



CONVEYING FRESH-CUT PRODUCE

The State-of-the-Industry Report

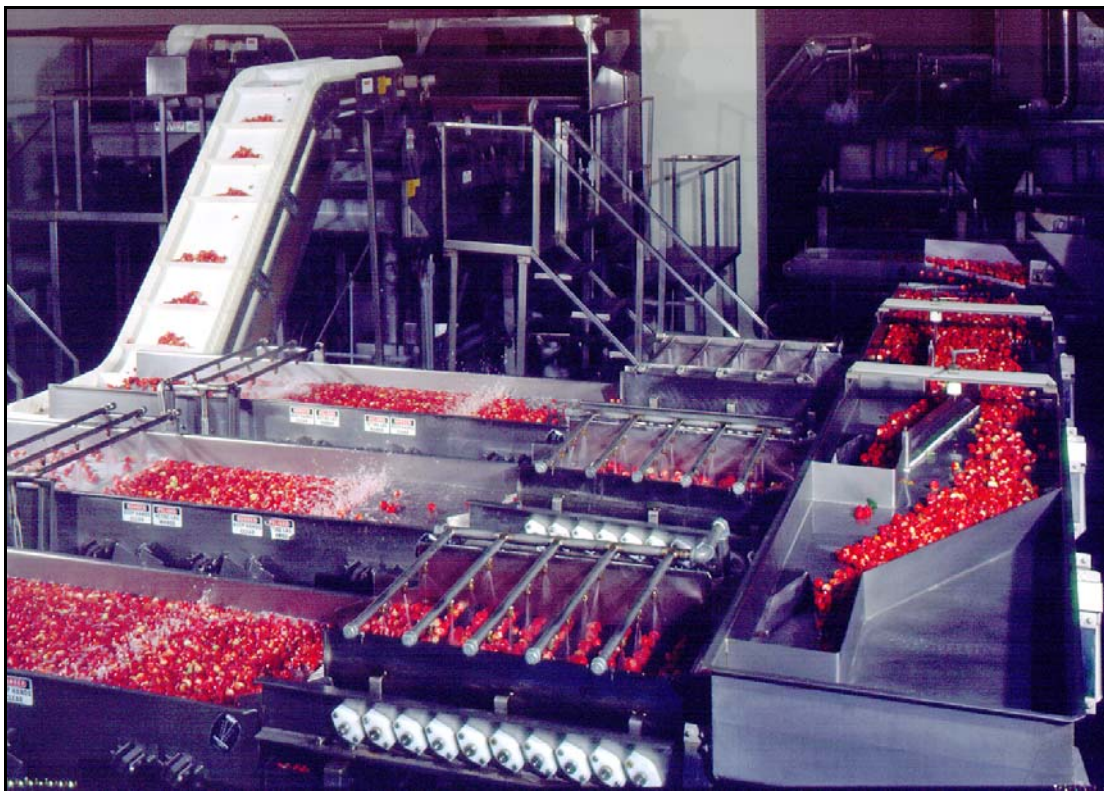
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Summary:

Many fresh-cut produce processors and packers have traditionally relied on belt conveyors to transport bulk and packaged product on their production lines, in part because low capital costs make these conveyors seem so affordable. But when ongoing maintenance and sanitation costs are factored in, the affordability equation shifts in favor of other conveyor types. Add performance issues like gentle handling and throughput into the analysis and each fresh-cut product and application points to its own ideal conveying solution.

In this white paper, we will explore the types of conveyor systems that are suitable for fresh-cut produce – belt conveyors, vibratory conveyors, and horizontal motion conveyors – highlighting the strengths and weaknesses of each. We will consider a variety of fresh-cut products from leafy greens to whole and cut fruits and vegetables as well as a range of applications from simple conveying to dewatering, fines removal, and more.

The goal of this paper is to help fresh-cut processors and packers identify the most effective conveying solutions for their specific applications.



A combination of conveying types provides effective distribution, sizing and washing on fresh strawberries

Belt Conveyors

Belt conveyors typically offer the lowest initial capital cost of all the conveying solutions, which contributes greatly to their popularity. But such a simple cost analysis is shortsighted because high maintenance and sanitation costs cause the total cost of ownership of a belt conveyor to quickly rise.

Although the initial price tag for a vibratory conveyors and horizontal motion conveyors is often \$8,000 to \$10,000¹ more than belt conveyors, that higher upfront cost is quickly recouped because it can cost \$3,000² a year more to maintain and clean a belt conveyor. Keep a conveyor in operation for more than three years, and the vibratory or horizontal motion shakers usually cost less.



