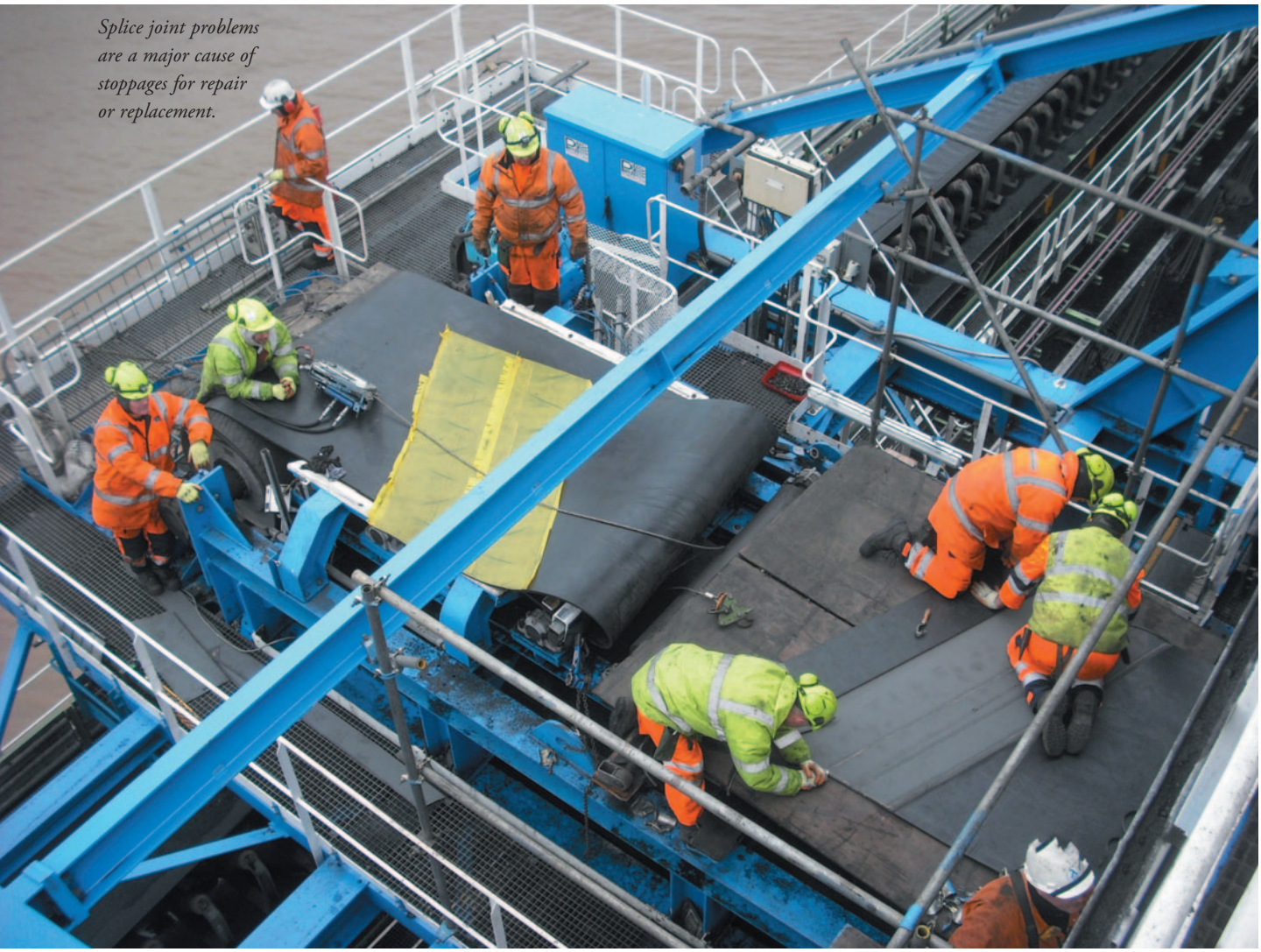
On the right track

with high-tech conveying systems



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

No time to lose: conveyor stoppages – the causes, the cost & the solutions

When a conveyor has to be stopped to carry out running repairs or unplanned maintenance, the materials being transhipped stop moving but the costs most certainly do not. In fact, quite the opposite, not only in terms of the remedial work itself but even more significant is the cost of lost and delayed output. Losses caused by conveyor stoppages in the bulk handling industry run into many millions every year and the primary causes are either the conveyor belt and/or the conveyor itself. *Specialist Bob Nelson explains* how much of that loss is entirely avoidable.

Unreliable splice joints: the weakest point of any conveyor belt is the splice joint. Consequently, splice joint problems are a very common cause of 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 maximize the strength of the splice and consequently its reliability and durability.

Apart from poor workmanship, joint problems are most prevalent in belting imported from Southeast Asia. The two most common causes are poor adhesion, particularly between the layers of the belt's carcass and insufficient elongation (stretch) of the belt. Having the optimum level of adhesion has an enormous impact on the reliability of a splice joint. Adhesion levels that are too high can cause significant difficulties and prolong the making of both hot and cold vulcanised joints. Conversely, and far more commonplace, is that an inadequate level of adhesion compromises the strength of the joint.

