Inspecting Solid-Dose Pharmaceuticals State of the Industry Report

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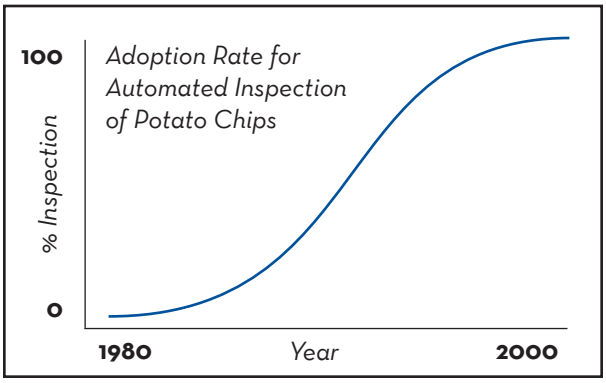
Given the relatively high value of solid-dose pharmaceuticals, the risk of mix-ups and exposure to lawsuits, it seems logical that pharmaceuticals would routinely be subjected to a higher level of quality control than a mundane product like potato chips. Surprisingly, that's not the case.

Virtually all potato chips are inspected by an optical system prior to packaging to assure final product quality. Currently, most solid-dose pharmaceuticals are inspected only via statistical sampling, which leaves companies vulnerable to a range of quality problems and the recalls and lawsuits that could come with it.

In this white paper, we will explore inspection processes used in the pharmaceutical industry to assure the quality of solid doses. The objective is to help brand owners, product manufacturers and contract packers understand what technologies are available, be aware of the shift that is occurring in defining "best practices" and prepare to lead this shift rather than follow it and be exposed to unnecessary risks.

Historical Perspective

In general, the pharmaceutical industry has been focused on creating therapeutic value, and the manufacturing and packaging of solid-doses have received less attention. However, recent recalls motivated by foreign tablets and broken tablets found in packages are putting increased focus on manufacturing and packaging operations, including inspection processes.



Nearly all potato chip processors use optical inspection to ensure final product quality

Until recently, automated inspection of solid-dose pharmaceuticals was either crude (in the case of mechanical size graders) or expensive, slow and difficult to changeover (in the case of single-file optical inspection systems). Historically, 100 percent product inspection was considered cost prohibitive, unless the product was destined for Japan, which requires 100 percent inspection.

As a result, most solid-dose pharmaceutical manufacturers and contract packers rely on statistical sampling to inspect products prior to packaging in addition to metal detectors on their packaging lines.

While metal detectors can be highly effective in achieving their stated purpose, they do not detect "foreigners" or "strangers" (tablets or capsules from a different product run), broken tablets or foreign material other than metal. Even x-ray systems fail to detect most foreigners and defects. To assure these potential problems are eliminated, products must be inspected prior to packaging.

Relying only on statistical sampling to inspect products prior to packaging means there is no sentinel on quality, which leaves a company vulnerable. Recent recalls have been triggered by tiny counts of defective doses and foreigners in packaged products, and statistical sampling is insufficient in detecting a very small number of problems in a large batch.

Most solid-dose pharmaceuticals are inspected only via statistical sampling

Companies relying only on statistical sampling are taking the greatest risk that foreigners, foreign material, broken tablets and defects make their way into packages. Additionally, these companies would potentially be exposed to the most serious regulatory actions and the largest settlements because they could not demonstrate much diligence in their quality assurance programs.

Within the past few years, advancing technology has ushered in a new type of bulk vision inspection system for solid-dose pharmaceuticals that offers an effective, affordable and fast way to achieve 100 percent inspection. This new technology prevents foreign tablets and capsules, foreign objects, broken tablets and defective products from being packaged. It confirms that 100 percent of the doses are correct and keeps records verifying such. This new technology is fueling industry leaders to reevaluate the viability of 100 percent inspection in an effort to adopt the best practices now available.

100 Percent Inspection

The advantages of using manual labor for inspecting products prior to packaging include no capital costs and it provides a basis for claiming diligence. The biggest problem with this practice is that humans are spectacularly poor at inspection, especially over time as vigilance decays. Another big drawback is that labor is expensive and these costs are rising. Yields suffer as laborers pull good product out in their efforts to be active. Finally, adding people to the process can actually increase the risks of contamination and product security from both malicious acts and unintentional mistakes.

Mechanical sorters – both traditional diverging roller sorters and newer vibratory size graders – are effective in removing broken tablets, under-filled/over-filled capsules and foreigners of a different size, but they do not remove defects and foreigners that are the same size as good product.

Many blister packing lines have integrated inspection systems that verify each blister pocket has a tablet. But since these systems do not typically verify the color, size or shape of the tablets, they are not effective at detecting and removing blisters with defects or foreigners. To assure final product quality, additional inspection should be upstream of the blister packing equipment.

Single-file or single-stream optical inspection systems, which were first introduced 25 years ago, have been implemented only when the need to assure the highest product quality outweighs other commercial considerations. Most of these systems are highly effective in detecting and removing defects and foreigners based on differences in size, shape and color. However, they have not been widely adopted due to the systems' extremely high capital costs, low throughput (often around 50,000 doses per hour), many expensive change parts and changeovers that often take as much as eight hours to complete.

The first bulk optical inspection system for pharmaceuticals was introduced only six years ago, but similar technology has a long and successful history in the food processing industry. Like single-file systems, bulk optical inspection systems are highly effective in detecting and removing foreigners and defects based on differences in size, shape and color. Unlike single-file systems, bulk optical inspection systems need not single-file or orient the products prior to inspection. They achieve high throughput, often inspecting up to one million tablets or capsules an hour, and they can be cleared and cleaned in less than five minutes. Bulk optical inspection systems are roughly one-third the cost of single-file systems, based on equivalent capacity.

Trends

Three industry trends are exacerbating the risk of mix-ups. As more pharmaceutical manufacturing and packing is outsourced, more contract facilities are running a larger variety of products, making it necessary to change lines over more frequently, which, all else equal, increases the chance of cross-contamination. The increased separation of manufacturing from packaging introduces a greater risk of mix-ups as well as foreign material making its way into product. As industry consolidation drives existing plants to handle a greater number of products, the chance of problems dramatically increases.

Best Practices

Today's best practice relies on 100 percent inspection of tablets and capsules immediately prior to packaging to remove foreign material, broken tablets and foreigners and verify the doses. While both single-file optical inspection systems and bulk optical inspection systems can be effective in this regard, bulk systems are more commercially viable due to their relative affordability and high production throughput.

The most effective bulk optical inspection systems recognize subtle difference in color, size and shape to assure every tablet and softgel conforms to product specifications. If the system offers ultra-high resolution (defined as 0.17 mm square pixels), then the system can detect and remove foreigners as well as the smallest color and shape defects. This is best achieved with systems that use four color cameras that are located both above and below the product stream to view product from top and bottom.

The effectiveness of the optical inspection system relies not only on the hardware but on the algorithms that define acceptable and unacceptable product. The equipment manufacturer's experience and success with optical inspection systems in use in the pharmaceutical industry are key indicators of their ability to deliver systems that will achieve optimal performance.

Based on what has occurred in other industries, using bulk optical inspection systems to verify pharmaceutical products immediately prior to packaging will likely evolve from being a "best practice" and become an industry standard, much like metal detection.

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