



Critical Success Factors for Optimizing Electronic Inspection

by Tim Reardon of Key Technology, Inc.
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Summary:

As technology advances and capabilities grow, electronic sorters are accomplishing things that were not even dreamed of 30 years ago. For many food processors, these optical inspection systems have become invaluable tools for optimizing product quality and assuring food safety by automating the removal of defects and foreign material (FM). But getting the most from this sophisticated equipment – superior performance and the maximum return on investment – requires planning and attention.

The plant environment, product presentation, product outfeed, sorter operation and maintenance all influence the performance of optical inspection equipment. To operate at peak performance, many factors that are critical to success should be considered and the appropriate changes implemented. In this white paper, we will examine steps that processors can take to achieve optimal performance, regardless of the exact make or model of their sorters.

Plant Environment

The ideal environment for a sorter is steam-free and dust-free. It may sound obvious but it's sometimes ignored – if visibility is obscured, it challenges the sorter, which relies on cameras and/or lasers getting a good view of the product. If a steam or dust problem exists, consider placing an exhaust system near the dust- or steam-generating device or even building a controlled atmosphere or purged enclosure for the sorter.

Likewise, factory lighting can make a difference in sorter performance. Relying on ambient lighting in the plant can be a problem since the quality of the light changes depending on the time of day, time of year and weather conditions. Ideally, plant lighting will be constant, with no direct sunlight or even reflected sunlight hitting the sorter and interfering with the cameras and/or lasers viewing product.

Vibration is an environmental factor that can challenge a sorter installed on a mezzanine. To minimize this disturbance, old bed-driven shakers that distribute a significant amount of vibration to their support structures should be replaced with shakers featuring frame-mounted drives that minimize the vibration being transferred to the structural support.

The compressed air supplied to the sorter should be dry and oil-free. To extend the life of the sorter's valves, a filtration system should be installed on the air supply and properly maintained. The benefits in maintenance cost savings are significant. Too many processors overlook this easy-to-justify aspect of the system.

Water is sometimes required for a sorter's cooling system or a clean-in-place system. To assure the cooling system functions properly, it is important that the temperature of the water be adequate and consistent. Additionally, chemicals, which are sometimes added to the water supply to control bacteria, can adversely affect the cooling system so discuss the use of these chemicals with the sorter manufacturer prior to use.

Hard water can be a problem for clean-in-place systems because it leaves mineral deposits on the camera and lighting windows that were intended to be cleaned. For plants with hard water and clean-in-place systems, a water softening solution might be necessary.

Product Presentation

To most effectively remove defects and foreign material, the sorter's cameras and/or lasers need an unobstructed view of each object. It is important to spread product out with minimal overlapping as it is presented to the sorter since overlapping product can hide defects and foreign material from view.

Flow rate control is critical to maintaining product separation. Surges in flow rates always result in less than optimum sorting performance. Ensure consistent flow rate, and the electronic systems will function better.

Most sorters have built-in infeed conveyors or chutes that are wider and faster than the conveyors and chutes in the plant. This wider, faster infeed helps spread product across the width of the sorter and front-to-back. To improve the spread, consider a customized infeed shaker for the products being handled on the line. A bias discharge shaker is very effective for some products, while specially designed chutes or diverters are more effective in other applications. If product clumping at the sorter is still an issue, additional steps such as changing the frequency or stroke of the infeed shaker or adding screens or structures to the infeed shaker can be taken to help singulate product.



Shaker Screens

To further improve the sorter's performance, reduce, as much as possible, the objects in the product stream that are not good product. For example, when producing potato products, it is important to remove slivers and fines upstream of the sorter by using shakers with screens or rotary sliver removers. An example of this is when peeled potato products are being produced, take steps to maximize the effectiveness of the scrubber to remove all loose peel. For products conveyed in water, dewatering prior to sorting minimizes the "optical noise" caused by water.



Rotary Sliver Remover

Sorter Discharge

After product is spread coming into the sorter via wider and faster handling, the product stream must come back down in speed and width at the discharge of the sorter to match the downstream equipment. The objective is to accomplish this with no product breakage or bruising.

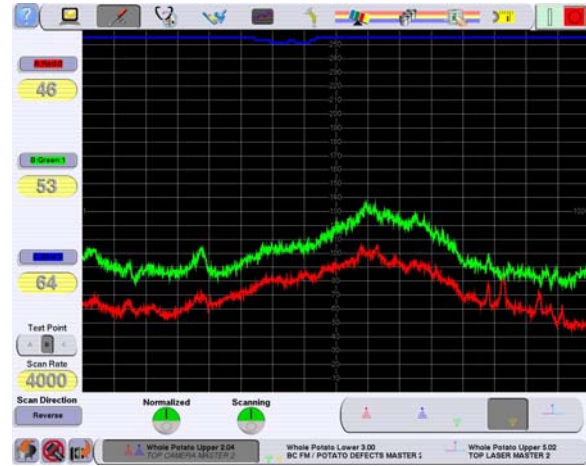
Depending on the product, a simple outfeed chute can cause breakage as the product slams into the wall of the chute. Gentler handling can be achieved with a belt or shaker that moves product in the same direction as the discharge. Although this same-direction outfeed consumes more floor space, it can be well worth it for reducing product breakage. Because the space requirements of the ideal outfeed fluctuate widely, it is best to thoughtfully consider the outfeed concept given the products being produced when the line is being designed rather than after the sorting system is installed.

