Plant Efficiency Ideas: Mechanical Fasteners in Conveyor Applications

Boosting Uptime

By Beth Miller and Jim Wingfield

Are you searching for ways to take your productivity to higher ground? One good way is by getting all the uptime you can from the belt conveyors that carry materials, parts, and finished/packaged products throughout your plant. As moving, wearing equipment, conveyors naturally demand a certain amount of downtime for maintenance and parts replacement, but keeping those events as seldom and brief as possible is what uptime is all about.

In most light-duty conveyor systems, one of the key factors in obtaining conveyor uptime is achieving the optimum splice. For conveyors using endless belts, consider the possibility and benefits of switching to mechanical fasteners in order to increase uptime. If you're already using mechanical fasteners, consider the possibility and benefits of switching to a different type. In either case, reviewing the available alternatives against the realities of your conveyor system will suggest which type might serve your needs best.

Belting designed for light-duty applications has improved greatly in the past few decades but has proliferated into many specialized variations. Once basically cotton plies with rubber covers, light-duty belting has become infused with synthetic alternatives reflecting European influences, offering higher efficiencies due to thinner, lighter constructions with less drag and lower horsepower consumption. Generally built on polyester fabrics, with binders or covers of various or thermoset materials, today's light-duty belting thicknesses range from about ¼ in. (6.4 mm) down to an almost paper-thin 0.03 in. (0.76 mm) with working strengths from 20 to 200 PIW (pounds per inch of belt width).

When it comes to connecting conveyor belt ends together, there are two basic methods: vulcanization and mechanical fasteners. Let's review each below.

Mechanical Fasteners vs. Vulcanization

Vulcanization is a process of fabricating the two belt ends together either through heat or chemical activation, making the belt a continuous, endless length. The alternate method, the use of mechanical fasteners, physically attaches a row of fasteners to each belt end. These fasteners are then meshed together and connected with a hinge pin.

Hinged plate fasteners

Various types of mechanical fasteners are available, but all offer similar benefits when it comes to a quick repair. The splices are easy to install, requiring only basic mechanical skills. And, unlike vulcanized splices, the wear on the splice is visually apparent, allowing maintenance crews to complete the repair during a scheduled downtime. In addition, mechanical splices offer the advantage of being hinged or separable. This allows the belt to be installed or replaced without having to disassemble the conveyor system or remove the belt from the conveyor structure &#151 a huge time saver. It also allows for easy cleaning of belts, by simply removing the hinge pin and pulling the belt ends apart.

A vulcanized splice is very quiet in operation, will not mark the conveyed product, and is a strong, long-lasting splice. Its main drawbacks are related to the downtime and cost of installing the splice. Unlike mechanical splices, which require only basic mechanical skills and simple installation tools, vulcanized splices need highly skilled personnel to install the splices with expensive equipment. Due to these factors, the vast majority of vulcanized splices are installed by an outside crew, taking hours, if not days, to install a single splice. To avoid this lengthy downtime, many users will keep spare belts for emergencies. Even so, since the belt is endless, the conveyor structure must be partially disassembled to install the belt, which leads to more downtime.

Stamped metal tooth fasteners

There are two basic methods of vulcanizing light-duty belts. Belts with thermoplastic binders such as PVC, RMV (rubber modified vinyl), and urethanes lend themselves to endless fabrication because these materials flow together under heat and cool into a homogeneous mass. Fabricators typically install a "finger splice" into these belts, in which a dovetailing zigzag die-cut across both belt ends optimizes the edge-bonding area in between them. If belt thickness permits, a "split-finger" technique also separates the belt into upper and lower layers, with their finger-cuts

staggered so that bonding occurs between layers as well as between fingers.
Belts made of thermoset materials &#151 including rubber, neoprene, Buna-N, and some urethanes, which don't flow under heat &#151 usually are made endless with a "step splice," in which both belt ends are cut into steps at complementary angles, typically diagonal to the belt length, which overlay each other when the belt ends are drawn together. The step interface is bonded with an adhesive, either cold-set or heat-activated.
Both endless-belt fabrication methods can produce long-lasting splices, but their downtime and cost factors need to be taken into consideration. Aside from the downtime issues mentioned earlier, vulcanized splicing costs considerably more than mechanical fasteners.
Still, if endless belts work well in your application, and replacing them doesn't give you the kind of downtime headaches described here, they may be a good choice. But if the downtime is starting to feel endless, reconsider your conveyor &#151 just because it started out with an endless belt doesn't mean you're stuck with it forever.

