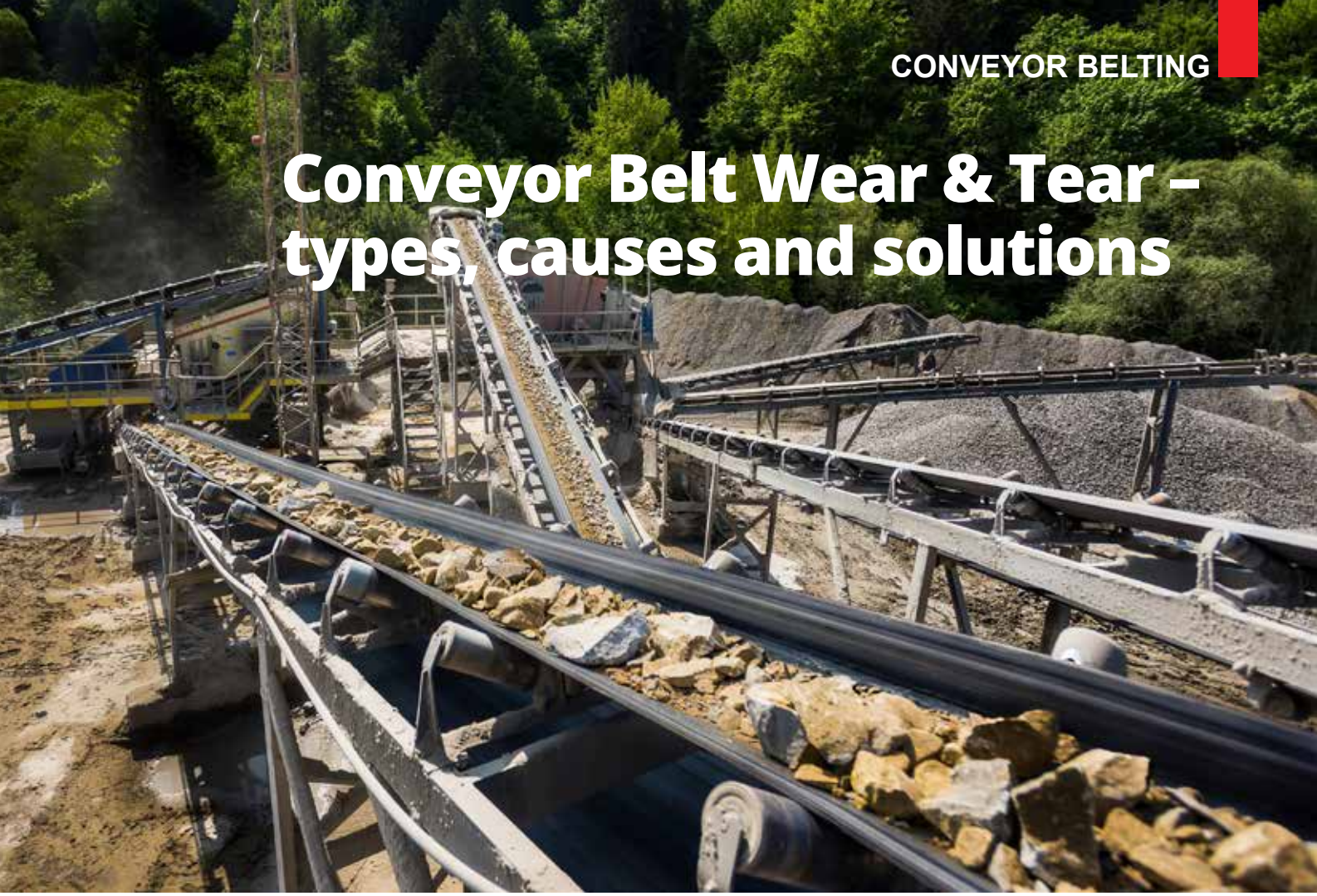
Conveyor Belt Wear & Tear – types, causes and solutions



The wear resistant qualities of the outer covers of a conveyor belt are the biggest single influence on the working life of the belt and consequently its 'whole life' cost. Here, conveyor specialist Leslie David looks at the question of durability and resilience and how it determines the working life and ultimately the true cost of your conveyor belts.