Although a total cost of ownership analysis indicates that vibratory and horizontal motion conveyors are less expensive than belt conveyors in the long run, there are fresh-cut applications that are best served with belt conveyors, warranting their use despite the higher cost. These applications include the following:

- Belt conveyors are ideal for achieving significant changes in elevation. Vibratory shakers are effective if the required incline angle is 10 degrees or less but beyond 10 degrees, a belt conveyor is needed.
- Layering belts where incoming product is loaded either manually or automatically are best accomplished with belt conveyors because of the slow rate of movement - typically 3 to 4 feet per minute - which is needed to achieve a well-mixed product.
- Trim tables can be served with either belt conveyors or vibratory shakers. Belts are sometimes preferred because they offer the most flexibility in speed.
- Two-level storage conveyors that convey fresh-cut produce from a washer to a dryer are belt conveyors for two reasons. First, there is usually a significant rise in elevation. Also, a belt conveyor can easily move both forward and backward, which allows the two-level storage belt to transition product to the lower level if the dryer is mid-cycle and then bring that product from the lower level back when the dryer is available for loading.
- Conveying packaged product can be achieved effectively with either a belt conveyor or a vibratory shaker. The sanitation advantage of a vibratory shaker is less of a factor with packaged product, making a belt conveyor appropriate here.

Vibratory Shakers

There are two main types of vibratory conveying systems – true natural frequency conveyors that feature mechanical drives and electromagnetic conveyors that feature electromagnetic drives. Both use frame-mounted drives and spring arm assemblies to distribute energy to the conveyor bed, producing a diagonal, harmonic motion that moves product forward.

Traditional vibratory conveyors that use mechanical drives produce a low amplitude, high frequency movement. Electromagnetic shakers allow conveying pan amplitudes to range from zero to 100 percent, which makes them ideal for lines that handle a wide variety of products as well as lines that require precise metering.



Compared to belt conveyors, vibratory conveyors are inherently cleaner with stainless steel product zones and no belt to pulley/gear laminations. They also reduce maintenance, which results in a lower total cost of ownership over the life of the conveyor. Some newer vibratory shakers take low maintenance to the extreme with “lube-for-life” mechanical drives that eliminate the need to lubricate or change oil.

In addition to these across-the-board benefits, there are specific applications that do particularly well with vibratory conveyors, as follows:

- Leafy greens are conveyed more effectively with vibratory shakers than with horizontal motion shakers. This is because the product actually absorbs the energy of the shaker so the slight vertical lift of the vibratory conveyor helps move the product forward.
- Vibratory conveyors are ideal for dewatering, as the vibration releases the bond between surface moisture and product. As it conveys, the product tends to turn over, exposing each side to the additional pull of gravity, enhancing the shedding of water. Furthermore, the water can be easily collected from a vibratory shaker, which allows a processor to recycle it. This dewatering application is ideal for a wide variety of fresh-cut produce including leafy greens, mushrooms, green beans, onions, carrots, celery, and some fruits such as strawberries, blueberries, and cut apples.
- Vibratory conveyors are beneficial for product distribution on processing lines and packaging lines because gates can be easily opened and closed to divert product to multiple points.
- Depending on the product, vibratory conveyors can work effectively for sizing. A multi-deck shaker is fitted with screens that allow product of a particular size to drop to the lower level. An operator can quickly swap the screen to change the size. If the product is prone to binding, another type of vibratory conveyor – a diverging bar grader – may be ideal.

- Fines removal is handled well with either a vibratory conveyor or rotary-style sliver sizer remover. The rotary style remover is perfect for many round products such as tomatoes, where sliver shaped fines are created during the cutting process. The vibratory shaker is perfect for many non-round products such as spinach where processors need to remove the cotyledon leaf.
- Vibratory conveyors, especially electromagnetic shakers that start and stop quickly, are ideal for scale feed applications where accurate metering to scales greatly enhances scale and bag performance.
- Feeding a cutter or slicer, where product orientation and singulation improves the effectiveness of the operation, is handled best with vibratory shakers.
- Removing core from cut lettuce or other heavy materials from other lighter products can be accomplished with a multi-deck density separation shaker - a type of vibratory shaker.
- Cooling and drying can be maximized using vibratory shakers equipped with a device that circulates chilled air through the product during conveying. Vibratory shakers can also be fitted with a jacket that circulates refrigerated coolant under the conveyor bed to chill product.

