Material build-up accelerates wear and can cause tracking problems.

Six keys …

… to conveyor belt longevity

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To provide true efficiency and genuine value for money, conveyor belts should run with little or no significant intervention for several years. Conveyor belts that require less maintenance, fewer repairs and longer replacement intervals have a much lower whole life cost. The mathematics are simple and undeniable. The keys to achieving these goals are clear and, fortunately, very manageable.

It's not what you expect, it's what you inspect

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 any drum linings are in good condition. Belt tracking is also important because a mis-tracked belt can catch on the conveyor framework. Again, cleanliness is vital because mis-tracking is often caused by material build-up on the bottom side of the conveyor belt or drums and pulleys.

A major cause of conveyor belt damage is the result of 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 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 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 dealt with through regular inspection.

Double trouble — a damaged component and an unclean environment.

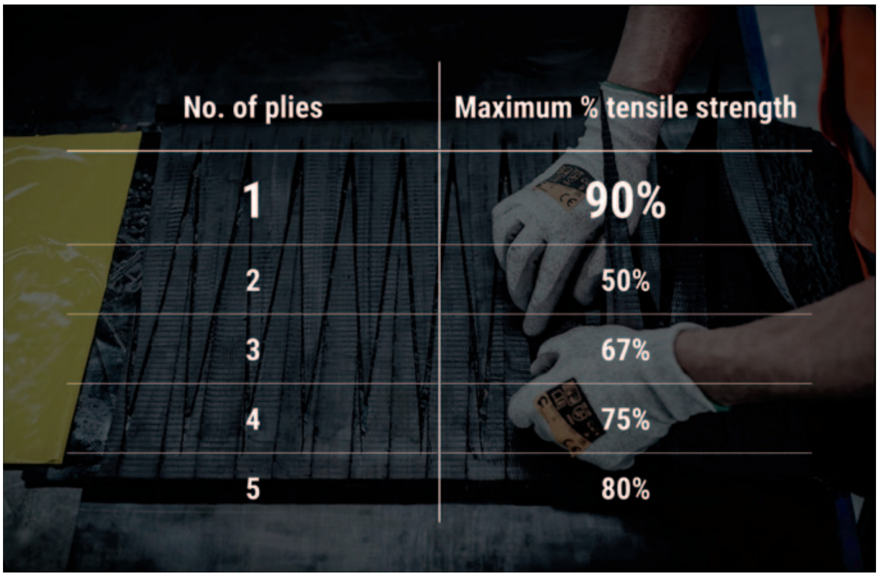
The weakest link

The joints used to create a continuous loop are the weakest point of any conveyor belt. It is estimated that splice joint problems account for some 80% of unplanned repair stoppages. The cost of repairing splice joints including the cost of lost output is considerable but should not be necessary at all. The biggest causes of splice problems are shortcomings in the quality of the conveyor belt itself, the materials used to join the belt and the quality of the workmanship.

Low-quality rubber and poor adhesion between the inner plies and outer covers are both faults commonly found in the low-grade belts and make the job difficult even for the most skilled splicer. The cost of splice joint repairs and the associated lost output should always be included when calculating the whole life cost of a conveyor belt.

The most common splice joint method is the step splice, which requires the removal of one of the layers of fabric plies so that the two belt ends can be overlapped and then either cold glued or hot vulcanized together. It is not physically possible to join a belt without some loss of longitudinal tensile strength, but the biggest disadvantage of the step splice is that it always creates a proportional loss of tensile strength equivalent to one ply. For example, a 3-ply step joint can only achieve a maximum longitudinal tensile strength of 67%. This effectively means that in a typical multi-ply belt containing three plies or more, at least one ply exists purely to compensate for loss of the longitudinal strength incurred by making a step splice joint.

The cost of splice repairs and lost output is considerable.



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

One of the best ways to increase splice reliability is to employ the finger splice method, ideally by changing to the new generation of super-strength single and dual-ply belts pioneered by Fenner Dunlop.

As can be seen in the table above, in comparison to the loss of up to 50% in a step splice, the finger splice method retains up to 90% of the 'static' tensile strength, which is, of course, an enormous advantage. Another crucial advantage is in dynamically stressed conditions when the belt is working and underload because the finger splice is vastly superior to a stepped splice in terms of resistance to dynamic failure. A finger splice joint is also much flatter, so it is not prone to being damaged by scrapers.

Wear resistance

Conveyor belts used to carry a variety of dry bulk materials need to have the type of rubber (cover grade) that can 'multi-task'. First and foremost, the abrasive wear properties of all abrasion resistant conveyor belts should be at least DIN Y standard (ISO 4649/DIN 53516 test maximum 150mm^3 loss) to achieve reasonable economic longevity (whole life cost). If particularly sharp, abrasive materials are sometimes conveyed then higher-grade DIN X covers (maximum rubber loss under testing of 120mm^3] may be more suitable because as well as abrasive wear, it is also more resistant to cutting and gouging. However, a good quality DIN Y rubber used by a premier brand manufacturer is often more wear resistant than a DIN X grade rubber produced by an 'economy driven' manufacturer.

