

How to Increase Conveyor Line Efficiencies by Removing Change-over



Discover real-time conveyor equipment that eliminates or reduces the need for change-over on multi-SKU lines.

Change-over is defined as the work and time involved between making the last good product of one recipe and making the next good product that from a different recipe at normal production speed. According to Consulting Engineer1 magazine, the losses associated with change-overs range from 5% to 25% of available production hours -- can be eliminated.

For high-volume food and consumer goods manufacturers, every minute of change-over down-time can cost thousands of dollars in unproduced product. In high capacity production environments, forward thinking manufacturers look to minimize or eliminate the need for change-over and at the same time plan for system adaptability for product sizes of the future.

In this white paper, conveyor equipment and controls solutions are highlighted that solve the problem of increasing through-put on multi-SKU lines:.

1. Conveyor systems that eliminate change-over tasks.
2. Conveyor systems and devices that can change-over while machines and conveyors are still running.
3. Quick change-over technology that requires a shut-down to accomplish the task.

Mistakes to Avoid When Eliminating Change-over Tasks

The first premise to understand when designing a multi-SKU manufacturing conveyor line is that in order to reduce or eliminate change-over, the guide rails need to be set for a group of products. Typically, the guide rail opening will be set to the largest product size running on the line, and similar sizes will travel within that guide rail setting without changing the rail setting.

In planning for generalizing guide rail settings, it is important to also plan for issues that arise with product handling. Product control is different when tighter guide rails are not utilized. Some common mistakes that happen when planning multiple SKU lines are:



No change-over required on conveyor system.



Guide rail change-over required by product grouping.

Avoid Accumulation in the Turns

Products nest differently when backed-up through turns. As the chain continues to run while the products are stopped and accumulated, the products begin to skew. If the guide rails are too wide, the package can actually become disoriented. Without guide rail control, accumulating through turns can also cause product damage. Product disorientation can cause a jam either on the conveyor equipment or at the in-feed of machines on the line, and most likely will require a production shut-down to correct.

In order to plan for fewer guide rail changes on production lines, accumulation should be avoided in turns and replaced with smooth, positive product flow.

Too Much Diversity of Product Types and Sizes

Packaging machines on the line may require exceedingly different in-feed requirements to handle different package types. Even on lines with like package types, but with different diameters, the machine interfacing, guide rail settings and rates could still be too dissimilar to be feasible for removing change-over processes.

In planning for a reduced or no-change-over line, find the grouping of products that will work for the minimum amount of change-overs.

Uncontrolled High Speed Manipulation

Conveyor systems can be designed for high-speeds in many applications; the problem comes into effect when the product needs to be stopped. The faster the product travels, the more it gains in momentum and the harder it stops.

Manipulation, like clamps, metering devices, and pushers, require a product stop. Both the line speeds and the device should be controlled so products enter the manipulation zone smoothly and controlled. If there is too much back-pressure entering the manipulation device or zone, jams can occur.



Products must be controlled through turns to prevent skewing.

Conveyor Equipment that Does NOT Require Change-over

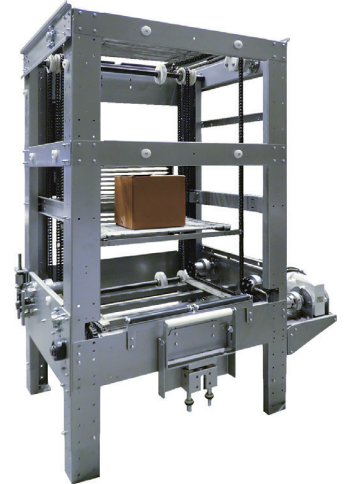
The following systems do not require guide rail change-over between product sizes. These systems are ready for a different product without a system shut-down or stopping production.

Vertical Conveyor Lift

The Vertical Conveyor Lift can elevate or lower products on a platform without the need for guide rails. The products are either pushed or timed to enter the platform at speeds of 30 CPM (cases per minute.) The elevator can handle cartons, cases and bundles weighing up to 40 lbs.