WHAT IS WEAR AND TEAR?

'Wear and tear' is an umbrella term used to encompass a number of different kinds of action that progressively damages and wears out industrial conveyor belts, eventually necessitating their replacement. These are abrasion, cutting & gouging and rubber degradation. A fourth kind of damage is ripping & tearing. Although more usually associated with more catastrophic damage affecting both the inner carcass as well as the outer covers, ripping and tearing of the rubber covers can dramatically shorten the operational lifetime of the belt. Different causes of wear and tear require rubber compounds that have very specific properties. The overriding solution to literally every kind of wear and tear lies in the quality of the rubber.

ABRASIVE WEAR

As a general rule, 80% of conveyor belt surface wear occurs on the top cover of the belt and approximately 20% of the wear on the bottom cover. Wear on the top cover is primarily caused by the abrasive action of the materials being carried, especially at the loading point or 'station' where the belt is exposed to impact by material landing on it. In almost all cases, the shorter the belt then the faster the wear rate because they pass the loading and discharge points at more frequent intervals. The selection of the correct type of cover quality (grade) for shorter length belts therefore becomes even more important than usual.

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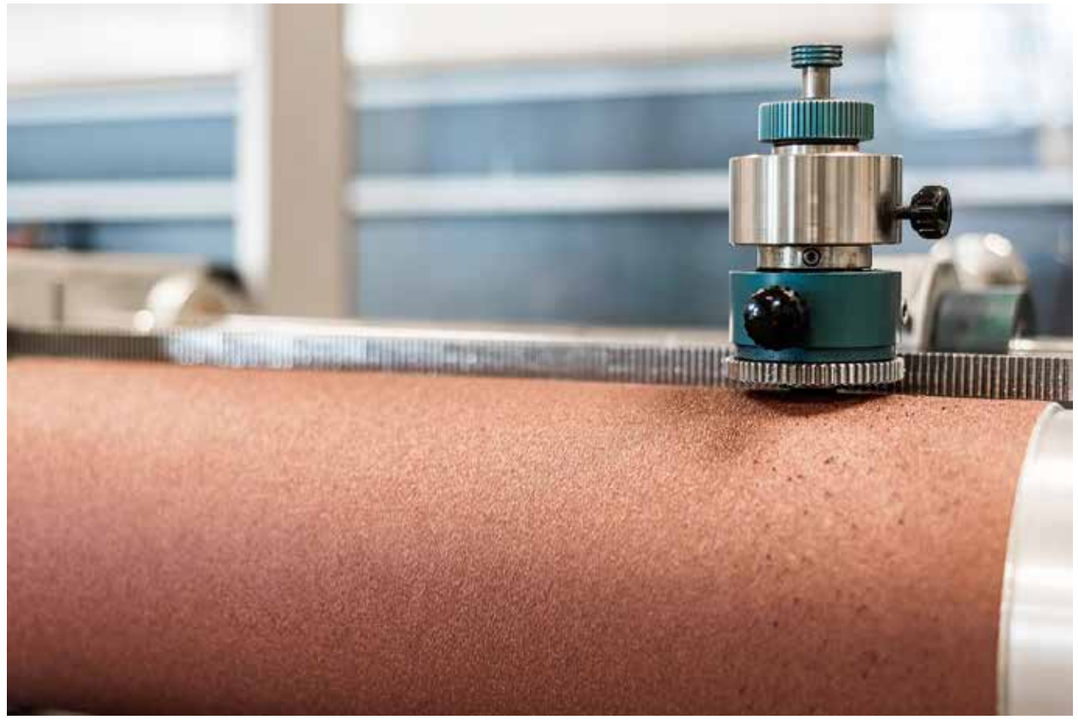

ISO 4649 / DIN 53516 abrasion testing.

