MEASURE TWICE, SPLICE ONCE

Figure 1. Workers pull new belt onto a long overland conveyor and prepare for the splice.

Liam Sheeder, Belt Tech Industrial, USA, discusses how belt hardness relates to splicing success, and factors to consider when purchasing used conveyor belt.

Picture this: you just bought a house built in 1954. It seemed like a great deal – charming, sturdy, and affordable. Sure, the fuse box needed upgrading, but that was manageable. Then, as the electrician works, more issues emerge: outdated wiring, hidden leaks, dry rot. That great bargain quickly turns into an expensive nightmare.

Hidden factors like these can cause huge headaches – not just in homes, but in material handling operations too. Take conveyor belts, for example. Used belts can seem like a cost-saving goldmine, but without a clear understanding of how belts age and what factors to test, that bargain belt might leave you footing a much larger bill down the line.

The good news is, these 'hidden' factors are not impossible to find. With some basic tools and understanding, an operator can feel more confident in their choices, or in suggestions from a service provider.

The allure and potential pitfalls of used belt

Every industry struggles to maintain the balance between costs, profits, and return on investment. Add to that the constant ebb and flow of opinions and directives from shareholders and upper management. The next generation of operators and plant managers is entering a work environment that has grown more complex and expensive, and are navigating it without the advantage of years of experience.

These people may find themselves inheriting an operation that has been running on a razor's edge. Now, they are tasked with catching up on maintenance issues that have fallen by the wayside. With all these factors, pressures, and expenses clamouring for attention, it only makes sense to search for low-hanging fruit in the budget that can get the job done at the lowest cost.

Enter used belt. A new operator may look at the cost of new belt specified for their conveyor system, then compare this price to heavier-duty used belt. The used belt costs less and seems like a logical choice – less money, more belt (see Figure 1).

Experience tells a different story. Even assuming the used belt is in good condition and everything goes well, there remains the problem of improperly matching a belt to an existing system. Heavier belts require larger pulleys, more robust motors, and so on. An even worse situation is purchasing a different weight of belt and trying to splice it with the belt currently on the conveyor.

To put it another way, used conveyor belts bring the same types of challenges as used tires. It is possible to find decent used tires, but usually, they are for sale because someone took them off their vehicle for a reason. One of them may fail at an inconvenient time. Uneven wear will make the car more difficult to drive. Replacing only some of the tires will create even more issues (read: mixing old and new belt is not a good idea).

A new driver may feel the pressure to go for the cheapest option and 'hope for the best.' It may be okay, or it may cost even more and possibly create a dangerous situation.

Figure 2. A durometer measures belt hardness in Shore A units.

Figure 3. A crew expertly splicing a conveyor belt, a process requiring precision to ensure long-term durability and performance.

Pulling back the curtain on some hidden issues

Belt hardness and ageing are closely intertwined. Just as ageing affects skin, paint, concrete, or roofing materials – making them less resilient and more prone to damage – conveyor belts undergo similar changes. Over time, exposure to various elements causes the belt material to lose elasticity and become brittle.

Some signs of ageing, like skin wrinkling, paint peeling, concrete cracking, or shingles curling, are easy to spot. Similarly, conveyor belts may develop visible cracks or damage. However, before these signs appear, invisible changes, such as hardening, occur. Hardening rubber, much like hardening arteries, is a ticking time bomb for conveyor belts.

As the belt hardens, it loses flexibility and its capacity for effective splicing, particularly with hot vulcanisation.

Environmental factors such as extreme temperatures, high humidity, chemical exposure, and coal dust contribute to the premature ageing of conveyor belts. The challenge with purchasing a used belt is that its previous environmental conditions are often unknown, making it difficult to assess how these factors may have affected both the rubber surface and, more critically, the belt's internal carcass.

Equipment alignment and usage significantly impact a belt's condition. If a belt has been used on an improperly aligned system, it may have been 'trained' to mistrack, leading to persistent alignment issues. Additionally, such misalignment can cause micro-tears or weaken the carcass, compromising the belt's structural integrity over time.

Assessing the true condition of a used belt is not easy. An operator faces a daunting challenge because, by its very nature, the majority of a long roll of belt is hidden. The only way to get an idea of its condition is to unwind it and examine the entire length for gouges or other damage. Even then, that still would not tell the whole story.

