Unplanned conveyor stoppages – causes, effects and solutions

When a conveyor is shut down to carry out running repairs or unplanned maintenance, the materials it is carrying may stop flowing but the costs most certainly do not. In fact, quite the contrary because the cost of the remedial work can be multiplied many times over by every minute of lost productivity. It is an excellent example of the maxim 'Time costs money'. Losses caused by conveyor stoppages run into many millions every year. The root causes fall into two categories: the conveyor belt and the conveyor structure itself. The frustrating part is that much of the loss is entirely avoidable. Conveyor specialist *Bob Nelson* explains

THE CONVEYOR BELT – UNRELIABLE SPLICE JOINTS

The weakest point of any conveyor belt is the splice joint. Consequently, splice joint problems are widely regarded as the most common cause of conveyor stoppages. Because of the serious loss of output, as well as the safety implications caused by sudden splice joint failure, it is critically important to maximise the strength and long-term durability of the joint.

Apart from poor workmanship, joint problems are prevalent in low-grade, imported belting. Within that, the two most common causes are poor adhesion within the belt or between belt and splicing materials, and insufficient elongation of the belt. Having the optimum level of adhesion has an enormous impact on the creation and ongoing reliability of splice joints. Adhesion levels that are too high can cause significant difficulties and delay when making both hot and cold vulcanised joints, but not necessarily affect the end result. At the opposite end of the scale, and far more commonplace, is that an inadequate level of adhesion compromises the strength of the joint.

As with nearly all other failings in conveyor belts, the root cause of poor adhesion is the use of low-grade (low cost) raw materials, the quality of the rubber and other cost-cutting methods used to manufacture so-called 'economy' belts. Low grade ingredients such as polymers, fillers such

Splice joint problems are a major cause of stoppages for repair or replacement.

as carbon black, vulcanising agents and curatives all have a negative impact on adhesion levels, even when fresh and high-grade splicing materials are used.

On multi-ply belts, insufficient elongation is symptomatic of low-grade belting due to poor quality rubber and fabric ply material. This is mostly an issue in areas where the belt needs to stretch, such as troughing and bending round pulleys and can cause localised tension build-up, which can have an especially negative effect on the splice joint.

In addition, low elongation can lead to shear stresses that may in turn cause delamination (ply separation) issues. On the flip side, too much elongation can result in insufficient tension, which can lead to premature wear and tear.

Insufficient elongation can cause delamination.

HOW TO IMPROVE SPLICE JOINT RELIABILITY.

The most common method of making a splice joint is the step splice, which requires the removal of one of the layers of fabric plies so that the belt ends can be overlapped and then either cold glued or hot vulcanised together. This method is popular because it is regarded as being easier and quicker. However, although it may take a little longer to make, a far stronger and more reliable joint is achieved using the finger splice jointing method, where a zigzag pattern is cut into both sides of the belt ends, creating several interlocking ‘fingers’. These are then aligned, interlocked together and finally bonded using a hot vulcanising press to make a splice that is very strong and flat. An additional benefit is that this flatness makes it almost impossible for the joint to be damaged by scrapers.

Finger splices are far stronger and more reliable and retain a much higher tensile strength. (Image courtesy of Fenner Dunlop Conveyor Belting).

Crucially, when the belt is working under load, the finger splice is vastly superior to a stepped splice in terms of resistance to dynamic failure. The superior strength and durability of finger splices therefore reduces the frequency to repair and re-splice.

The conveyor belt – carcass related stoppages. The inner carcass is the core structural element of every conveyor belt, tasked with supporting the materials being conveyed, and providing inherent characteristics such as tensile strength and elongation (elasticity or 'stretch' under tension).

There can be enormous differences in the strength and quality of the synthetic fabric used to create the carcass. This is entirely dictated by whether the belt manufacturer is at the 'quality end' of the market or the 'cut-price' end. Although they may be the same specification on paper, the strength under load both longitudinally and transversely can be inconsistent. Although the amount of material used in the longitudinal strands of the fabric may be sufficient to achieve the required tensile strength, in an effort to reduce cost, the use of the more costly nylon transversal weft material is kept to a minimum.

As a consequence, rip and tear resistance are reduced, leading to stoppages to carry out patch and clip repairs and, in more serious cases, inserts or whole belt replacement. In addition, the low elongation common to low-quality fabric plies can cause problems with transition distances, a general inability to accommodate the contours of the conveyor and its drums and pulleys and, as mentioned earlier, unreliable splice joints.