Wear on the bottom cover of the belt is mainly caused by the friction contact with the drum surface and idlers. The rate and uniformity of this type of wear can be adversely affected by many other factors such as misaligned or worn drums and idlers set at incorrect angles. Unclean environments where there is a build up of waste material and damaged idlers and rollers also accelerate wear. Belt cleaning systems, especially steel edged scrapers, can be another cause of wear to the top cover if not kept correctly adjusted.

TESTING

The test method for resistance to abrasive wear (ISO 4649 / DIN 53516) is measured by moving a test piece of rubber across the surface of an abrasive sheet mounted on a revolving drum and is expressed as volume loss in cubic millimeters (mm^3).

The most important thing to remember when comparing abrasion test results is that higher figures represent a greater loss of surface rubber and therefore a lower a lower resistance to abrasion. Conversely, the lower the figure the better the resistance to abrasive wear. A belt with good abrasion resistance can often run for longer than the combined working life of two or even three or more lower grade ‘economy’ belts.

QUALITY STANDARDS

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 and is the most commonly used, with a maximum volume

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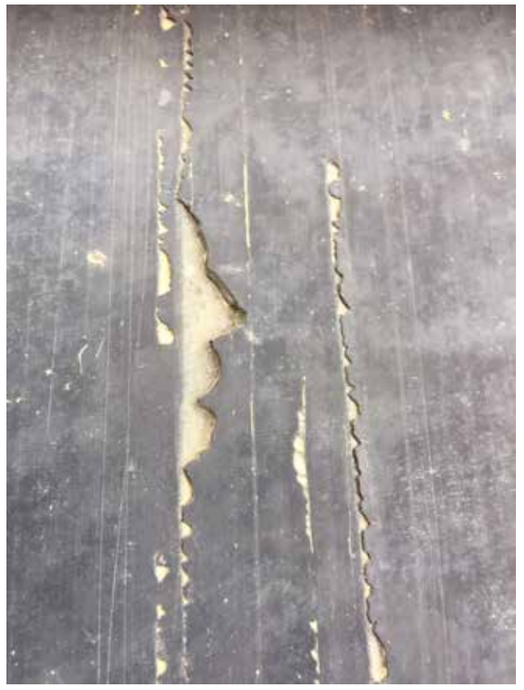


Surface cuts can propogate and link up with other areas of damage, causing pieces of rubber to detach completely if low grade rubber is used.

the claimed test standards applicable rather than the actual performance achieved during the test on their technical datasheets. The welcome exception is Netherlands-based Fenner Dunlop, who show the average test results extracted from their routine quality control testing against each applicable property. They have done this for many years, with the regularly updated averages shown alongside the minimum required standard data. At least in this way their customers can better compare and have more of an indication of the level of performance they can expect rather than just promises of what should be.

CUTTING AND GOUGING

Belts that transport heavy and/or sharp rocks, that cause cutting and gouging of the belt surface need different resistance properties compared to belts carrying ‘fine’ materials such as aggregate, sand and gravel. If the material being conveyed is particularly sharp, such as dolerite or granite rock for example, then a DIN X (ISO 14890 H) belt with a rubber compound that is more resilient to cutting is probably the best option. Another cause of surface cutting and gouging are stones and rocks that become trapped between rotating components such as drums and the belt. Good quality DIN Y (ISO 14890 L) abrasion resistant rubber should be able to cope up to a point but marginal or low quality rubber is quickly compromised, requiring all too frequent patch repairs and resultant loss of output due to stoppages. In all cases, good quality belt should not suffer from surface cuts that propogate and link up with other areas of damage, causing pieces of rubber to detach completely.

loss of 150 mm^3. Strangely, there is no direct equivalent ISO standard. The nearest is ISO 14890 L, but in several respects, it is a much lower cover class than DIN Y. In other words, if you want a belt that meets DIN Y standards then do not accept ISO 14890 L.