These details are not an exhaustive list, nor does it mean that buying used belt is never a good idea. Some operations successfully employ used belt, especially when they are recycling it from another plant and know how it has been used or what damage it has.

However, this information provides a framework to help make purchasing decisions.

Since the exact previous usage of a belt may be unknown, one thing that can be focussed on and measured is belt hardness.

Belt hardness and hot vulcanisation

Belt hardness is typically measured using a durometer, a tool that assesses the material's resistance to indentation. The hardness is expressed in Shore A units for rubber materials, with values generally ranging from 50 to 100. A lower Shore A value indicates softer, more flexible rubber, while a higher value signifies harder, more rigid material. For conveyor belts, a hardness around 70 durometers is typically considered ideal for vulcanisation, ensuring the rubber remains flexible enough for effective bonding. As belts age and harden, the durometer reading increases, indicating less pliability and reduced suitability for certain splicing methods (see Figure 2).

Understanding how belt hardness affects a belt's ability to be vulcanised requires knowing what happens during the splice.

Vulcanisation is a fascinating process that combines science, art, and skill. Key steps and chemical reactions work together to create a strong, durable splice (see Figure 3). It is not simply a matter of gluing two ends together – vulcanisation actually changes the rubber's properties. Once the belt ends are squared, prepared, and joined, heat and pressure make the transformation happen (see Figure 4).

Imagine the rubber molecules as strands of freshly cooked, flexible spaghetti in a bowl (see Figure 5). Before vulcanisation, each strand can move freely and independently. During vulcanisation, sulfur is introduced into the rubber compound, and heat and pressure activate the process. The heat energises the rubber molecules, causing them to move more vigorously and interact with the sulfur. In turn, the sulfur acts like staples, connecting the strands at various points and creating a mesh-like network that is both strong and flexible. This cross-linking provides the perfect balance of toughness and elasticity.

Now, imagine uncooked spaghetti in the bowl. The cross-linking is less effective, more brittle, and more likely to separate. Or consider a mix of both dried-out and freshly cooked spaghetti; the process becomes ineffective, and the chemical reaction may not take at all, or at best, it might hold for a while before failing.

For this reason, some belt service providers either will not vulcanise rubber that is too old or hard, or they will not warranty the splice. Therefore, purchasing rubber must be done with an understanding of cause and effect. If the belt does not fit the specifications for the current conveyor system, the result will be decreased efficiency or damage. If the rubber's hardness is not within the proper range, fewer splicing options are available, and there is a greater chance of splice failure. Consequently, costs will rise for an item intended to reduce expenses.

Figure 4. A belt technician tightens bolts in preparation for vulcanising.

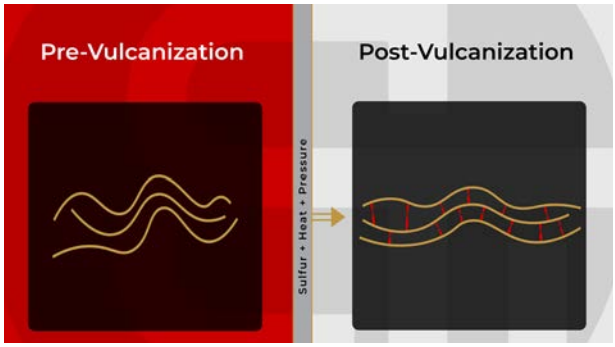

Figure 5. The chemical process of vulcanisation: heat and pressure activate sulfur, creating cross-links between rubber molecules for enhanced strength and flexibility.

Making the most out of reality

As mentioned at the outset, mines and material handling operations face difficult decisions. When choosing between purchasing a new belt or a used one, it would be ideal to always operate under perfect conditions – no budget constraints, getting exactly what is needed when it is needed.

However, some operators may go as cheap as possible, running equipment until it breaks, moving from one emergency to another, resulting in constant stress and dissatisfaction.

The reality for most operators lies somewhere in between. They strive to make the best decisions they can, with the knowledge they have, and within budget constraints. While increasing funds may not always be an option, expanding one's knowledge base and improving communication certainly are. When faced with the dilemma of what belt to purchase, being honest with a service provider can go a long way. Explaining the situation, listening to their advice, applying it where possible, and collaborating on the problem helps find the best solution.

When an operator and service provider face challenges together, clear communication and alignment help them operate more effectively as a unified team. This collaboration not only ensures that tasks are completed efficiently, but also fosters strong, lasting partnerships that benefit both parties in the long-run. WC