Oil and chemical resistance

In terms of their effect, the wide variety of oils and/or corrosive materials contained within the different types of dry bulk cargo such as grains, fertilizers and biomass, pose the single biggest challenge. Oil absorption causes a dramatic decrease in the ability of the rubber to withstand abrasive wear. As the rubber softens it loses tensile strength, becomes prone to ripping and tearing and swells and distorts.

There are two distinct sources of oils that damage rubber — mineral and vegetable/animal. Good quality oil-resistant belts should have outer covers that are based on a combination of SBR (Styrene Butadiene Rubber) and NBR (Nitrile butadiene rubber). Because of the high cost of nitrile butadiene, manufacturers who operate on the principle of price competitiveness rather than performance and longevity, not only use lower-grade nitrile but also use it in minimal quantities.

Mineral oil tends to be much more aggressive than most vegetable oils, so a full Nitrile butadiene rubber-based synthetic rubber is required. The greater the concentration of nitrile within the polymer, then the greater resistance there is, not only to oil but also to corrosives because nitrile provides protection against many aggressive chemical elements. Although premier brand quality belts come with a higher price tag, they can quite easily achieve double or treble the lifetime of so-called 'economy' belts and up to 500% greater lifetime compared to imported belts. Ironically, the price invariably reflects the difference in performance and longevity that you can expect.

The carcass

The inner carcass is the backbone of every conveyor belt. It provides the inherent characteristics such as its tensile strength and elongation (elasticity or 'stretch' under tension). Its importance should therefore never be underestimated. Most rubber multi-ply and single-ply belts use synthetic fabrics, most commonly a combination of polyester and nylon (polyamide), referred to as 'EP'. The basis of using a mix of polyester and nylon fabric in multi-ply belts is that it has the best balance of mechanical properties including allowing a conveyor belt to run straight, to trough, to flex round pulleys and drums, stretch, provide transversal rigidity, longitudinal strength and much more besides. Unless the weave pattern has been very specifically designed, the use of totally polyester fabric compromises a number of essential mechanical properties.

Unfortunately, an increasingly common deception employed by less scrupulous manufacturers, traders and importers is to supply belts that have totally polyester (EE) fabric plies in a carcass that is claimed to be an EP (polyester/nylon mix) construction. As a result, although the longitudinal

The price invariably reflects the quality and durability.

strands of the fabric may be sufficient to achieve the required tensile strength, rip and tear resistance are reduced, and elongation (stretch) is lowered. This in turn can cause problems with transition distances and a general inability to accommodate the contours of the conveyor and its drums and pulleys, ultimately lead to premature failure.

The sole reason for this deception is that polyester costs some 30% less than nylon. This is significant because, after rubber, the fabric is the highest cost component. Consequently, using lower cost polyester fabric is a big help towards achieving the perception of a lower 'like for like' price. This particular trait is most often found in belts imported from Southeast Asia.

Not what they claim - some belts are supplied totally polyester (EE) fabric plies in a carcass declared as being an EP (polyester/nylon) carcass.

Ozone and ultraviolet resistance

This final key to belt longevity is the most common but least recognized cause of premature belt deterioration, which is the degradation caused by ozone and ultraviolet light. At ground level, ozone becomes a pollutant that is created by the photolysis of nitrogen dioxide (NO_2) from automobile exhaust and industrial discharges. The reaction, known as ozonolysis, affects the molecular structure of rubber. Exposure, which is unavoidable, increases the acidity of carbon black surfaces and causes reactions within the molecular structure of the rubber. This has several consequences including surface cracking and a marked decrease in the tensile strength, all of which accelerates the wear and general degradation of the rubber.

Belts that are not fully resistant to ozone and UV have a much shorter lifespan.

The first visible sign is cracks in the surface of the rubber. These steadily grow until they complete a 'circuit' and the product separates or fails. Its 'partner in crime' is ultraviolet light from sunlight and fluorescent lighting, which accelerates rubber degradation by producing photo-chemical reactions that promote the oxidation of the rubber surface resulting in a loss in mechanical strength. These processes begin as soon as rubber is vulcanized.

Damage can easily be prevented by including antioxidants in the rubber compound but the overriding desire to gain a price advantage means that this life-prolonging option is widely ignored. Laboratory testing reveals that up to 90% of belts sold in Europe, Africa and the Middle East are unprotected. The simple answer is to always insist that the belt you are considering buying is guaranteed to be 100% ozone resistant according to EN ISO 1431 test methods.

Conclusion

Aside from regular inspection and preventative maintenance, the use of low priced, low-grade belting is the primary cause of avoidable stoppages and premature belt replacement. It is physically impossible to make a belt that can stand the test of time without frequent intervention and provide a cost-effective operational lifetime using anything less than top-grade raw materials. Belts produced to compete on price rather than reliability and longevity will always prove much more costly in the end.