The elevator can accept a direct controlled in-feed or a right angled pusher in-feed. The platform is rigid in the vertical conveying mode and collapses in the return path, which reduces the foot print of the equipment.

The Vertical Lift Conveyor can handle any size box that fits on the platform without need for change-over. If there is a large difference between the cases on the line, it is also possible to double up smaller cases on the platform, which will help to maintain the rates required.



Vertical Lift Conveyor



Live Drum Spiral Conveyor

Live Drum Spiral

The Live Drum Spiral has the ability to single or mass flow products through a spiral incline or decline. The wide belt and slight incline allows the equipment to be used for many types and sizes of products, as long as the products fit on the chain and between the tiers.

Regardless of the conveyor length, the rotating stainless steel drum imparts the driving force to the inside edge of the belt, creating very low tension on the belt. The benefit of the Live Drum's low belt tension allows for exceptionally long runs translating into significantly increased number of tiers. The substantial quantity of the conveying belt and the increased elevation changes makes the Live Drum Spiral a high capacity elevator.

Bi-Directional Accumulation Table

The Bi-Directional Accumulation Table can handle a diversity of diameter sizes. The continuous movement of the table is a benefit in handling various sizes of containers because it expands to accumulate in mass flow.

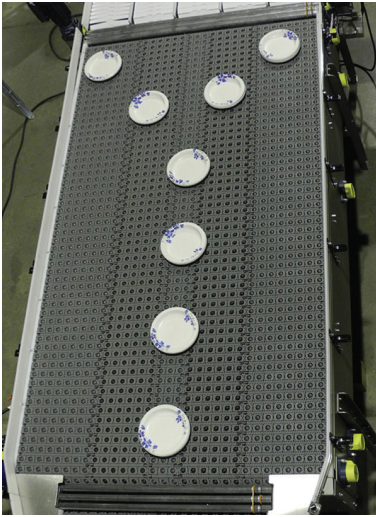
The accumulator can handle round containers and bottles. It provides temporary right-angle storage for line blockage or machine adjustment. When the blockage is cleared, or after the machine has been serviced, the stored products are automatically fed back onto the primary conveyor line at production speeds.

The equipment is best utilized in reduced change-over situations with similar diameter containers. The larger the product diameter, the fewer products will fit on the table, thereby reducing the accumulation time during a production delay.



Bi-Directional Accumulation Table

Conveyor Equipment that Does NOT Require Change-over *Continued*



This ARB system directs products to the center in order to singulate packages required for downstream applications.

Activated Roller Belt

Activated Roller Belt technology, licensed by Intralox, involves the activation of rollers that are integrated into Intralox chain. A mechanism under the belt engages the rollers which direct the flow of packages traveling on the chain.

Activated Roller Belt (ARB) systems can handle a variety of package sizes and types, providing the packages have a flat, rigid bottom and enough density so the rollers acknowledge some resistance. It can also handle a variety of product weights.

ARB systems can utilize a Vision system to control diverting functions. If downstream sortation is not required, the ARB can divert mixed products in real-time without the need for guide rails or complex controls.

ARB systems can sort, turn, center, switch, divert, merge, align and singulate, without the use of mechanical pushers or gates.



This ARB system utilizes a Vision system that scans the bar codes and sends the signal to control the direction of cases into specific lines.

Live Roller Metering and Merging Conveyor

The Live Roller Metering and Merging Conveyor is another technology that utilizes Intralox roller belt. Products are conveyed onto a roller top belt that has sections with rollers and sections without rollers, called pockets. Underneath the chain, a mechanism engages rollers in a spinning motion. Products float on the roller sections briefly until the pocket emerges, then the products are conveyed forward. Simple plow rails or powered side rails are used to merge multiple lanes into single file.

