KEY TECHNOLOGY
A DURAVANT COMPANY

White Paper

A Step Change in Digital Sorting

As technology evolves, there are times when changes are incremental and times when a step change massively disrupts the status quo. Digital sorting has recently experienced a step change. The disruptive new technology, now in commercial use at food processing facilities around the world for more than a year, offers new capabilities and delivers new standards of performance.

What's new? Everything. From the sorter's mechanical architecture to its sensors, software, ejection system, user interface (UI) and more, a combination of incremental and disruptive changes have been brought to the market. This white paper will describe what's different and present the benefits these new features bring to processors of frozen and fresh cut fruits and vegetables, leafy greens, wet and frozen potato strips, potato chips and other snacks, nuts, dried fruits, confections, IQF seafood and more.

Driving the Changes

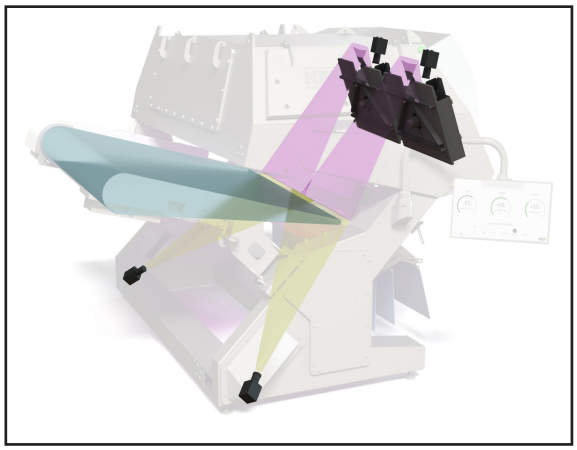
The evolving needs of food processors are what push processing technology advancements. Processors seek the next level of improvements in product quality, increases in yield, greater automation to minimize labor, enhanced equipment ease of use to reduce training requirements, superior sanitation, simplified maintenance, greater operational efficiencies and lower cost of ownership. What's new is how today's advanced digital sorters are doing more to better satisfy these objectives.

All-Sided Surface Inspection

For years, food processors looking to achieve advanced product quality objectives have wanted total surface inspection of each item in their product stream, but the production challenges of sustainably achieving this have seriously hindered its success – until now.

Thoroughly inspecting all sides of a product enables all defects and foreign material (FM) to be detected and removed. Positioning cameras and laser sensors orthogonally to the product flow allows two-sided viewing, while arranging cameras in an off-axis configuration achieves all-sided viewing of each object.

The problem with legacy belt-fed sorters is that the bottom-mounted sensors, when present, are located such that they are subject to splatter, where product residue, other debris and/or water can splash onto the sensor windows, which gradually inhibits the sensor viewing performance until the windows can be cleaned. In high-volume, continuous production environments where major sanitation routines are scheduled far apart, those extended runtimes essentially render the bottom-mounted sensors useless after a short period.



Now, a giant leap forward in full-surface inspection functionality is here. This dramatic step change is possible thanks to a new mechanical architecture on belt-fed sorters that positions bottom-mounted sensors, along with light sources and backgrounds, strategically away and protected from product splatter. With a radical new design that keeps these surfaces clean, full viewing of the product stream is sustained throughout even the longest production cycles and in the most aggressive production environments. Blind spots are eliminated and 100-percent surface inspection is maintained as accurately after equipment sanitation as it is following days and weeks of continuous operation.

Chute-fed and freefall sorters have long been able to accommodate front-and-back mounted sensors but have been limited to double-sided laser scanners and single-sided cameras or vice versa. Now, when the application warrants, the most modern chute-fed sorters can be fully configured with both laser scanners and cameras mounted on the front and back of the product stream. Since cameras are better at recognizing product defects based on color, size and shape and laser scanners are ideally suited to detect FM, equipping a sorter with both sensor types front-and-back maximizes product quality.

