Considerations When Selecting a 90-Degree Sortation System

White Paper
Introduction

The different sortation systems on the market today can be classified according to three aspects of functionality: type of product handled, sorting speed, and how products exit the sorter. The purpose of this white paper is to examine different sorting technologies based on the way products exit the sorter, identifying which solutions are available, and what criteria should be noted.

There are roughly three different ways that products exit a sorter: at an angle of 90 degrees with a change of orientation; at an angle of 20-30-45 degrees; or at random into a large chute. This white paper will focus on the first one, where products are sorted at a 90-degree right angle with a change in orientation.

Classifying 90-Degree Sorting Technologies

When selecting a 90-degree sorting technology, it is important to identify the required specifications. As with any type of sorting, the most important information is required throughput, product type, and available footprint.

Throughput

Product type

Space
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Classifying 90-Degree Sorting Technologies

Throughput

For any sorting system, the throughput will be based on system speed, product dimensions, required gap, and sorting accuracy. For example, while a cross belt sorter can sort over 200 products per minute, a pusher is typically limited to 40-50 PPM.

Table 1 shows the throughput ranges that various sorting technologies can typically accommodate. If multiple sorters can meet a certain throughput, then other criteria like product type or investment and operational costs will dictate sorter technology choice.
Classifying 90-Degree Sorting Technologies

Product/Package Type

Defining all of the different product types a sorter needs to be able to handle can be difficult. In certain situations, it may be acceptable to exclude particular low-volume products from the automated sorting system in order to select the desired sorting technology; however, it is unadvisable to exclude any significant portion of the product flow from the sorter in order to reduce sorter investment costs. It is important to consider not only the direct cost of labor to sort these products manually, but also the cost and inefficiency associated with having two sortation systems in place (automated and manual), as well as the effect on cycle time to complete an order. It is impossible, in certain cases, to completely prevent having non-conveyables, but preventing them where possible may provide a quicker return on investment than anticipated.

Table 2 shows what products each sortation system is capable of handling.

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<th>Pushers on Belt Conveyor</th>
<th>Right Angle Transfers</th>
<th>Pop-Up Roller in Strip Belt Conveyor</th>
<th>Dual Activated Roller Belt</th>
<th>Tilt Tray</th>
<th>Cross Belt</th>
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Key:  ■ Excellent  □ Good  □ Fair  □ Poor
Considerations when Selecting a 90-Degree Sortation System

Classifying 90-Degree Sorting Technologies

Space

Available floor space will dictate whether a line sorter or loop sorter may be used. With line sorters, product is fed in at the front and sorted off to the side. With loop sorters, products are fed in from the side – usually from multiple positions – and sorted off to a side. Cross belt and tilt tray sorters are typically loop sorters; the other sorters listed are typically line sorters.

Other parameters to consider with regard to space are the required width of the outfeed and the centerline distance between outfeed conveyors. (If the outfeed conveyors are very wide and there are several meters between outfeeds, this factor is less important. If the width of outfeed conveyors needs to be limited, or if it’s desired to place outfeeds close together, this factor deserves consideration.)

When a product of a certain weight is moving forward at a certain speed and is then diverted at an angle of 90 degrees, kinetic energy remains in the product as it is diverted. When the product is pushed to the side, it will not just move sideways, it will also continue to move forward. As a result, the product is not traveling at a true 90-degree angle, and the continued forward motion must be calculated in the outfeed width. Note that this effect will not be the same for all products — heavy products will have more kinetic energy and therefore typically move forward more. Also, in the case of pop-up systems, products which have weaker contact between their bottom and the divert rollers will not accelerate to the side as fast, and therefore will require a larger outfeed.

For pop-up systems and pushers, this effect caused by the kinetic energy in the product can be countered with a stopper blade pop-up at the outfeed, which interrupts the product’s forward movement (and thus takes away its kinetic energy). This practice, however, requires larger gaps and as a result reduces throughput. Also, one should pay attention to the speed and impact with which the product hits the stopper blade, as it may compromise product integrity.

The DARB Sorter S400 counters this effect differently. When sorting a product at 90 degrees, it accelerates the product not just sideways, but also backwards. This allows sortation of the product into a very narrow outfeed. Because the backwards acceleration (relative to belt travel) is proportional to the machine speed, this method is effective even at high throughputs, enabling gentle sorts into an outfeed just 4” (100 mm) wider than the product’s length. This not only allows for narrower outfeed conveyors, but also for the tightest divert spacing amongst all right angle line sorters.
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Sortation Technologies

Low- to Mid-rate Sorters

**Pushers**

A pusher uses a mechanical diverter to push products off the side of a conveyor at the sort location. Standard pusher sorters can typically handle throughputs of up to 2,500 PPH. The throughput rate is limited by the maximum acceptable impact to the product by the pusher and by the time it takes for the pusher to extend and retract (which determines product gapping). Higher throughputs can be obtained by using turning pusher pedals, where the pusher does not need to retract, or with overhead pushers, which work according to a similar principle.