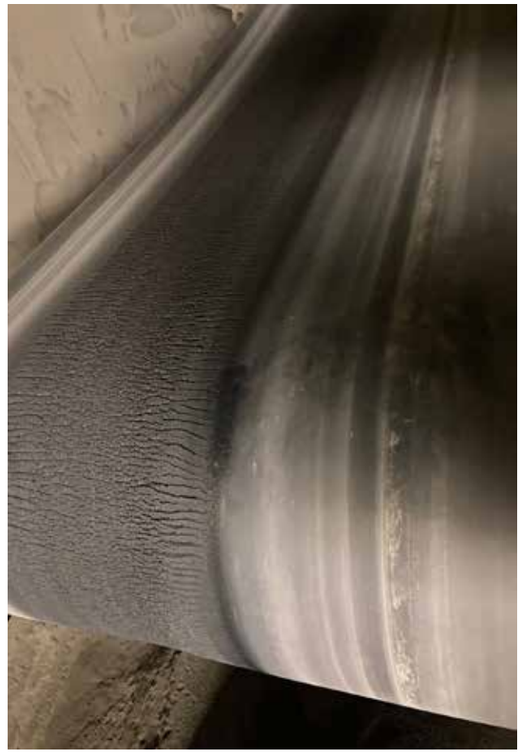
DIN X (ISO 14890 H), with a maximum volume loss standard of 120 mm^3, is a little more versatile because in addition to resisting abrasive wear it also incorporates good resistance to cutting, impact (from high drop heights) and the gouging that is often caused by heavy, sharp materials. However, as far as abrasive wear is concerned, the highest grade is DIN W (ISO 14890 D), with a maximum volume loss standard of 90 mm^3.

REALITY VERSUS PROMISES

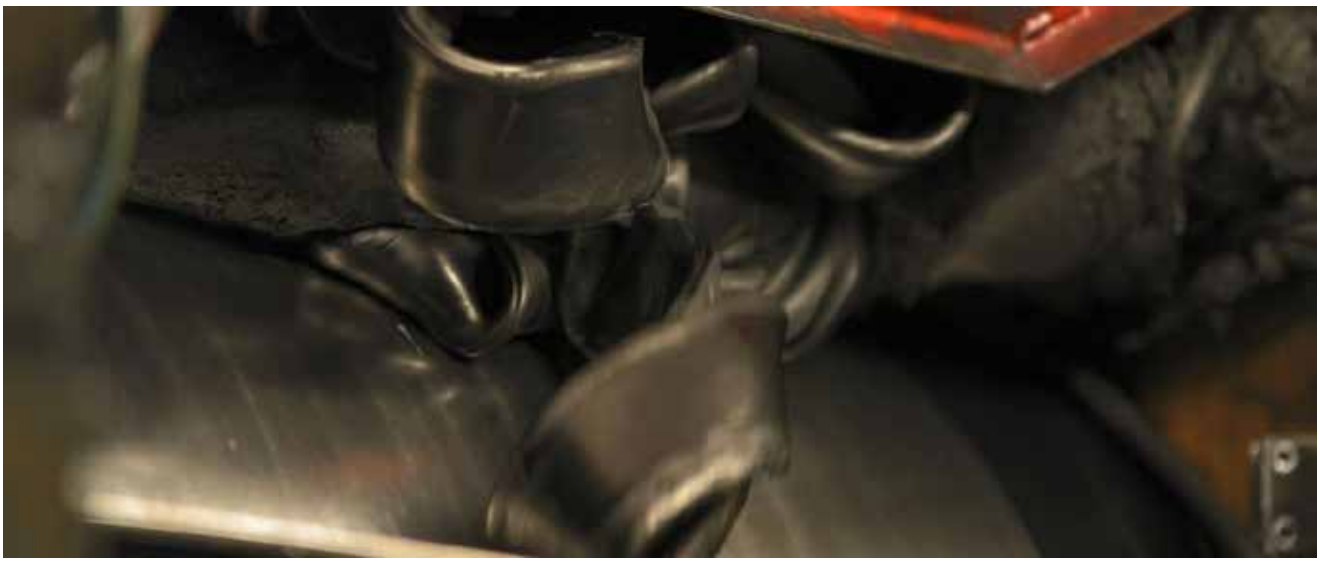
It is important to bear in mind that DIN and ISO standards are only the minimum benchmark of acceptability. Even then, although signified as being a certain grade on the manufacturer’s technical datasheet, laboratory tests consistently reveal that more than 50% of conveyor belts are found to be significantly below those minimum standards.