This Live Roller Conveyor is a simple solution for merging or metering products without the use of clamps, stops or complex controls. It can be utilized in multi-SKU lines for products that fit on the roller-less pockets.

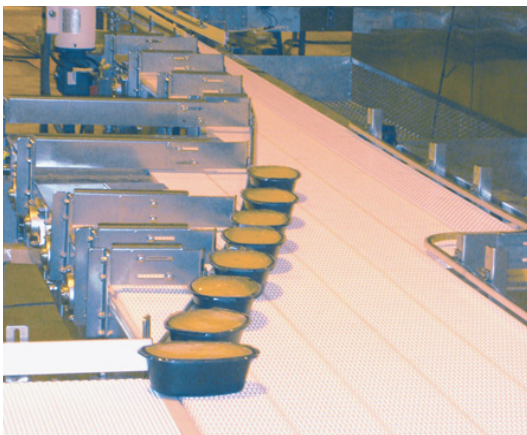
This equipment also handles pouches, cartons and over-wrapped products without any back-pressure or impact on the packages.



The Live Roller Metering/Merging conveyor system shown here is handling over-wrapped products.

Pressure-less Combiner

The Pressure-less Combiner uses multiple belts and specially calculated chain speeds in order to single file products or containers. There is no back pressure using this combining method which prevents scratching, denting, and breakage of the label and the container.



The Pressure-less Combiner can also be used to single file tapered or oblong containers.

An advantage of pressure-less combining is that there is no guide rail adjustment required between products runs of similar product heights. The Pressure-less Combiner can be used to handle a variety of products including plastic industrial containers, as well as non-round or tapered containers. Guide rail systems are designed to the requirements of the product grouping.



Due to the low back pressure benefits, the Pressure-less Combiner is often used to single file glass bottles to reduce breakage.

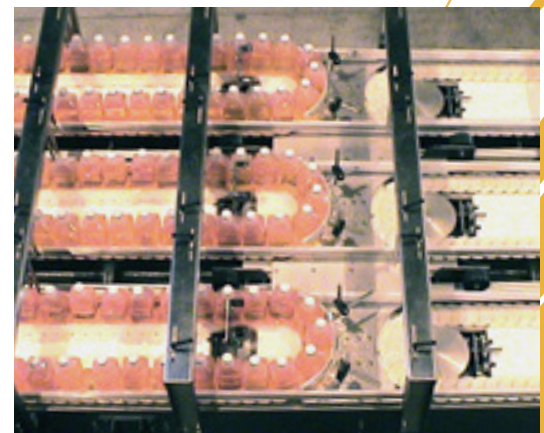
Minimal Change-over Systems and Equipment

These systems can handle similar sized products without change-over, but would require a production stoppage to make the quick change between different product sizes. The conveyors however can be running while the changes are being made as long as safety precautions are followed.

Flex Flow Accumulator

The Flex Flow Accumulator operates on the concept of an expandable travel path which automatically changes length to match fluctuations in production. Reducing downtime of the high capacity machines on the line, the Flex Flow increases overall production efficiency and operating profits. The in-line accumulation delivers a more consistent product flow to downstream equipment which in turn increases the operational reliability of these production line machines.

Due to the pressure-less properties of the Flex Flow Accumulator, side transfer is required at two points -- the in-feed and at the discharge. This guide rail change can be manual or automatic, but requires stopping the product flow to the accumulator. At all other corners the product is driven around the radius, preventing locking or wedging. Product is carried on one continuous crescent style chain, ensuring the production line back-pressure is non-existent, which allows for similar sized products to be accumulated.



The Flex Flow Accumulator utilizes a moving carriage that increases and decreases the travel path.

Minimal Change-over Systems and Equipment *Continued*

Re-Flow Accumulation Table

The Re-Flow Accumulation Table is an in-line accumulator that handles round containers. The unique single filing concept of the Re-Flow Accumulation Table ensures smooth jam-free combining of product. The recirculation design relieves back pressure in the combining area and aids in overall accumulation pressure relief.