Horizontal Motion Shakers

Like vibratory conveyors, horizontal motion conveyors offer more gentle production handling than belt conveyors and lower maintenance and sanitation requirements lead to a lower total cost of ownership than belt conveyors.



Horizontal motion conveyors provide gentle handling for delicate products that can slide on the conveyor bed without being damaged, such as whole mushrooms. Leafy greens, however, get scuffed and damaged by riding on the bed of a horizontal motion shaker so vibratory conveyors provide gentler handling for these types of products. Also, the slower conveying speed of horizontal motion sometimes encourages processors to run product deeper to get the throughput they need, and loading delicate products deep can cause damage.

Another significant difference between horizontal motion and natural frequency vibratory conveyors results from dynamic loading. Horizontal motion shakers create high dynamic loads during operation and require isolation via a separate deck, while vibratory shakers require no additional isolation and can be suspended from overhead, mounted to other machinery, or supported from the floor. Thus, horizontal motion conveyors have less installation flexibility and higher installation costs compared to vibratory conveyor systems.



Despite the general advantages of greater throughput, improved installation flexibility, and reduced installation costs that vibratory shakers have over horizontal motion shakers, there are specific applications in which horizontal shakers are ideal, including the following:

- Horizontal motion conveyors are perfect for some delicate products when high throughput is not important. In addition to whole mushrooms, whole potatoes, which bruise easily, are handled well with horizontal motion when they are not loaded too deep into the conveyor bed. This gentle handling advantage must be considered on a product-by-product basis because many seemingly delicate products such as blueberries are handled well with vibratory conveyors and other products like leafy greens are actually handled better with vibratory conveyors.
- For fresh-cut produce that is not delicate, especially products that have no flat sides to scuff along the bed of conveyor, like baby whole carrots, horizontal motion conveyors work well. For these products, the throughput that can be achieved with higher-speed vibratory shakers can be matched on horizontal motion shakers by increasing the depth of the product flow.
- Unlike vibratory conveyors, some horizontal motion conveyors can reverse product flow, which increases the flexibility of the line.
- Although the noise of a horizontal motion conveyor drive is similar to that of the traditional vibratory conveyor drive, some products such as baby whole carrots that would make a drumming noise on vibratory shakers will run more quietly on horizontal motion shakers. That said, electromagnetic drives are the most quiet of all, so if product drumming is not an issue, an electromagnetic vibratory shaker will be the quietest solution.
- Because horizontal motion conveyors can be heavily loaded, they provide some bulk storage capacity on the production line when conveying product in which gentle handling is not important.

Conclusion

To select the ideal conveyor for each situation, fresh-cut processors and packers should take into account a wide variety of factors from costs to performance issues.

To determine the total cost of the conveyor system, start with the initial capital cost plus the cost of installation and add the projected annual maintenance and sanitation costs over the anticipated life of the equipment. Such a long-term view highlights the relative affordability of vibratory and horizontal motion shakers over belt conveyors.

Beyond costs, the strengths and weaknesses of each conveyor type should be considered as well as the specific applications in which one particular type of conveyor excels. Some delicate products such as leafy greens are gently handled with vibratory conveyors while other delicate products such as whole potatoes are handled well with horizontal motion conveyors. The benefits each type of conveyor must be judged on a product-by-product basis.

To help navigate this complicated analysis, processors and packers should consider working with an equipment supplier that offers expertise in the fresh-cut industry and provides a full

range of conveying solutions to choose from. With a deep and broad knowledge base, such a supplier can be a valuable resource in identifying the ideal conveying solutions that create competitive advantages by improving the performance on the production line. Because, if designed properly, conveyors can do much more than simply move product throughout the plant. Gentle handling, effective dewatering, and chilling, to cite just a few examples, can improve product quality and extend shelf life.



A Vibratory Inspection Conveyor

¹ For a conveyor that is 24 inches wide and 15 feet long, a typical belt conveyor might cost \$12,000 to \$16,000 while the cost for a comparable vibratory or horizontal motion shaker is closer to \$20,000 to \$25,000.

² For a detailed breakdown of ongoing maintenance and sanitation costs, go to <http://www.key.net/files/products/fresh-cut-solutions.pdf>; see the table titled *Yearly Operating Cost Comparison* on page two.

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