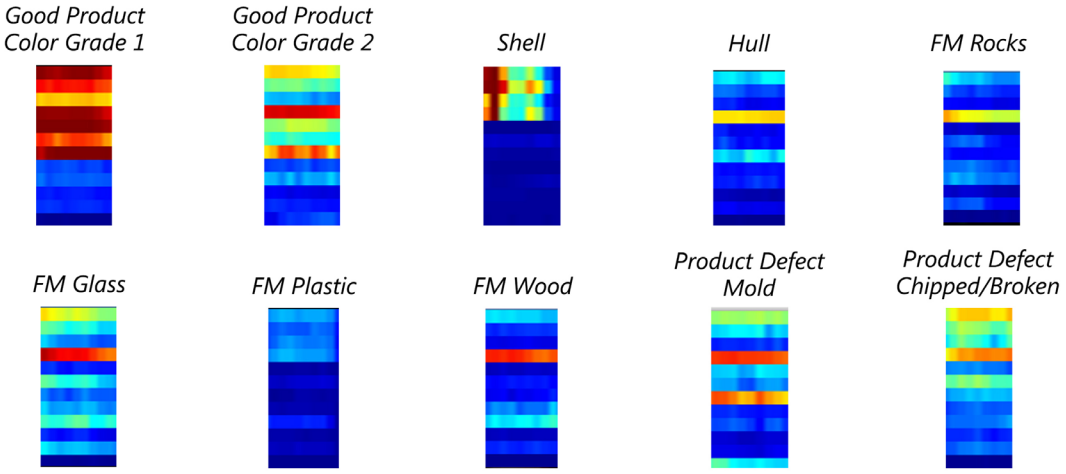
FM and Defect Discrimination

Both incremental improvements and a step change are enhancing the sorter's ability to consistently differentiate FM and defects from good product. Today's advanced digital sorters feature next-generation 4-channel cameras and laser sensors configurable with up to 8 digital channels, all at twice the resolution of previous generation systems. Higher resolution sensors can detect smaller defects and FM, and the clarity and volume of channel information from the sensors help achieve clearer discrimination between good product, product defects, and FM contaminants.

A step change is introduced on sorters that incorporate the new multi-sensor Pixel Fusion detection concept. Pixel Fusion uniquely combines pixel-level input from multiple cameras and laser sensors for the greatest detection accuracy possible. This multispectral level of analysis allows a sorter to detect and remove even the most difficult-to-detect FM and surface defects with fewer false rejects. Pixel Fusion also helps the sorter identify specific FM

types for the purpose of automatically alerting when a particular FM finding occurs during production. This capability is of most value when the tolerance for FM is particularly tight, such as when inspecting final product quality at the end of the production line, immediately upstream of packaging. Understanding when a specific FM finding occurs and being able to view a sensor image of the found FM type stored by the sorter can help food processors identify and correct the root cause of the FM introduction into the product stream. And it can help link FM and other quality issues to specific batches of raw product being processed.

Pixel Fusion™ generates unique digital signatures for next-gen material discrimination



For processors interested in leveraging chemometric analysis in addition to product quality management and FM elimination, hyperspectral imaging technology is a powerful solution. Already in widespread use on chute-fed sorters for nuts when managing a high volume of incoming shells and available as an option on ADR systems for removing potato strip sugar ends, hyperspectral imaging allows invisible product conditions to be identified and measured or used as a criteria for automated sorting.

Independent of the sensor types employed, today's intelligent sorters improve FM and defect removal by leveraging more advanced software and algorithms. For example, object-based recognition is achieved by connecting pixels, identifying the background and electronically extracting and separating each object as images are processed. This enables a variety of detailed calculations to be performed, including measuring the length, width, area, symmetry and/or shape of each object as well as the location of a defect on the product and/or the total defective surface area of an object to make accept/reject decisions.

Maintaining Grade

The primary job of any sorter is to maintain product grade, as defined by the processor, while maximizing process yield. An effective tool in this pursuit is intelligent Sort-to-Grade (STG) software, which is popular with potato processors because it enables them to accurately maintain complex final product specifications without operator intervention. As this STG capability is developed for other products, dramatic new operational and product quality benefits will become available to more food processors.

