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White Paper

A New Approach to Control Potato Strip Defects

Many electronic sorters and Automatic Defect Removal (ADR®) systems are capable of identifying the same types of defects on potato strips with equal effectiveness. Sorters reject the entire strip containing the defect while the ADR actually cuts the defect from the strip. For processing lines combining ADR and sorters, the question becomes which comes first, the sorter or the ADR?

The most common approach currently used by most processors to control defects in potato strips includes a sorter, followed by an ADR on the sorter's reject stream, followed by a nubbin grader. The 64 percent defect removal rate that this configuration is capable of achieving has historically been sufficient for many potato processors.

However, those processors looking to sell to upscale markets by offering higher quality product and those plagued by poor incoming product quality may benefit greatly from an alternate approach. This solution, called ADR®First, achieves a defect removal rate of 80 to 93 percent, depending on the configuration. With this development, processors can now improve the quality of their finished product while simultaneously controlling the length of strips in ways that were previously impractical.

In this white paper, we explore various line configurations that can be used to control the quality of potato strips. We will highlight the benefits of each and identify the processors that are ideally suited for each based on their production volume, range of products, and quality objectives.

The goal of this paper is to help potato processors identify the ideal line configuration for their specific applications.

A Brief History

When ADR systems were first introduced in 1983, potato processors were able to remove scores of workers previously required for hand-trimming defects. In addition to reducing labor costs, they increased yields and improved product quality.

But these early ADR systems, which featured water-actuated knives and water cooled lights, could suffer from failures of valves or lighting. Sorting systems came on the market in 1986, allowing processors to install optical sorters upstream of the ADR systems. By placing a sorter upstream of an ADR and sending only the sorter's rejects to the ADR, 70 to 90 percent of incoming strips bypassed the ADR, improving reliability over those early ADR systems while retaining the benefits of automating defect removal.

This sorter-ADR line configuration is the de facto standard in the industry today.

The typical sorter rejects 80 percent of all incoming defects and sends them to the ADR, which then removes about 80 percent those defects. Thus, a net defect removal of 64 percent is achieved (80 percent of 80 percent). This is what most potato strip processors are experiencing today.

The Changing Situation

In 1999 the fourth generation ADR system was introduced. In addition to a new generation of electronics, it began using air valves rather than water valves to extend the knives; the reliability of the valves improved dramatically and inadvertent white cube generation became virtually non-existent. The advantage of positioning a sorter upstream of the ADR came into question and alternative line configurations began to be explored. Several market conditions are increasingly fueling this exploration.

For processors wanting to satisfy the most quality-conscious customers, a net defect removal rate of 64 percent is insufficient. Many Asian markets, including Japan, require quality that is difficult to achieve with the current sorter-ADR processing line. These processors want a new approach that improves the quality of their finished product.

Other processors are looking to produce more typical finished product quality but regularly suffer from substandard incoming product quality. As the industry expands into new geographies where crop dusting, adequate irrigation, or rapid harvesting and transportation to storage facilities are less available, raw potato quality often declines. In some areas, processors must grow their own crops, leading them to use potatoes even when the quality of the crop is poor. For these processors, the standard 64 percent defect removal rate of the traditional sorter-ADR line may be insufficient.

The third type of processor most interested in an alternative to the standard sorter-ADR line is interested in maximizing yields. Even infrequent experiences with poor incoming product quality on a traditional sorter-ADR line can have costly consequences because an overloaded ADR leads to excessive white cube generation. Additionally, ADR is highly effective in smart cutting and controlling strip length but when 80 percent of the product bypasses the ADR system, this yield-enhancing capability can be only marginally effective in optimizing quality and recovery.

The ADRFirst Approach

In a processing line where most of the production is strips, the ideal ADRFirst line configuration is an ADR followed by a nubbin grader. This system will typically achieve an

80 percent defect removal rate, a significant improvement over the 64 percent typically achieved with the sorter-ADR line. At the same time, eliminating the sorter reduces capital costs and maintenance. However, this solution controls quality only for strips.

For lines that handle cuts other than strips, an alternative ADRFirst solution may be preferred, one that includes a sorter downstream of the ADR and a recirculation system from the sorter's reject stream back to the ADR. This configuration provides the highest defect removal of any solution. Of the incoming defects, 80 percent are removed during the first pass through the ADR, sending 20 percent of the defects to the downstream sorter that rejects 80 percent of those defects. Thus, the system recirculates 16 percent of incoming defects (80 percent of 20 percent) back to the ADR. After passing the recirculation flow through the ADR, the net defect removal of this line is an impressive 93 percent.

This ADR-nubbin grader-sorter line configuration is ideal for maximizing product quality. It is also ideal for lines that handle a significant volume of cuts other than strips. While strips pass through both the ADR and sorter to achieve that 93 percent defect removal rate, wedges, waffle cuts, spiral fries, and pomme Parisians bypass the ADR and an 80 percent defect removal rate is achieved with the sorter.

Processors with small lines producing up to 3.6 metric tons of finished frozen potato strips an hour can benefit from the ADRFirst solution that features one ADR and a subsequent sorter. If the line uses only the ADR without the following sorter, the capacity is 4.8 metric tons. For processors with lines producing higher volumes, more than one ADR system can be installed to achieve these high quality objectives.

Additional Benefits of ADRFirst

As discussed, the primary benefit of ADRFirst is higher defect removal rates, which help processors of potato strips produce higher quality products and effectively handle higher incoming defect rates.

But even potato processors who only occasionally suffer from poor incoming product quality will benefit from this new approach. Traditional sorter-ADR lines plan for a maximum flow of product through the ADR of 30 percent, based on an incoming defect level of 20 percent and a 2:1 bad:good ratio in the sorter's reject stream. When incoming defect levels exceed that 20 percent, which happens often late in the storage season or when the sorter gets out of tune and rejects more good product than the typical 2:1 ratio, the ADR becomes overloaded. This condition results in more white cube generation, significantly reducing yield.

Even when incoming product quality is good, ADRFirst can improve yields. Since 1999, ADR systems have featured multispectral cameras that enable object recognition, allowing the system to identify individual strips. In addition to cutting defects, ADR can make a wide range of smart cutting decisions that help processors get the most from their product.

For example, if a particular product run can tolerate passing a minor defect, ADR can chose to pass one that would create nubbin loss instead cutting defects that won't result in this loss of recovery. Similarly, if a strip is longer than a specified threshold, ADR can cleanly cut it in two or three pieces, depending on its length, even if no defect is present. This length control capability results in fewer bag seal failures, improved line flow at gates, and increased yield by reducing product breakage, while meeting product specifications.

The Bottom Line

The early adopters of ADRFirst were processors with low volume potato strip lines, looking to control defects while minimizing capital costs. These early adopters have shown that the effectiveness of this new approach is better than the standard line configuration in use today in terms of improving defect removal, length control, and yield. The performance and payback are so compelling that ADRFirst should clearly become the new standard for potato strip processors, large and small.

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