

Mechanical Fasteners Improve Uptime Of Light-Duty Belt Conveying Systems

In applications that do not require endless belt constructions, various mechanical fasteners can boost overall operating efficiency and reduce splicing time and costs.

— BY BETH MILLER AND JIM WINGFIELD

As moving, wearing equipment, today's conveyors naturally demand a certain amount of downtime for maintenance and parts replacement. But keeping those events as infrequent and brief as possible is essential for minimizing downtime and increasing overall productivity in pulp and paper mills.

A key factor in minimizing uptime of most light-duty conveyor systems is achieving the optimum splice. In conveyor systems using endless belts, switching to mechanical fasteners may increase uptime, or switching to a different type of fastener in systems already using mechanical fasteners may further increase operating efficiency. In either case, reviewing available alternatives for a conveyor system will generally suggest types that might best serve a mill's specific needs.

Belting designed for light-duty applications has improved significantly 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 0.25 in. (6.4 mm) down to an almost-paper-thin 0.030 in. (0.76 mm), with working strengths from 20 to 200 PIW (lb/in of belt width).

Two basic methods are used to connect conveyor belt ends together—vulcanization and mechanical fasteners. 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, mechanical fasteners, physically attaches a row of fasteners to each belt end. These fasteners are then meshed together and connected with a hinge pin.

Various types of mechanical fasteners are available, but all offer similar benefits in regard to quick repair. Generally, mechanical fastener 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 have 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, which can be a major time saver. It also permits easy cleaning of belts, by simply removing the hinge pin and pulling the belt ends apart.

Vulcanized Splices

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 typically need highly skilled personnel and expensive installation equipment.

Most vulcanized splices are installed by an outside crew, requiring hours and sometimes days to install a single splice. To avoid this lengthy downtime, many users will keep spare belts for emergencies. But even with a spare on hand, because the belt is endless the conveyor

structure must be partially disassembled to install it, leading to more downtime.

Two basic methods are used for vulcanizing light-duty belts. Belts with thermoplastic binders such as PVC, RMV (rubber modified vinyl), and urethanes are suitable for endless fabrication because they 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 bonding occurs between layers as well as between fingers.

Belts made of thermoset materials (including rubber, neoprene, Buna-N, and some urethanes that don’t flow under heat) 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 downtime and cost factors need to be taken into consideration. Aside from the downtime issues previously mentioned, vulcanized splicing costs considerably more than mechanical fasteners.

Mechanical Fasteners

Basically, three types of metallic mechanical fasteners are used for light-duty belts—wire hook, hinged plate, and stamped metal tooth—and two non-metallic types. Each type of light-duty belt splice has characteristics suitable for certain applications, but large areas of overlap exist between the various types. This allows users to select the style that best fits their needs.



Figure 1. Wire hook mechanical fasteners are both economical and long lasting.

Wire hook fasteners (see Figure 1) produce 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.



Figure 2. A carded assembly holds individual wire hooks together and is subsequently removed after splice installation.

A carded assembly (shown in Figure 2) 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. With a welded assembly (see Figure 3), individual hooks are welded in position along a common crosswire. Both types provide the



Figure 3. With a welded assembly, individual hooks are welded along a common crosswire.

advantage of machine installation, which assures 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.



Figure 4. Hinged-plate fasteners provide extra holding strength due to upper and lower fastener plates that sandwich the belt ends and the use of dual staples.

Hinged-plate fasteners (see Figure 4) are strong and abrasion-resistant. This design gains extra holding strength through a combination of compression between upper and lower fastener plates (which sandwich the belt ends) and 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 assure proper spacing and alignment, with staples pre-inserted in the plates to eliminate the delay of handling and loading individual staples (as depicted in Figure 5). Hinged-plate fasteners are suited for applications with belt thicknesses from 1/16 in. to 1/4 in. (1.5–6.4 mm) and pulley diameters as small as 2.0 in. (50 mm).

Stamped metal tooth fasteners (see Figure 6) 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 (as shown in Figure 7) that are simply hammer-driven through the belt end. For higher-volume maintenance shops or OEM applications,



Figure 5. Hinged-plate fasteners with one-piece strips are easiest to install.



Figure 6. Stamped metal tooth fasteners require no specialized installation tooling.

installation machines are available for faster and more consistent results. Tooth-type fasteners accommodate belt thicknesses up to 1/2 in. (13 mm) and a minimum pulley diameter of 1.0 in. (25 mm).

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 (Figure 8) 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, then using the application tool to spin-set the molded-in “rivets.” This fastener is suitable for low-tension applications that forbid metal fasteners, on belt thicknesses up to 1/8 in. (3.2 mm), operating at less than 65 PIW (11kN/m), and over minimum pulley diameters of 1-1/2 in. (38 mm).

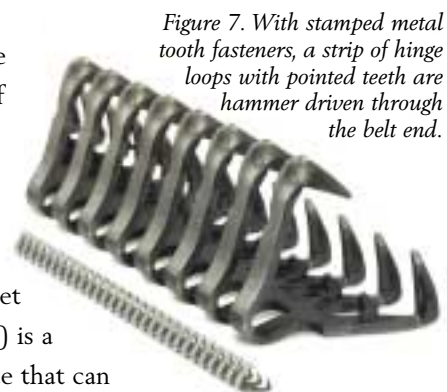


Figure 7. With stamped metal tooth fasteners, a strip of hinge loops with pointed teeth are hammer driven through the belt end.



Figure 8. Non-metallic fasteners such as the plastic rivet fastener can be installed on-site with a portable installation tool.



Figure 9. The plastic spiral fastener has a very low profile and can operate over small pulley diameters.

The plastic spiral fastener (shown in Figure 9) 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 that is fabricated into the belt ends through various vulcanization processes; thus it is 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° F (200° C).

Good Installation Important

Good installation practices affect both splice life and belt life. Machine installation—typical of wire hook, plastic rivet, and sometimes tooth-type fasteners—promotes uniformly flat, quickly installed, un-rippled joints that avoid

high spots and simplify hinge-pin replacement. Hammer-installed fasteners offer greater on-site convenience while avoiding the cost and maintenance of installation machines.

Whichever fastener is used, good splice installation begins with a straight, squared belt end, otherwise tracking problems and belt-edge damage will occur. Care must be taken to not “over install” the fastener, which can deform the hinge loops, in turn accelerating hinge-pin wear-out and making pin replacement difficult. The leading edge of the trailing belt end must always have its corners notched inward to prevent catching on the belt framework. ■

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