Simply speaking, STG allows a sorter to recognize and categorize every surface defect as well as the size of individual objects, intelligently performing accept/reject decisions based on how the outcome will impact the aggregate 'in the bag' product grade. For example, if the target grade permits a certain measure of minor defects to be present, an STG-enabled sorter will automatically pass only the allowed amount of that defect type. By controlling the quality of the output to a defined grade, STG ensures final product specifications are consistently met. By accurately passing only allowed defects, STG increases process yield by one to three percent while making grade. By eliminating manual adjustments, it dramatically reduces the need for any operator intervention during normal production.

Accurate Ejection

Supporting all the technology advances realized in defect and FM detection, improvements in the sorter's ejection systems have kept pace. The most modern ejection systems are customized to match the needs of the application, with air nozzles spaced ideally for each product type. Intelligent software on advanced sorters adjusts the power, pattern and duration of the air nozzles to suit the size, shape and weight of each object targeted for separation. Smart sorters can actuate one or more nozzles using contour-based or centroid-based calculations to target precise hit points on the object, maximizing removal accuracy and preventing the targeted item from disturbing the path of other objects around it. Matching superior detection accuracy with superior ejection accuracy maximizes product quality and minimizes the amount of good product inadvertently rejected.

Easing Use

At the same time digital sorters are getting more sophisticated in their ability to detect and eject FM and defects, their increased processing power is being harnessed to ease use and enhance automation. Navigating with swipes and taps, much like a smartphone or tablet, the newest sorters feature a UI that is so intuitive a new operator with minimal skills can master the full extent of its capabilities in less than one hour. UIs can provide different views and functionality access to users of various levels, depending on their needs.

New automation intelligence helps maintain peak performance while easing use by allowing a sorter to run virtually unattended during normal production. In addition to STG, which makes the smartest accept/reject decisions to achieve grade and maximize yields while eliminating manual adjustments, today's most intelligent sorters offer a host of smart features.

Auto-learning allows the sorter to automatically process trend variations in incoming product quality and determine if sort recipe adjustments are necessary. Then, self-adjust algorithms enable the sorter to automatically adapt to normal changes in the product or operating environment. Predictive system diagnostics alert users to attend to critical system components before the component has an opportunity to fail. Advanced sorters can also be programmed to send smart alarms to remote devices if certain conditions of interest begin trending in problematic directions. The FM Alert function captures, time-stamps and saves sensor images of critical FM to immediately alert to such critical FM findings. Recipe-driven operation and repeatable system calibration ensure consistent sorting performance day after day, including when running the same sort recipe across multiple sorters in different lines or plant locations.

Big Data

Modern digital sorters can be leveraged to collect, analyze and share useful information across the processor's enterprise. Called 'Information Analytics,' this highly customized capability enables a sorter to collect real-time data and generate reports about the sort process and every product and object flowing through the sorter, including leveraging data additional to that which is required to perform the sorting operation. By turning data into knowledge, it facilitates the processor making more informed decisions about line functions upstream and downstream of the sorter.

What's evolving rapidly is the ease of harnessing large amounts of valuable data. Today's most sophisticated sorters feature advanced software that enables universal connectivity via an OPC-compliant infrastructure, supporting integration with virtually any factory automation system such as MES or SCADA from various manufacturers. Additional integration scenarios include support for Modbus and Ethernet/IP devices, as well as the creation of CSV and database files.

Sorter connectivity enables the remote management of the system in addition to data reporting. Remote access via a secure portal eases use by allowing the sorter to be monitored and controlled by personnel off the plant floor, including management and the sorter's supplier located off-site. This capability increases the first-time fix-rate, reduces in-plant service requirements and speeds issue resolution time to improve performance, increase uptime and extend equipment life.

Conclusion

For food processors looking to enhance product quality, increase yield, reduce training requirements and improve operational efficiencies, the newest digital sorting equipment is worth close consideration. Those who recognize and implement successful new technologies ahead of the rest – the early adopters – put themselves in a position where valuable competitive advantages can be won.

Published by:

Key Technology, Inc.
150 Avery Street
Walla Walla, WA 99362

T 509.529.2161
E product.info@key.net
www.key.net