It can accumulate containers of various diameters on a multi-SKU packaging line, but an extreme difference on product size would reduce the accumulation time during a production stoppage.

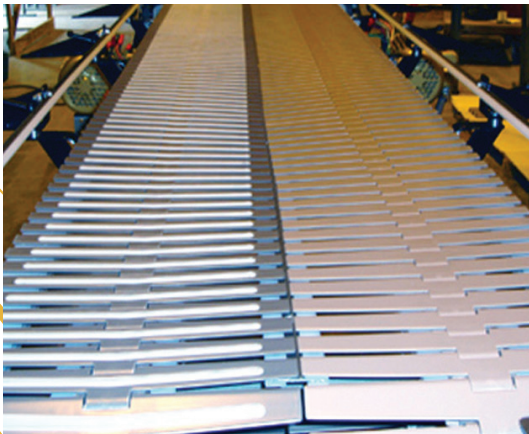
The in-feed and discharge conveyor guide rails need to be changed between different product sizes running on the line.



Re-Flow Accumulation Table

Dual Lane Rotator

A Dual Lane Rotator can change the axis of the package to either 90 or 180 degrees. A pressure-less rotating solution, side by side chains are programmed with different speeds to perform the orientation. This type of solution is dependent on the characteristics of the product or package as well as the rates of the application.



Dual Chain Case Turning Conveyors

A slight pause in production is sufficient to change the speeds of the dual lane rotator with a Human Machine Interface (HMI) to accommodate a different size package.

Automatic Guide Rail Systems

For high volume packaging lines handling multi-SKU packages, Automatic Guide Rail Systems may prove to be an investment that creates ongoing change-over efficiencies.

Pneumatic guide rails use cylinders with a single set point. Typically, pneumatic systems are used in high volume and also overhead conveying systems where manual rail adjustment is too time consuming and hard to access. These systems are designed to lift one rail into the single point position. Multiple positions are possible using multiple cylinders set at the required positions.

Electric actuated cylinders are also used on automated guide rail systems. This solution allows for a range of variable product widths. The purchase cost is among the highest of automated guide rail solutions, but it is the fastest, most versatile and accurate system for rail adjustment.

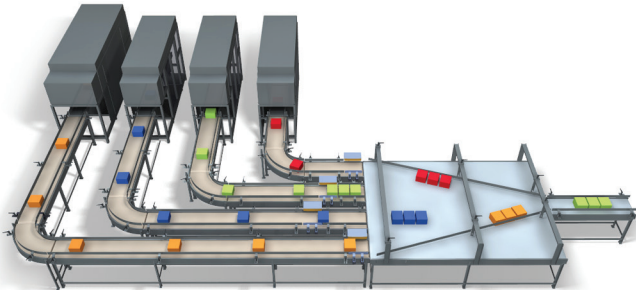


Dual lane automatic guide rail system utilizing electric actuated cylinders.

Case History: Before and After

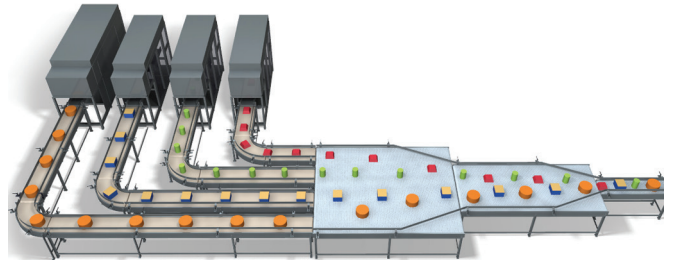
From Plow Merge to ARB Singulator

Before



In this BEFORE layout, there are multiple lanes feeding one merge conveyor. Each individual lane has a clamp and product stop to allow for the products to be metered into the merge section. Each line requires independent rail adjustments for a change in product size.

