Standing the test of time

For conveyor belts to provide genuine value for money, they need to stand the test of time. The longer they run and the less maintenance and repair intervention that is needed then the lower the cost. Apart from the most extremely aggressive applications, modern-day conveyor belts should run with little or no problem for several years. The past two decades have seen a growing domination by Southeast Asian manufacturers. In line with that growing domination has been a corresponding decline in life cycle and a parallel decline in the level of expectation amongst end-users, invariably encouraged by those who choose to supply, fit and maintain them.

SACRIFICED ON THE PRICE ALTAR

Such low levels of life expectancy are unwarranted because good quality belts can achieve up to five times longer working life compared to low-grade imported belts that are 50% or more, lower in price. In many cases, quality and longevity is knowingly sacrificed on the price altar but, in just as many cases, the sacrifice is being made unwittingly. Conveyor belts may look smooth and shiny when they first arrive on site but looks can be very deceptive. Poor quality belts contain a whole set of 'timebombs' caused by poor quality, unregulated materials and low production values. They start ticking the moment the belt is installed and, in some cases, even earlier.

INHERENT WEAKNESSES

Conveyor belts are much more complex than many people give them credit for. The 'ticking timebombs' are weaknesses commonly found in both the outer covers and

Poor quality belts contain 'timebombs' that quickly start ticking the inner carcass of poor-quality belts. Individually they lead to excessive repair and maintenance intervention and ultimately to significantly premature replacement, all of which massively inflates whole life cost and destroys any perceived ‘savings’. These in-built weaknesses can be categorized as follows:

- Poor resistance to abrasive surface wear, cutting and gouging.
- Rubber degradation.
- Prone to rip and tear damage.
- Carcass failure caused by delamination.
- Unreliable splice joints.

ABRASIVE SURFACE WEAR, CUTTING AND GOUGING

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 wear and damage is the use of low grade ‘economy’ rubber with an inadequate resistance to abrasive wear, ripping, cutting and gouging rather than rubber engineered to withstand such demands over much longer periods. 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 small, seemingly insignificant area of damage in the cover 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 small pieces of rubber to be cut out from the surface rather than being simply worn thinner.

Surface cuts can propagate and link up with other areas of damage, causing pieces of rubber to detach completely if low grade rubber is used.

Rubber forms some 70% of the volume mass and more than 50% of the material cost so it is the biggest opportunity for manufacturers to cut costs and improve their price competitiveness. Most conveyor belt rubber is synthetic. Dozens of different chemical components and substances are used to create the rubber compounds needed to cope with the different demands placed upon them. These chemicals and polymers are costly so using low-grade, unregulated versions at the absolute minimum levels, or in some cases not using them at all, is integral to the manufacturer’s ‘lowest sales price’ objective.

A good example is carbon black polymer, which is a key component of rubber and makes up around 20% of a typical rubber compound. Carbon black prolongs belt life by slowing the ageing process and is also an important reinforcing compound. Despite its crucial role, it is a prime cost-cutting target because good quality carbon black is costly. This is more significant than ever because Russia was a major source of good quality carbon black but the Russian – Ukraine conflict has stopped this source of supply. Belts offered with significantly lower prices are virtually certain to contain low-grade carbon black, much of which is now sourced from Southeast Asia.

There are two internationally recognised sets of standards for abrasion, EN ISO 14890 (H, D, and L) and DIN 22102 (Y, W, and X). The longer-established DIN standards are usually the preferred reference in Europe. Generally speaking, DIN Y relates to ‘normal’ service conditions

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

and is the most commonly used, with a maximum volume loss of 150 mm³. Good quality DIN Y (EN ISO 14890 L) abrasion resistant rubber should be sufficient, but marginal or low quality rubber is quickly compromised, requiring frequent patch repairs and resultant loss of output due to stoppages. DIN X (EN ISO 14890 H), with a maximum volume loss standard of 120 mm³, is a little more versatile because in addition to resisting abrasive wear it also incorporates good resistance to cutting, impact (from high drop heights) and the gouging that is often caused by heavy, sharp materials. However, as far as abrasive wear is concerned, the highest grade is DIN W (EN ISO 14890 D), with a maximum volume loss standard of 90 mm³.