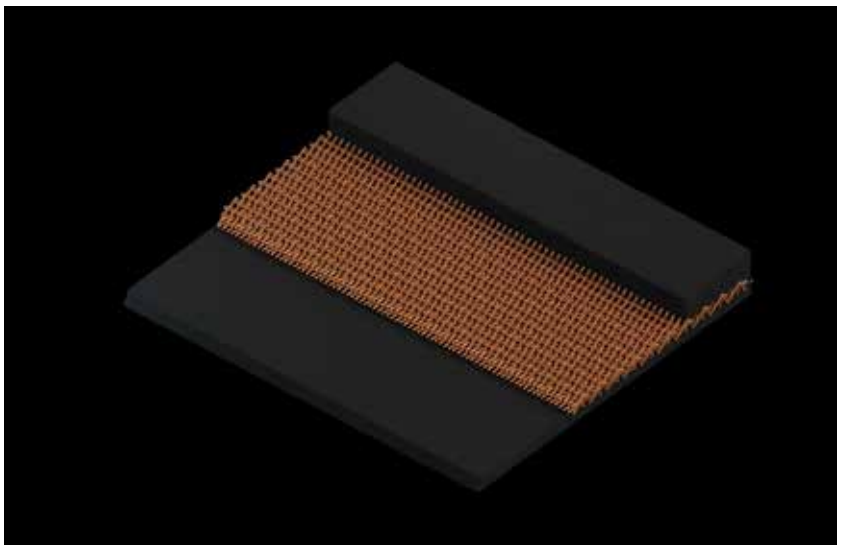
THE CONVEYOR BELT – COVER RELATED PROBLEMS

The physical properties of the rubber are the single biggest influence on the length of a belt's operational lifetime. The primary cause of cover damage is the use of rubber with an inadequate resistance to wear & tear, ripping, cutting and gouging rather than rubber that is deliberately engineered to withstand such demands.

Much also depends on the overall strength of the rubber and its resistance to cut and tear propagation. If the latter is insufficient, then even a seemingly insignificant area of damage can easily increase in size due to the continuous material loading and the flexing around the drums and pulleys. In time, this spreads and links up with another area of damage causing pieces of rubber to be cut out

'Cheap' imported belts are much more prone to ripping.

Surface cuts in low grade rubber propagate more quickly and link up with other areas of damage, causing pieces of rubber to detach completely.



Special weave design, super-strong fabric plies are the best way to combat rip, tear and impact damage.

from the surface and becoming yet another reason to stop and carry out running repairs.

Although the standard of its physical properties plays a critical role in minimising the need to intervene and carry out repairs, it is important to bear in mind that rubber represents some 50% of the material cost of producing a conveyor belt. Consequently, it provides an irresistible temptation for manufacturers to sacrifice standards of resilience who want to create a price-competitive edge. This is why the sharp stone that finds its way between the drum and the belt will cut into low-grade rubber with ease whereas it will hardly make a mark in higher quality, more resilient rubber.

Thicker is not always better. When faced with recurring stoppages caused by belt damage, there can be a temptation to fit a thicker, heavier belt but almost invariably, this is not necessarily the solution. First and foremost, it is the quality, strength and design of the rubber and the inner plies that have the biggest influence rather than the thickness of the covers and the number of plies. There are also a number of downsides including increased dynamic stress within a carcass that is too thick for the size of pulleys and drums and reduced flexibility in both length and width leading to troughing and handling problems. Thicker covers will also not prevent surface damage and its propagation, and neither will they prevent rip and tear. For rip, tear and impact damage problems, the only true solution is to fit belts that have been specifically engineered to handle such demands including super-strong, special weave pattern fabric plies.

The conveyor. Under-pinning all the issues concerning conveyor belts is the conveyor itself. Design elements suited to the installed belt are critical, for example trough transitions, convex curve radii and pulley dimensions. You can have the best quality belts in the world, but stoppages will still occur unless the conveyor, including all its components, are inspected daily. Regular, preventive maintenance, good quality components and a clean working environment all help to prevent stoppages and extend conveyor belt life. Other factors include making sure that any scrapers are correctly adjusted and that drum linings (where applicable) are in good condition. Belt tracking is also important because a

mis-tracked belt can catch on the conveyor framework. Again, cleanliness is important because mis-tracking is often caused by material build-up on the bottom side of the conveyor belt or drums and pulleys.

A big cause of stoppages to carry out running repairs is damage to conveyor belts caused by material becoming trapped. When lodged in part of the conveyor mechanism or simply finding their way between the belt and the drum, even small, sharp stones can puncture the belt cover. Larger objects can penetrate the carcass and, in some cases, cut the belt lengthwise. The first step in reducing the risk is to identify where foreign objects and rogue material is most likely to become trapped and take preventative measures such as installing skirts or screening for example.

Apart from increasing the chances of an object becoming trapped, waste build-up is a common cause of damage to idlers and drums, which can cause a lot of collateral belt damage. A significant proportion of belt damage is caused by incorrect installation of auxiliary equipment, damaged, protruding steelwork and components vibrating loose and ultimately becoming detached, all of which can be identified and rectified through regular inspection.

SUMMARY

Downtime is hugely expensive and, as I have hopefully explained, the use of low-grade components is the primary cause. It is therefore essential that the cost of such stoppages in terms of lost output, together with the actual costs of repairs and replacements, becomes an integral part of the calculation when evaluating the cost rather than just the price of primary components such as the conveyor belt and ancillary equipment such as idlers and rollers for example. As the old adage goes, price is what you pay but cost is what you spend.

Bob Nelson

Double trouble – a damaged component and an unclean environment.