As with nearly all other conveyor belt failings, the root cause of poor adhesion is the use of low-grade (read cheap) raw materials and poor-quality rubber. Low-grade ingredients such as carbon black, vulcanizing agents and curatives all have a negative impact on adhesion levels, even when fresh, good quality splicing materials are used.

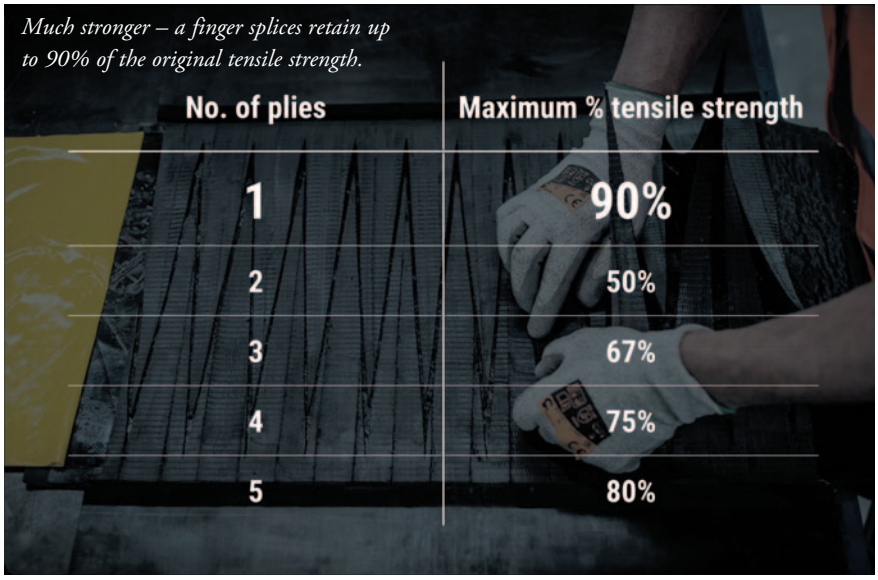
As with poor adhesion, insufficient elongation is symptomatic of low-grade belting, again due to poor quality rubber and fabric ply material. This is mostly an issue in areas where the belt needs to stretch, such as troughing and bending round pulleys and can cause localized tension build-up, which can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

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

How to improve splice joint reliability: because they are quicker and easier to make, the most common splicing method 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 vulcanized together. 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 vulcanizing press to make a splice that is very strong and flat.

The enormous advantage of finger splice joints is that they retain up to 90% of the belt's original tensile strength. By comparison, a two-ply step splice only retains a maximum of 50% and a three-ply step joint only achieves a maximum tensile strength of 67%. 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

Insufficient elongation can cause delamination.



Much stronger – a finger splices retain up to 90% of the original tensile strength.

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

superior strength and durability of finger splices therefore reduce the frequency to repair and re-splice. An additional benefit is that this flatness makes it almost impossible for the joint to be damaged by scrapers.

Belt carcass related stoppages: the inner carcass is the core structural element of every conveyor belt, providing the inherent 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 claimed to be the same specification, the strength under load both longitudinally and transversely can vary enormously. Although the longitudinal polyester strands of the fabric may achieve the required tensile strength, the use of the more costly nylon transversal weft material is kept to a minimum in an effort to minimise cost.

Consequently, rip and tear resistance is reduced, leading to stoppages to carry out patch and clip repairs and, in more serious cases, inserts or ultimately, whole belt replacement.

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

Outer 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 depends on the resistance to cut and tear propagation. If it is insufficient then even a seemingly insignificant area of damage can easily spread due to the continuous material loading and the flexing around the drums and pulleys. In time, this links up with another area of damage causing pieces of rubber to be cut out 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 minimizing 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 who want to create a price-competitive edge to sacrifice even the most basic standards of resilience.

Thicker is not the answer: when faced with recurring stoppages caused by belt damage, fitting a thicker, heavier belt is almost invariably not 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.

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, preventative 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 (often caused by material build-up on the bottom side of the conveyor belt, drums or pulleys) can catch on the conveyor framework.

Special weave patterns using super-strong synthetic strands like Fenner Dunlop's X Series range are the best way to combat rip, tear and impact problems.

Double trouble – a damaged component and an unclean environment. Keep it clean.

Keep it clean

Repairing damage to conveyor belts caused by trapped objects is a big cause of avoidable downtime. When lodged in part of the conveyor mechanism or simply 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.

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.

No time for downtime

Downtime is hugely expensive and, more often than not, the use of low-grade components is the cause. The best advice I can give is to make the cost of such stoppages, together with the actual costs of repairs and replacements, integral to the calculation of the whole-life cost of conveyor components because the lowest price often comes at the highest cost.