**Benefits:** Relatively low-cost solution (Turning pusher pedals or overhead pushers tend to be more expensive.)

**Disadvantages:** Impact on the product; safety concerns; limited rate; package type limitations

**Right Angle Transfers**

Right angle transfers are commonly used for sorting a smaller product size range, or, preferably, for one product size, such as in automated systems that work with standardized totes. The system consists of two or more narrow belts that pop up from between the rollers of the main conveyor line. It sorts products off without impact and is relatively easy to incorporate into long conveyor systems. The throughput of these systems is generally limited to 1,600-2,400 PPH.

**Benefits:** Relatively low-cost solution; no impact on the products

**Disadvantages:** Throughput is restricted; limited product size range; package type limitations

**Pop-up Rollers in Strip Belt Conveyors (Narrow Belt Sorter)**

Pop-up rollers are somewhat the inverse of pop-up belts — the rollers pop up from between a set of narrow belts. This system can handle a throughput as high as 2,400-3,600 PPH; above that rate, the kinetic energy in the product and the abrupt sideways acceleration make the sort less controlled. For a long time, pop-up rollers allowed for the highest throughput for 90-degree sorting, without requiring a loop sorter.

**Benefits:** No impact on products; reasonably priced

**Disadvantages:** Throughput restricted; limited product size range; package type limitations; each divert requires as individually wired 480VAC motor
Mid- to High-rate Sorters:

**DARB Sorter**

The DARB Sorter is a modular plastic belt with embedded rollers that extend above and below the belt surface. When the belt rollers are activated, they begin spinning to sort products off. Because the rollers are embedded in the belt in such a way that their spinning motion compensates for the forward motion (and thus kinetic energy) of the product, the DARB Sorter allows for precise sorting at higher throughputs. The roller surface provides capable product handling, allowing this sorter to handle almost the same product range as a cross belt or tilt tray sorter.

**Benefits:** The highest throughput of low/mid-rate sorters; product handling capability near that of high-rate sorters; if rate is achievable, a DARB sorter can be considerably less expensive than high rate options; high divert density

**Disadvantages:** More expensive than low/mid-rate sorters
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Sortation Technologies

High-rate Sorters:

**Tilt Tray Sorters**

With this sorter, typically built in a loop design, product is introduced from the side onto large trays. These trays travel forward until they reach the right sort destination. At that point, the trays tilt to allow the products to slide off into the outfeed. These trays can travel at high speeds, and, because the technology requires little gaps, throughputs can reach very high levels. The product range that tilt tray sorters can handle is vast. Any product that can be placed on the tray is able to exit the tray with the force of gravity.

**Benefits:** Very good product handling; very high throughput; high divert density

**Disadvantages:** High-cost system; layout must accommodate a loop design; sorter induction is more complex and costly than other alternatives

**Cross Belt Sorters**

Like tilt tray sorters, cross belt sorters are generally built in a loop. They consist of a number of small flat belt conveyors called “trays” that run perpendicular to the forward movement of the tray. Products enter from the side, where the belt on the tray can be used to get an even larger product range onto the system. When the tray is at the right destination, the belt will start running, sorting products off to the side. Because the trays can move very fast, this system can also handle high throughputs.

**Benefits:** Very good product handling; very high throughput; high divert density

**Disadvantages:** High-cost system; layout must accommodate a loop design; sorter induction is more complex and costly than other alternatives
Conclusion

There are several sorting technologies on the market for 90-degree sorting, all of which have benefits and disadvantages. Whether a particular sorter is a good choice for a particular project will depend on the details of the situation. To choose the right sorter, first identify the required product type, throughput, and available space for the system, and then any additional desires for the system, and choose accordingly.

Table 3 lists all criteria described in this white paper to help identify, according to product type and sorting rate, which technologies are appropriate for certain projects.

| Throughput (PPH) | 0-500 | 500-1000 | 1000-1500 | 1500-2000 | 2000-2500 | 2500-3000 | 3000-3500 | 3500-4000 | 4000-4500 | 4500-5000 | 5000-5500 | 5500-6000 | 6000-6500 | 6500-7000 | 7000-7500 | 7500-8000 | 8000-8500 | 8500-9000 | 9000-9500 | 9500-10000+ |
|-----------------|------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|
| Boxes (standard type & size) | | | | | | | | | | | | | | | | | | | | | | |
| Boxes with rounded bottoms | | | | | | | | | | | | | | | | | | | | | | |
| Small products (<6" wide or <9" long) | | | | | | | | | | | | | | | | | | | | | | |
| Large product range (bottom dimensions) | | | | | | | | | | | | | | | | | | | | | | |
| Large product range (height) | | | | | | | | | | | | | | | | | | | | | | |
| Flat products (>10 mm) | | | | | | | | | | | | | | | | | | | | | | |
| Fragile products | | | | | | | | | | | | | | | | | | | | | | |
| Bagged products | | | | | | | | | | | | | | | | | | | | | | |
| Heavy products (>75 lbs) | | | | | | | | | | | | | | | | | | | | | | |

**Pushers**

DARB Sorters

Right Angle Transfers & Pop-up Rollers

Tilt Tray Sorters & Cross Belt Sorters

How to use this table:

- Pick a product from the left of the table. If you are sorting multiple products, choose the product that is lowest on the list.
- Where throughput and product type columns meet on the table indicates the sorters that are the lowest-cost technologies for the required circumstances.

Note: When pushers are indicated but are not an option due to concerns of worker safety and product damage, either right angle transfer or pop-up rollers are acceptable alternatives.