UNPLANNED CONVEYOR STOPPAGES

Steven Kidd, Conveyor Belt Specialist, outlines the causes and effects of unplanned conveyor stoppages, and investigates the extent to which repair costs and loss of productivity can be easily avoided.

When a conveyor stops running, the costs do not stop. The cost of lost productivity and the cost of carrying out running repairs and emergency belt replacement runs into many millions every year. This article explains the causes and how much of the loss can be avoided.

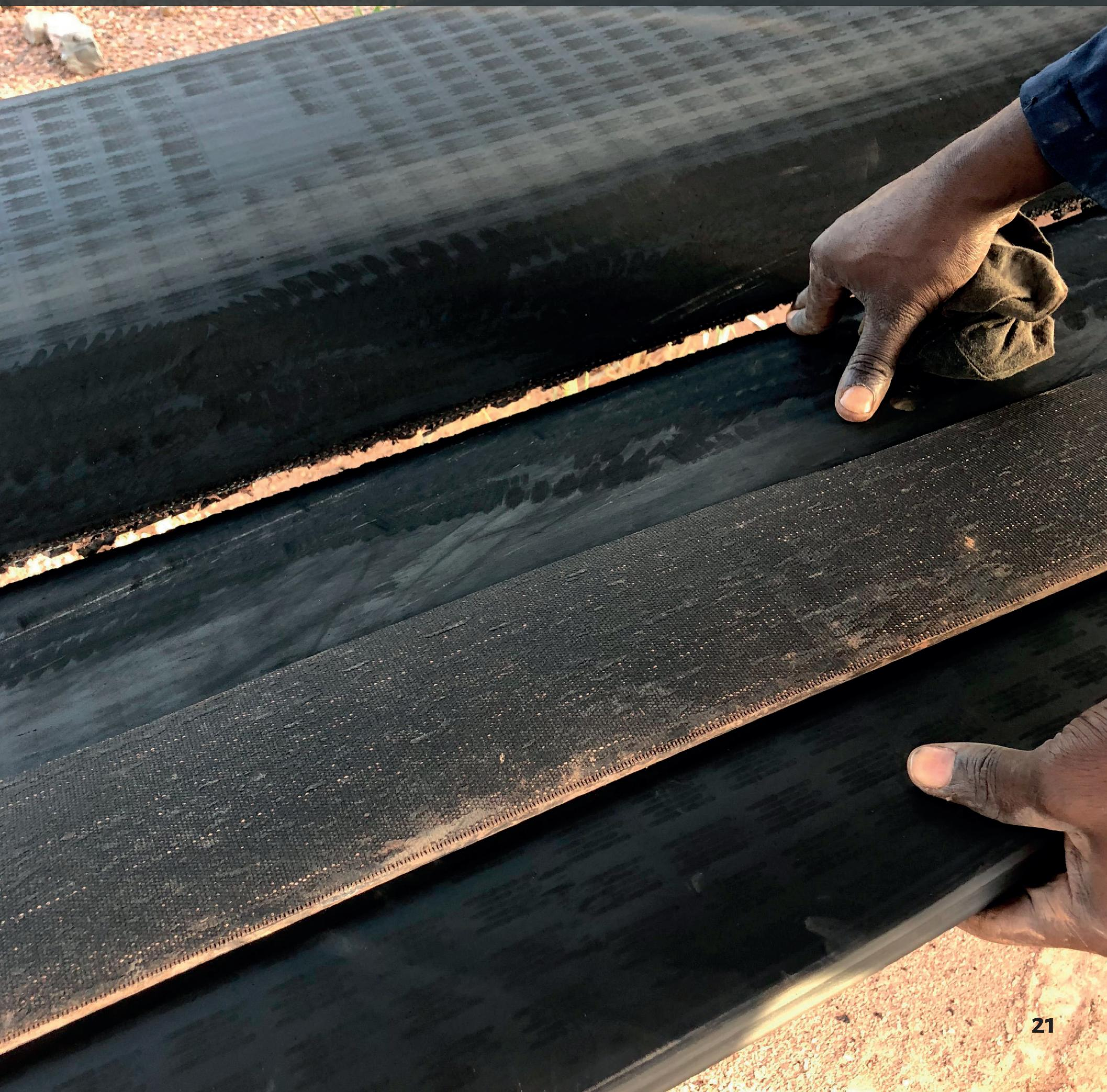

Figure 1. 'Cheap' imported belts are much more prone to ripping.

