This article discusses how combining magnetic separators and metal detectors can help maintain product purity on the production line.

**MATCH THE PROPER MAGNET WITH A METAL DETECTOR TO AVOID MATERIAL CONTAMINANTS**

Eric Confer, Eriez

While productivity is the end goal for any company involved in bulk material handling, there are considerable challenges to meet customers’ demands for product purity. Regulations coming from the FDA, the USDA, and a processing facility’s hazard analysis and critical control point (HACCP) program are especially stringent regarding any type of metal contamination.

Processors proactively invest millions of dollars annually into inspection and detection equipment, reducing the risk that any foreign objects or contaminants will become embedded in a bulk solid material and eventually make its way to end-use consumers. Increased attention to product purity on the production line has never been greater, creating the need for plant operators to detect and eliminate foreign objects before end products reach the consumer. Best-practice manufacturing operations now include detailed inspection systems to help limit product recalls and liability claims. This increased interest includes a need to protect against contaminants such as fine ferrous and nonferrous metal particles entering the material stream. Besides contaminating material, allowing foreign metal objects to pass through undetected can damage expensive downstream equipment.

**Detect and separate**

Installing magnetic separators and metal detectors can help avoid both material contamination and equipment damage in dry bulk processing. Magnetic separators come in a variety of configurations and divert ferrous materials such as fines, shavings, abraded machine parts, screws, washers, and other pieces from the material process stream.

Metal detectors detect metal contaminants entering a specific field — for instance a pipe, a conveyor, or a material chute — and then activate a rejection mechanism to remove the intruding particle. The most sensitive metal detectors can detect ferrous and nonferrous metals down to submillimeter sizes.

Matching a metal detector with a magnetic separator can be a plant’s best defense against any metal contaminants reaching end-use consumers. Why install both? No magnetic separator is ever 100 percent effective in removing contamination. The same is true for metal detectors. Removing ferrous contamination first with a magnet also means the metal detector will “reject” less frequently, reducing valuable product losses. The separator and detector working in combination can provide an as close to a perfect product yield as possible.

**Eliminating contamination early stops downtime**

Metal contamination comes from a variety of sources and at various locations in the process. Any type of fine metal can come into a process with raw material or find a way into material because of processing equipment component wear or failure. Objects from transportation vessels — truck beds, rail cars, barges, or ship holds — also may be involved. Or the contamination could originate in a loading station, silo, refinery, or from within the plant, itself, from material grinding, crushing, or general abrasion. Then there’s the human factor. Inevitably, coins, pens, and processing tools can fall into a material stream. By removing contamination early in the production stage, the right magnetic separator installed prior to a metal detector can help prevent damage to grinders, ovens, screeners, and other vital equipment.

There are several types of magnetic separators and metal detectors that work well together in dry bulk processing. This dual approach is especially effective...
in eliminating metal from whole bulk foods such as almonds, coffee and cocoa beans, and raisins, as well as from more granular bulk items like sugar, flour, crushed chili peppers, and various spices. The magnet removes the ferrous contamination, while the metal detector focuses on any ferrous metals, as well as non-ferrous metals such as aluminum, copper, brass, and stainless steel, missed by the magnet.

**Separators and detectors**

Types of magnetic separators include:

- **Grate magnets**, as shown in Figure 1, work well for removing small and fine tramp iron from dry, free-flowing materials. These units are made of one-inch-diameter (25mm) magnetic tubes in a grid formation, which allows the feed material to cascade through the grate. This effectively spreads magnetic protection through the cross-sectioned area of a pipe, chute, or hopper. Grate magnets are designed for steep-sloped hoppers, floor openings, vertical closed chutes, and ducts and help prevent ferrous and small, weakly magnetic contaminants, such as work-hardened stainless steel, from contaminating the material mix.

- **Plate magnets**, as shown in Figure 2, remove ferrous material from a dry material flow. In a typical chute installation, the magnetic material adheres to the magnet face while the product slides across the face of the magnet. The magnetic field attracts and holds ferrous material until the plate is removed for cleaning. The magnet is usually hinged and swung away from the chute and cleaned manually. Plate magnets are simple and economical to install and are very efficient at removing occasional pieces of tramp metal.

For free-fall applications, combining a rare-earth grate or plate magnet and a metal detector with a “reject” mechanism, as shown in Figure 3, achieves the best results. Installing both at the beginning of the material flow helps protect vital equipment such as grinding mills. Metal contaminants are rejected through a quick-flap “reject” unit. Pipe sizes for these uniquely designed detectors range from 1.18 inch (30 mm) to 9.84 inch (250 mm).

Magnetic separators that have moving parts, such as the Roto-Grate, shown in Figure 4, can help speed up the processing and metal removal from light, fluffy materials that tend to clog and bridge when passed through small openings. In this case, a number of powerful magnetic tubes rotate through the material. The magnetic action attracts and holds the unwanted metal, and the rotary action prevents the material from packing and plugging the processing line.
Adding detectors
Once dry material cascades through these magnets, the next stop should be for it to pass through a metal detector to “reject” all magnetic and nonmagnetic metal contamination. Metal detectors are available in washdown or non-washdown designs, depending upon the hygienic nature of a processing operation and sanitary conditions.

A tunnel-style metal detector can be strategically placed during the processing stage when bulk material is transported on a conveyor belt and before final packaging (heading for washdown or after roasting, for example). These conveyor-system metal detectors are available in various belt widths and aperture heights and can be calibrated for different material sensitivities. As the bulk material makes its way through the detector, any lingering metal is detected and removed via the flip gate or head pulley rejection mechanism.

Dry bulk material can pick up trace metal contamination as it goes through a final hopper and into a super sack or bulk bag. For extra protection, a series of tube magnets, one is shown in Figure 5, coupled with a vertical metal detector and “reject” is recommended before bagging and sealing. This final step prevents an entire sack or bag from being rejected due to metal contamination, helping protect a processor’s brand name and reputation.

Using the right magnet with the proper metal detection technology can safeguard processing equipment, ensure product purity, and protect your brand name. The tried-and-true pairing of a metal separator and metal detector keeps dry bulk material under strict surveillance at all times and prevents unnecessary machine downtime and costly maintenance.

For further reading
Find more information on this topic in articles listed under “Metal detection/separation” in Powder and Bulk Engineering’s article index in the December 2018 issue or the Article Archive on PBE’s website, www.powderbulk.com. (All articles listed in the archive are available for free download to registered users.)

Eric Confer is Eriez’s market manager — light industries. He’s responsible for growing the company’s product lines sold to the food, pharmaceutical, chemical, plastics, wood, glass, rubber, and textile markets. He earned his bachelor’s degree in international business and marketing from Penn State University and an MBA from the University of Liverpool.

Eriez
Erie, PA
814-835-6000
www.eriez.com