A good outfeed plan also provides for the airflow coming from the ejector system. When defect rates run high, the ejectors fire often and that air will go where it can -- it follows the path

of least resistance. If the product is wet, mist travels with the ejector airflow and if the product is extremely dry, dust can be generated and carried with the airflow. Without proper planning, the airflow could cause mist or dust to collect on camera windows or other surfaces, which would degrade the sorter's performance or create sanitation issues. Ideally, the sorter's outfeed design allows the ejector airflow to travel out toward the rejected product stream or the good product stream.



Dirty Bottom Camera Window



Clean Bottom Camera Window

Sorter Operation

To maximize performance, the sorter must be correctly set-up to handle each product. In addition, a well maintained and properly cleaned sorter is critical to achieve optimal sorting results. While it is beyond the scope of this article to dive into every aspect of set-up, maintenance and sanitation, suffice it to say, the better trained the plant personnel, the better the outcome.

The most successful sorters typically operate in plants that have appointed one or more in-house sorting “champions.” The sorting champion digs deep to fully understand the equipment given the company’s products and operations. Ideally, the champion will receive in-depth sorter training from the manufacturer, followed with hands-on practice in his plant with his products. He maintains the procedures, which are often customized for the plant, production line and products. He becomes a resource for other employees who operate, maintain and clean the sorting equipment; he is available to assist them and he validates their training.



Sorter Champion

With his expertise and attention, the champion can help establish the proper settings for each product, with assistance from the sorter manufacturer. Typically, each product will have a unique set-up on the sorter to achieve the desired product specifications. Sometimes the settings are all electronic but other times, mechanical adjustments must be made to perfect the operation for each product. The software settings are usually stored in the sorter’s memory and recalled via the user interface but procedures for backing up these settings must be maintained, and procedures for establishing new settings must be in place and followed to optimize the sorter’s performance. All this is best managed by the sorting champion.

Avoid over-adjustment of the system. There is a common tendency in the industry today to make adjustments when they really are not needed. Further, it is common to see different operators using different procedures and settings; each one thinks theirs is optimum. The sorting champion and their operational procedures should help to avoid this issue.

Maintenance

Processors who believe they will save money by investing as little as possible in preemptive maintenance are sorely misguided because oftentimes, a sorter will achieve sub-par performance long before it actually fails. Sub-standard performance can be extremely costly because a resulting product quality problem can become a serious customer relations issue and a liability exposure.

Because the ideal maintenance program should take into consideration many variables that are specific to each sorter and each application, the sorter manufacturer should be consulted and their recommendations should serve as a starting point. Regardless of the specific equipment and application, quickly checking up on the sorter regularly, at pre-defined intervals, can pay huge dividends. These quick checks could be administered once every hour or once per shift or, at a minimum, once a day. Most good operation or maintenance manuals include preventative maintenance definitions and frequency recommendations.

Sorter Maintenance Schedule	
Component	Action
Each Shift	
Conveyor belt (1 day old)	Check tension
Daily	
Air and water pressure	Check pressure
Conveyor belt (1 day to 1 week old)	Check tension
Ejector valves	Cycle for 1 - 3 minutes prior to sorting
Lighting system	Verify all lamps are on
Squeegees and housing assembly at or below belt level	Wipe with a brush or damp cloth to keep clear of trapped product
Water nozzles	Check for proper operation
Windows	Wipe off
Weekly	
Cameras and laser	Normalize images. For instructions, refer to the online help system
Conveyor belt	Clean the inside of the belt with an open hose to remove any product that may have become lodged

Example Maintenance Schedule

Many potential problems can be detected very quickly, at a glance. Look at the optical surfaces – the windows that protect the cameras and lamps – to be sure they are clean. Inspect the background, which is the belt in the case of on-belt sorting, to be sure it is clean. The background inspection should include a visual check of the hardware and possibly the collection an image from the user interface, which can be examined it to be sure it is free of stains. If any of these surfaces are dirty, then spray or wipe them clean to dramatically improve the sorter’s performance.

The belt deserves a quick check to be sure it is tracking straight. Since a belt-tracking problem typically arises slowly over time and can result in unplanned downtime, taking care to inspect it and adjust it periodically can easily prevent problems.

Less frequently, perhaps once every day or two, the ejector valves should be checked. This is accomplished when the line isn’t running product, perhaps during a product changeover.

To quickly validate the sorter’s performance, look at the pass and reject streams to see whether the quality level looks reasonable. While this is a very subjective test, it is a useful check to perform. To more objectively verify the sorter’s performance, have Quality Control take samples of the pass and reject streams periodically. It is also useful to program the sorter to produce reports that quantify the occurrence of defects, by category, over time. If the defect rate has spiked up or down, it could be a problem with the sorter or with the product. Either way, it deserves investigation.

Many sorters possess the capability for their activity to be displayed remotely, for example, on a computer in a production office. Simple control chart use can provide an instant assessment of whether or not the sorter’s performance within expected boundaries.



Control Room

The Bottom Line

As the proliferation of optical sorters expands and reliance on the equipment grows, processors taking the time and trouble to utilize the technology to its greatest capability will earn the greatest rewards. By operating at peak performance, a processor's return on investment is maximized. But more importantly, product quality will be optimized and food safety assured, which will safeguard consumers, protect customer relationships and enhance the value of the brand.

Published by:

Key Technology, Inc.

150 Avery Street

Walla Walla, WA 99362

Tel: (509) 529-2161

Email: product.info@key.net

Website: www.key.net