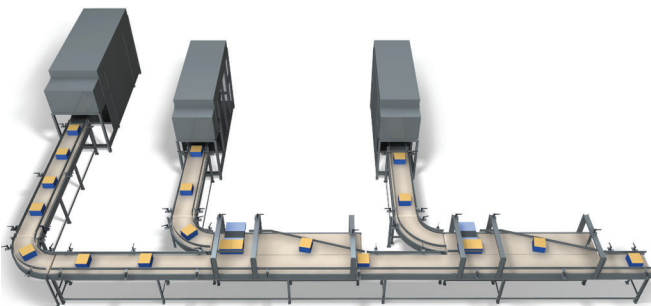
After



In this AFTER example, clamps and stops have been removed and replaced with ARB (Activated Roller Belt) singulating conveyors. Each ARB section provided a centering merge with speed changes that created gaps to handle the high volume product flow. The last section provided rail alignment as products exit the system. This solution saves 15 minutes on every change-over. At 60 packages per minute and a unit profit of \$.25, the \$60,000 system upgrade is paid off in 1.5 years in up-time alone.

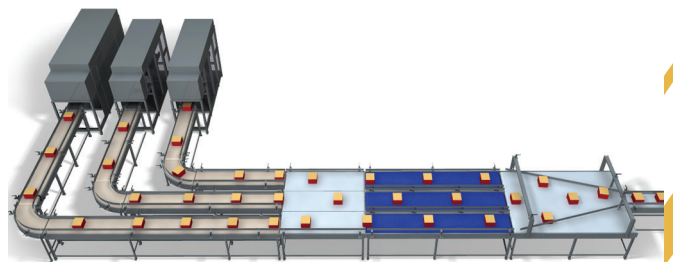
From Stop Merges to Live Roller Merge

Before



In this BEFORE layout, each of the lines need to be stopped to allow the other line to merge into the main trunk line. This is accomplished by the use of clamps and stops. The adjustments on this line between product sizes takes 30 minutes.

After



In this AFTER example, the stops have been removed and replaced with a Live Roller Metering and Merge system. This solution more than doubled the product rate and removed the need for change-over. With 30 minutes additional up-time per change-over, a throughput of 17 cases per minute, and a unit profit of \$.25, the system upgrade of \$36,000 is paid off in 1.18 years in up-time alone.

7 Steps to Reduce Change-overs

Certainly food and consumer goods manufacturers who master the economics of product variety, must also master their production assets. Best in class production performance dictates a choreographed response to market demand through effective planning, scheduling, inventory management and delivery.

According to Consulting Engineer's1, "Achieving Effective Change-overs Should Start with Eliminating those that are Unnecessary," half of change-overs in a typical plant could be eliminated by standardizing products and effective production planning. From the article, here are seven steps to reduce change-overs:



Separate internal from external change-over operations: Begin external operations that can be accomplished without stopping the production line before the system shut-down.



Convert internal to external change-over tasks: Convert as much of the change-over process as possible to external tasks. Keep the production shut-down to a minimum.



Create standard change-over tasks: Leave no change-over task to chance. Implement step-by-step procedures and assign roles and responsibilities. Then enforce adherence and compliance.



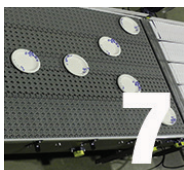
Eliminate fasteners: Traditional bolts are inefficient and require too much time to loosen, measure and tighten. In addition, this process introduces too much chance for error. Replace fasteners with quick-change, tool-less selections.



Utilize jigs and fixtures: The use of fixtures, such as set-in rails, will assure consistent, repeatable set-ups.



Adopt parallel operations: To the extent possible, eliminate all serial operations. Plan to complete change-over tasks simultaneously to eliminate wasted motion and reduce shut-down time.



Eliminate adjustments: As revealed in this white paper, eliminate adjustments from the production process. Combine similar product planning with equipment controls technology that eliminate as much change-over as possible to keep generating units producing on the line.

1. Consulting Engineer: The Best Change-over is No Change-over, 10/2012



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