Belt carcass related stoppages

The inner carcass is the backbone of every conveyor belt, providing inherent characteristics such as tensile strength and elongation ('stretch' under tension). There can be enormous differences in the strength and quality of the synthetic fabric used to create the carcass. These are dictated by whether the belt manufacturer is at the 'quality end' of the market or the 'cut-price' end.

Despite apparently being the same specification on paper, the strength under load both longitudinally and transversely can be inconsistent. Although the amount of nylon 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 nylon transversal weft material is often kept to a minimum and in many cases, not used at all.

Consequently, 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, low-quality fabric plies with an inconsistent longitudinal and/or transversal spread of tension can cause a conveyor to be stopped to rectify tracking, steering, and handling problems.

Such inconsistencies are problematic because the declared longitudinal tensile strength of a belt is the combined result of the individual fabric plies working together in tension. For example, an EP 630/4 belt contains four layers of polyester/nylon (EP) fabric reinforcement and has a nominal overall tensile strength of 630 N/mm. Each ply has its own breaking strength, typically around 160 N/mm. When the plies are bonded together to form the belt's carcass, their individual strengths effectively 'join forces' so consistency is highly important.

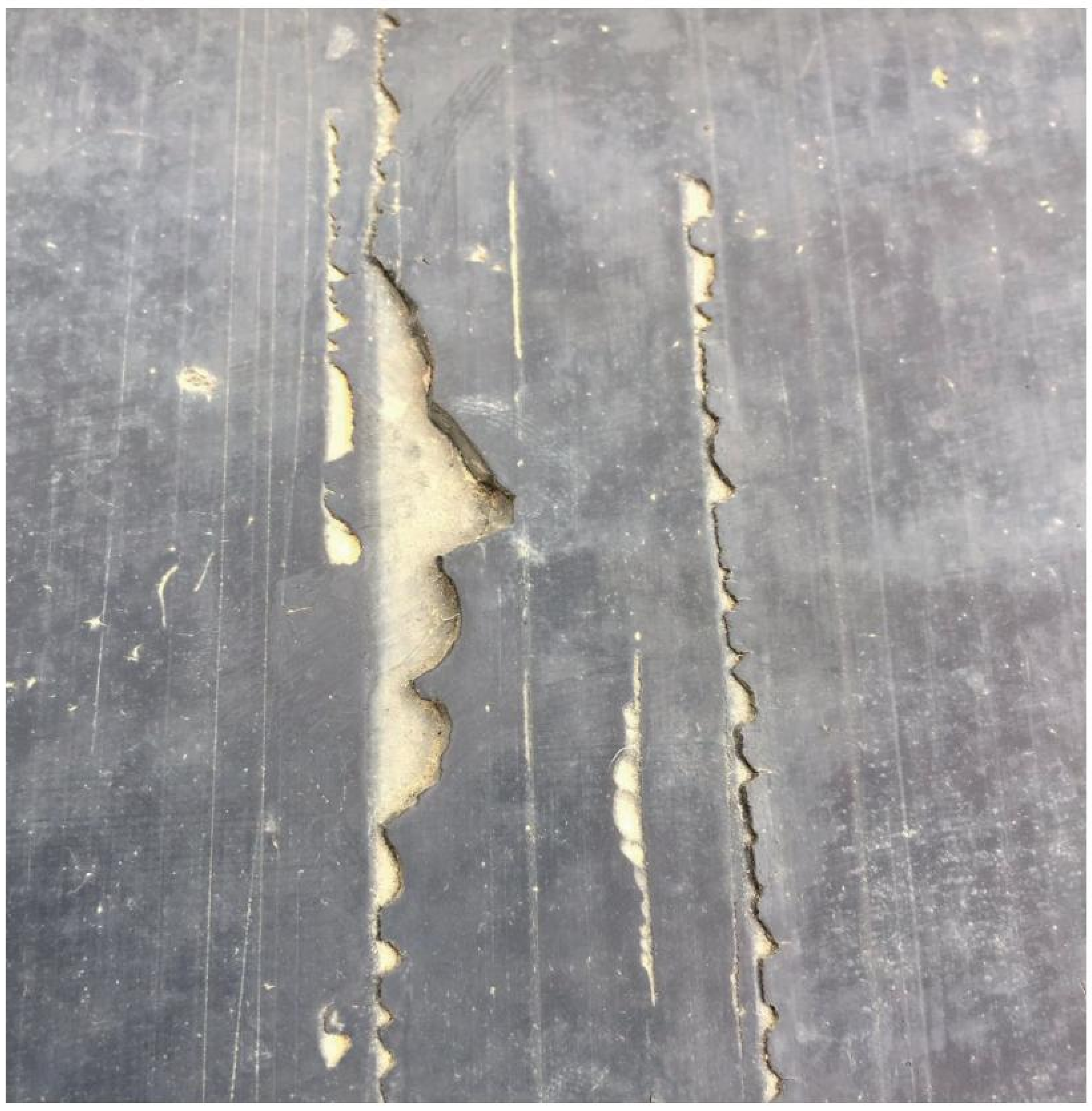

Figure 2. Surface cuts in low grade rubber propagate more quickly and link up with other areas of damage, causing pieces of rubber to detach completely.

Stoppages caused by cover related problems

The physical properties of the rubber are the single biggest influence on both durability and the length of a belt's working lifetime. The primary cause of intervention to deal with cover damage is an inadequate resistance to abrasive wear, cutting, and gouging of the surface. There are two internationally recognised sets of standards for abrasive wear, EN ISO 14890 (H, D, and L) and DIN 22102 (Y, W, and X). In Europe it is the longer-established DIN standards that are most commonly used.

Both standards measure abrasion resistance based on the amount of rubber lost during ISO 4649/DIN 53516 testing, but the test cannot measure resistance to cut and tear propagation. If it is insufficient, then a small area of damage can easily increase in size due to the continuous material loading and the flexing around the drums and pulleys, which spreads and links up with another area of damage causing pieces of rubber to be cut out from the surface and become yet another reason to stop and carry out running repairs.