It is important to remember that DIN and ISO standards are only the *minimum* benchmark of acceptability. Even so, laboratory tests consistently confirm that more than 50% of conveyor belts are significantly *below* the minimum standard. Even if a belt does marginally meet the required standard, manufacturers using higher quality rubber compounds can produce a significantly better resistance to abrasive action. In fact, one manufacturer's DIN Y grade belt can outperform another manufacturer's allegedly superior DIN X grade belt by a considerable margin. For example, Fenner Dunlop's DIN Y standard rubber (RA grade) has an average volume loss of 96 mm³, so it has some 36% greater abrasion resistance than the DIN Y standard and 20% superior abrasion compared to the DIN X standard.

PREMATURE RUBBER DEGRADATION

The most common but most unrecognised cause of belt deterioration is degradation caused by ozone and ultraviolet light. At ground level, ozone becomes a pollutant that is created by the photolysis of nitrogen dioxide (NO2) 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.

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 photochemical reactions that promote the oxidation of the rubber surface resulting in a loss in mechanical strength. Although damage may only start to become visible after a few months, these processes begin as soon as rubber is vulcanized. Prevention is achieved by the inclusion of antioxidants in the rubber compound but the overriding desire to gain a price advantage means that this life-prolonging option is widely ignored, with laboratory testing revealing that up to 90% of belts sold in Europe, Africa and the Middle East do not have such protection.

RIP AND TEAR DAMAGE

A great many belts are prematurely replaced as a result of catastrophic damage caused by impact and trapped objects. There is often a temptation to fit imported 'sacrificial' belts. This is neither a good technical nor economical solution. The reason why a belt is prone to damage is that the rubber and the inner fabric plies are low-grade and simply not up to the task. More frequent stoppages for repairs and change-outs make sacrificial belts even less sensible.

The only genuine solution is to fit a conveyor belt that has been specifically engineered to withstand the kind of punishment that would destroy a normal belt. Despite the higher purchase price, they are also the most cost-effective solution by far. The best examples use uniquely designed fabric plies that allow the nylon weft strands to stretch. As the belt is being pulled through the trapped object, the strands gather into a bundle that eventually becomes strong enough to stop the belt rather than propagate over a much long distance. The design of the fabric weave also allows energy created by heavy impact to be dissipated over a much wider area.

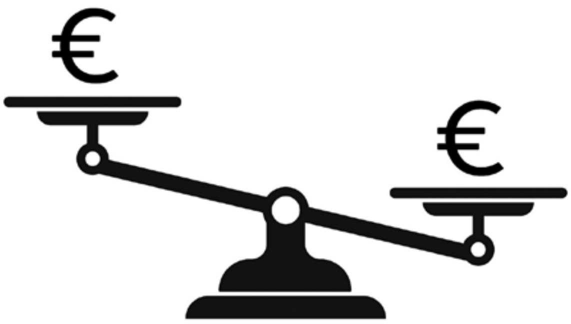
Ripping, tearing and impact – the best solution is to fit a belt specifically engineered for the purpose.

CARCASS FAILURE CAUSED BY DELAMINATION

The adhesion properties of a belt are a critical influence on both performance and longevity of any ply construction rubber conveyor belt. The term 'adhesion' relates to the adhesive bond between the inner ply layers to adjoining layers and between the surfaces of the outer plies and the rubber covers. It is defined as the force required to separate (pull apart) the adhesion between adjoining plies and/or between the plies and the outer covers. Good adhesion is fundamental to the durability, functionality and structural integrity of a conveyor belt. Conveyor belts continually flex over pulleys and drums. This repeated action creates stress. It is therefore essential that the belt has adequate ply adhesion to withstand this stress without delaminating, which is where the various layers separate, and the belt literally falls apart.

Delamination – layers separate and the belt literally falls apart.

Good adhesion enhances the belt's ability to trough and carry heavy loads without the risk of ply separation, making it suitable for more demanding applications. It also has an enormous impact on the reliability of splice joints because an inadequate level of adhesion compromises the strength and longevity of the joint. Unsurprisingly, the root cause of poor adhesion is the use of low-grade raw materials such as polymers, fillers such as carbon black, vulcanizing agents, plasticisers, resins and curatives. Other causes include overheating or overcooking during the vulcanization process and the use of bulking fillers such as chalk or clay.



CONCLUSION

It is physically impossible to make a belt that can stand the test of time and provide a cost-effective operational lifetime if anything less than top-grade raw materials are used to make it. Belts produced in order to compete on price rather than reliability and longevity will always contain in-built weaknesses that vastly outweigh the perceived savings of a lower sales price.

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