and knowledgeable application specialist can help in determining how to make the best use of bulk flow X-ray.

For more information about incorporating bulk X-ray technology in the inspection process, please visit www.thermoscientific.com/xrayinspection.

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