The overall quality and strength of the rubber is critical in minimising the need to carry out repairs. It is therefore important to understand that rubber represents some 50% of the material cost of producing a conveyor belt, so for manufacturers who want to create a price-competitive edge, it provides an irresistible temptation to sacrifice standards of resilience in return for greater sales and faster re-ordering of replacements. 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 good quality rubber that is deliberately engineered to withstand such demands.

Quality is more important than thickness

Faced with recurring stoppages caused by belt damage, there can be a temptation to fit a belt with thicker covers and more plies but almost invariably, this is not the solution. It is the quality and strength of the rubber and the strength and design of the inner plies that have the biggest influence. A belt that is too thick for the size of pulleys and drums and reduced flexibility in both length and width can result in dynamic stress issues and troughing and handling problems. Thicker covers will also not prevent surface damage and its propagation, or 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 weakest link

The splice joint is the weakest point of any conveyor belt and splice joint failures are widely regarded as the most common cause of conveyor stoppages. Quite apart from the loss of output and the repair/replacement costs, which are considerable, there are also safety implications, so maximising the strength and long-term durability of splice joints is invariably a good cost-saver.

Joint problems are most prevalent in low-grade, imported belting with poor adhesion between the plies or between belt and splicing materials, and poor belt elongation (elasticity) being inherent weaknesses. 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 slow the making of both hot and cold vulcanised joints. It can also result in insufficient tension, which can lead to premature wear and tear. Far more commonplace however is an inadequate level of adhesion, which can severely compromise the strength and reliability of the splice.

Low elongation is another symptom of low-price multi-ply belting and is mostly an issue in areas where the belt needs to stretch, such as troughing and bending round pulleys, which can cause localised tension build-up leading to shear stresses that may in turn cause delamination (ply separation) issues.

With raw materials making up around 70% of the cost of producing a rubber conveyor belt, the use of sub-standard rubber and fabric ply material is unavoidable.

Figure 3. Splice joint problems are a major cause of stoppages for repair or replacement.