And 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. So much so, in fact, that one manufacturer’s DIN Y grade belt can outperform another manufacturer’s allegedly superior DIN X grade belt by a considerable margin.

With one unique exception, belt manufacturers only show



Cracking up. Without ozone and UV resistant covers, wear and tear is accelerated.



It's all about the quality of the rubber.

Each manufacturer uses its own mix of polymers to create cover compounds with specific wear resistance qualities. The main polymers are SBR (Styrene-Butadiene-Rubber), which is a synthetic rubber and NR (Natural Rubber). In basic terms, SBR has good general resistance to abrasion while natural rubber has better resistance to cutting and gouging. Consequently, natural rubber should be a major part of the mix used to create DIN X grade rubber. Unfortunately, it is appreciably more expensive. As a result, many manufacturers try to avoid or at least minimise the amount of natural rubber used in order to achieve low prices, despite the reduced protection of the inner carcass, higher level of repairs and, ultimately, a shorter operational lifetime.

Surface ripping and tearing effectively falls into the same category of cutting and gouging but is simply more destructive. The size, weight and sharpness of the material being conveyed is the key factor, especially when heavy and sharp objects fall from height onto the belt surface. The damage this can cause goes beyond normal wear and tear because the cover can be punctured and expose the inner carcass. Depending on the severity, DIN X (ISO 14890 H) grade belt is certainly a good option but a belt specifically engineered and proven to handle severe conditions (impact, rip & tear) that has DIN W (ISO 14890 D) covers is most likely the best choice.

HOW OZONE & ULTRAVIOLET LIGHT CONTRIBUTE TO RAPID WEAR

There is absolutely no question that ALL rubber conveyor belts should be fully resistant to the damaging effects of ozone (O3) and ultraviolet light (UV). This is because ozone becomes a pollutant at ground level. Exposure, which is unavoidable, increases the acidity of carbon black surfaces and causes reactions to take place within the molecular structure of the rubber. Known as ozonolysis has several consequences such as surface cracking and a marked decrease in the tensile strength of the rubber.

Likewise, ultraviolet light from sunlight and artificial (fluorescent) lighting also accelerates deterioration. This is because it produces photochemical reactions that promote the oxidation of the surface of the rubber resulting in a loss in mechanical strength. In both cases, this kind of degradation causes an acceleration of the wear and tear process.

Rubber belts that are not fully resistant to ozone and UV can start to show signs of degradation even before they have been fitted simply by being exposed to open air and daylight. Sadly, despite its crucial importance in terms of operational lifetime, laboratory testing has revealed that some 90% of belt sold in Europe, the MiddleEast and Africa are not ozone and UV resistant. This is because the antiozonants needed to create that resistance are seen as an avoidable cost. My advice is to always make a guarantee of ozone & UV resistance compulsory when selecting any rubber conveyor belt.

IT'S ALL ABOUT THE QUALITY OF THE RUBBER

Ultimately, resilience to wear and tear is all about the quality of the rubber. Ironically, it is the size of the difference in selling price that is invariably the best indicator of that quality because rubber constitutes at least 50% of the cost of making a conveyor belt.

Consequently, it is the single biggest opportunity for manufacturers to cut corners in order to compete for orders on price. When it comes to the true cost of a conveyor belt, time will always tell.

ABOUT THE AUTHOR

After spending 23 years in logistics management, Leslie David has specialised in conveyor belting for over 17 years. During that time, he has become one of the most published authors on conveyor belt technology in the world.

Leslie David