Mechanical Fastener Alternatives

Mechanical splicing for light-duty belts presents three basic choices of metallic fasteners: wire hook, hinged plate, and stamped metal tooth. There are also two non-metallic choices. Each type of light-duty belt splice has characteristics that are suitable for certain applications, but large areas of overlap exist between the various offerings. This allows users to select the style that best fits their needs.

Plastic rivet fasteners

Wire hook fasteners offer users an economical, low-profile, yet long-lasting splice. They are available in a wide variety of sizes, metals, and configurations for belt thicknesses up to 25/64 in. (10 mm) and pulley diameters as small as 15/16 in. (24 mm). Wire hook segments are supplied in strips with hooks held in proper spacing and alignment by either carded or welded assembly. Carded assembly holds individual wire hooks together with a stiff paper channel that is removed after the hooks are locked into the installation machine and ready to receive the belt end. Welded assembly means that individual hooks are welded in position along a common crosswire. Both types provide the advantage of machine installation, which ensures a consistent, even splice. Installation machinery offers a variety of alternatives, from powered shop units to small portable tooling that allows anyone with basic mechanical skills to repair splices within minutes, directly on the conveyor.
Hinged plate fasteners present a strong and abrasion-resistant fastener choice. Their design gains extra holding strength through a combination of compression

between upper and lower fastener plates, which sandwich the belt ends, and the dual staples penetrating through both plates and cross-clinching on the bottom side. Installation requires only a hammer and a portable tool, making it very easy to install these splices on-site. Easiest to install are those offering fastener segments supplied in one-piece strips that ensure proper spacing and alignment, with staples pre-inserted in the plates to eliminate the delay of handling and loading individual staples. Hinged plate fasteners are suited for applications with belt thicknesses from 1/16 to ¼ in. (1.5 to 6.4 mm) and pulley diameters as small as 2 in. (50 mm).
Stamped metal tooth fasteners are often the best choice for low-volume users who want a low-profile, hinged mechanical splice, with no investment in installation tooling. This design provides a continuous strip of hinge loops formed with pointed teeth that are simply hammer-driven through the belt end. For higher volume maintenance shops or OEM applications, installation machines are available for faster and more consistent results. Tooth-type fasteners accommodate belt thicknesses up to 1/2 in. (13 mm) and minimum pulley diameter of 1 in. (25 mm).

Plastic spiral fasteners

Non-metallic fasteners combine the convenience and economy of hinged mechanical splices with the advantages of being non-metallic. Most notably, non-metallic fasteners are non-marking, non-abrasive, compatible with metal detectors, and made of FDA-approved materials. This combination of properties makes them a viable alternative to vulcanizing in applications involving X-ray or scanning, food handling, and finished products that are sensitive to being marked. There are two basic types of non-metallic splicing: plastic rivet and plastic spiral fasteners.
The plastic rivet fastener is a non-metallic splice that can be installed on-site with a portable installation tool. Installation requires punching holes into the belt, fitting the fasteners onto the belt through the holes, and then using the application tool to spin-set the molded-in rivets. This fastener suits low-tension applications that forbid metal fasteners, on belt thicknesses up to 1/8 in. (3.2 mm), operating at less than 65 PIW (11 kN/m) and over minimum pulley diameters of 1-1/2 in. (38 mm).
The plastic spiral fastener provides a non-metallic alternative with an extremely low profile and the ability to operate over pulley diameters as small as 1/2 in. (13 mm). The spirals are assembled onto a webbing material, which is fabricated into the belt ends through various vulcanization processes, so it's not typically installed by in-house maintenance crews. This design accommodates belt thicknesses up to 1/4 in. (6 mm) with mechanical fastener ratings up to 50 PIW (8.7 kN/m) and is able to withstand heat up to 392&#176F.
Beth Miller and Jim Wingfield are light-duty product managers at Flexco, Downers Grove, IL. More information is available by calling 630-971-0150.

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