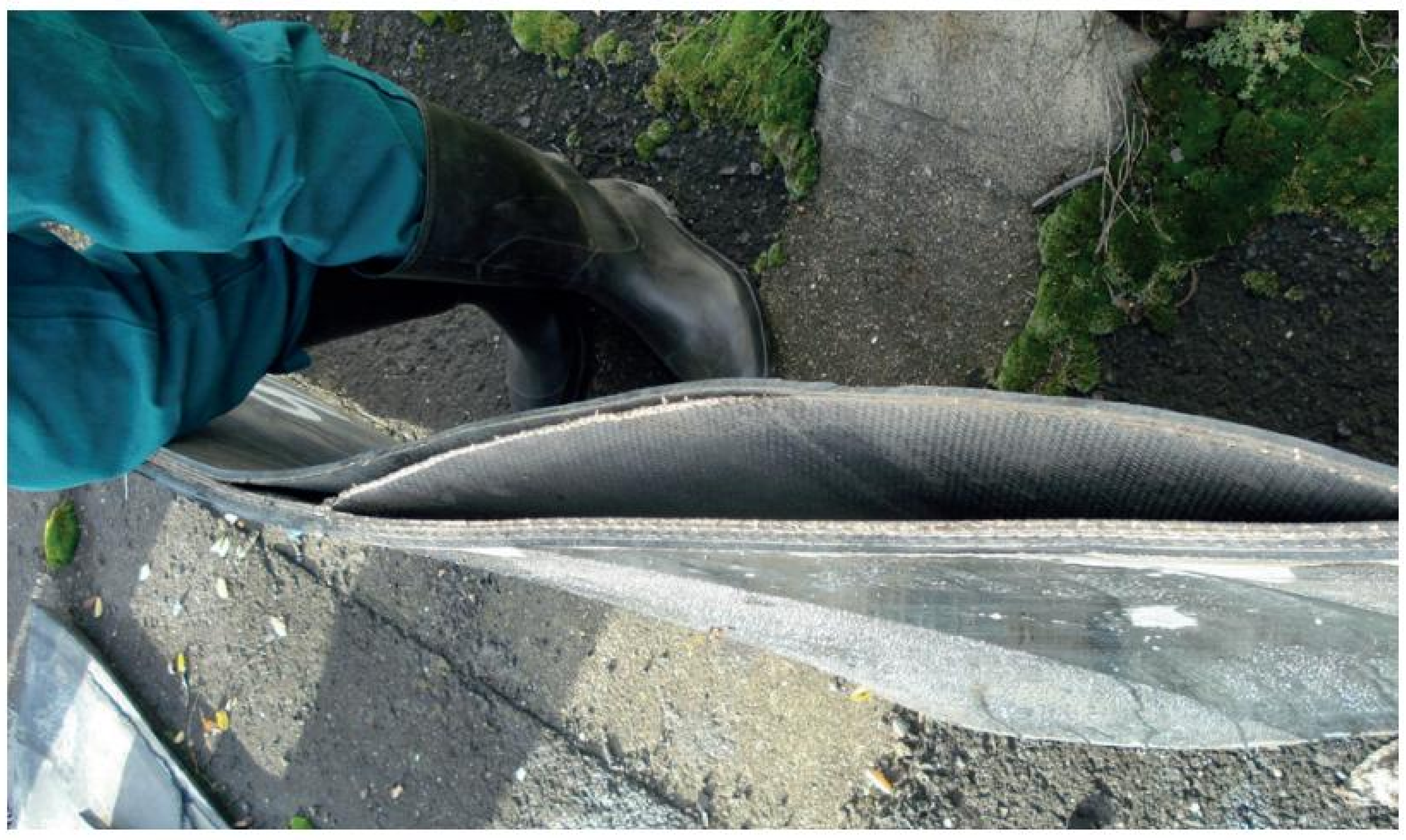

Figure 4. Insufficient elongation is a major cause of delamination.

No. of plies	Maximum % tensile strength
1	90%
2	50%
3	67%
4	75%
5	80%

Figure 5. Much stronger – a finger splicer retains up to 90% of the tensile strength. (Image courtesey of Fenner Dunlop Conveyor Belting).

Improving 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 takes a little longer to make and requires a higher level of skill, the finger splice method results in a far stronger and more reliable joint that, when made properly, can outlive a step splice many times over.

For the uninitiated, a finger splice joint is 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 create a splice that is exceptionally strong and smooth, which makes it almost impossible for the joint to be damaged by scrapers.

Crucially, when the belt is working under load, the finger splice is vastly superior in terms of resistance to dynamic failure because they retain up to 90% of the belt's original tensile strength.

By comparison, a 3-ply step joint only achieves a maximum tensile strength of 67%. The superior strength and durability of finger splices therefore reduce the frequency of repairing and re-splicing almost entirely.

In conclusion

There is no such thing as a 'cheap' conveyor belt because the irrefutable fact is that low prices necessitate the use of poor quality, low-grade raw materials, the omission of essential protectors such as antiozonants, and lower production values. Such deficiencies are the primary cause of unplanned stoppages and premature belt replacements. The often unseen cost of lost output and repairs is huge, so it is essential that it become an integral part of the calculation when comparing conveyor belt price offers. As the old adage goes, price is what you pay but cost is what you spend. WC