Wearing thin

Conveyors are the most efficient method of handling bulk materials, but their cost-effectiveness depends on the length of working life and lack of need for regular intervention to carry out running repairs.

Thanks almost entirely to one or two leading European and North American manufacturers, primarily Fenner Dunlop, the technology used to produce conveyor belts has advanced enormously in recent years. Today's leading brands are providing a working lifetime of up to five times longer than their competitors. Unfortunately, most operators continue to waste money by replacing belts far more frequently than should be necessary. Here, *leading conveyor belt specialist Jeremy Clark* explains why this is happening.

Synthetic rubber can be engineered and adapted to cope with a multitude of demands.

Belt longevity — the biggest influence

The quality of the rubber is the biggest single influence on the performance and longevity of a conveyor belt. There are many different types of rubber compound used for rubber multi-ply belts because modern-day belts have to deal with a multitude of different (and often combined) demands including abrasion, heat, oil, ozone, fire and more. These compounds are commonly referred to as known as 'cover grades' or 'cover qualities'. They are almost entirely synthetic because of its greater versatility and, by using literally dozens of different chemicals and substances, they can be engineered and adapted to cope with a multitude of demands.

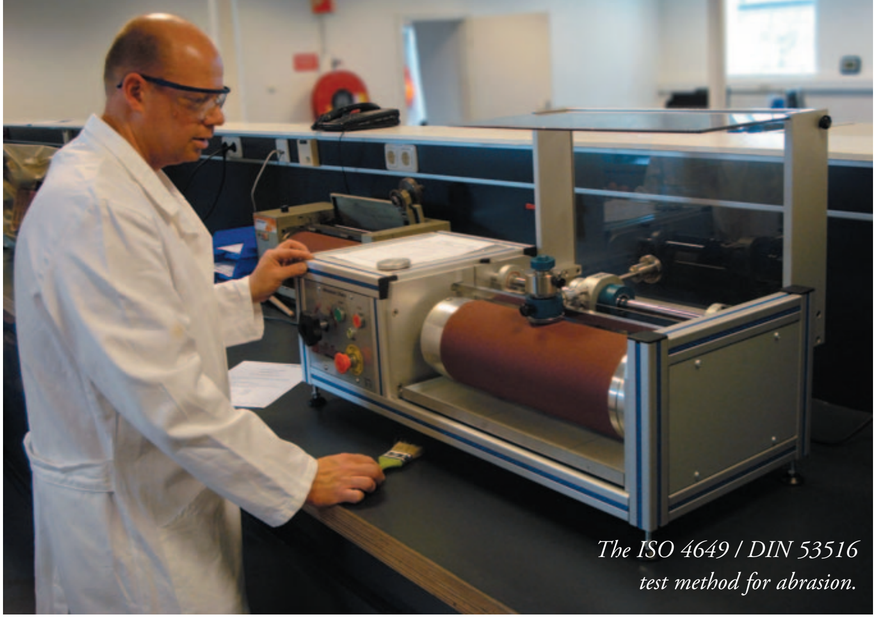
There are two internationally recognized sets of standards for abrasive wear, EN ISO 14890 (H, D and L) and DIN 22102 (Y, W and X). In Europe, it is the longer-established DIN standards that are the most commonly used. DIN Y (ISO 14890 L) generally relates to 'normal' service conditions. In addition to resisting abrasive wear DIN X (ISO 14890 H) also has good resistance to cutting, impact and gouging. DIN W (ISO 14890 D) is usually reserved for particularly high levels of abrasive wear, which is relatively uncommon in the world of bulk material handling.

Surface cuts and gouges link up.

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 the bulk material and at the discharge point where the material is effectively 'accelerated' across the belt surface. Many bulk cargoes such as coal are not especially abrasive but materials that are sharp and hard can cut and gouge the surface causing accelerated deterioration. Although the size of the damaged area is often fairly small, they tend to join up with other damaged areas, resulting in pieces of rubber cover being literally cut out of the belt surface.

Wear testing

The test method for abrasion (ISO 4649/ DIN 53516) is actually quite simple. Abrasion resistance 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 millimetres. The most important



The ISO 4649 / DIN 53516 test method for abrasion.

thing to remember when comparing abrasion test results is that higher figures represent a greater loss of surface rubber which means that there is a lower resistance to abrasion. Conversely, the lower the figure the better the wear resistance. Regardless of the type of cargo, in bulk handling the absolute maximum volume loss should be no more than 150mm³.

A word of caution here because a good quality DIN Y (ISO 14890 L) grade rubber can often have a better level of abrasion resistance than a poor-quality DIN X (ISO 14890 H) or even DIN W (ISO 14890 D) grade rubber.

Comparing an offer from one manufacturer to another is made very difficult because the technical datasheets provided by manufacturers and traders only show the minimum figure demanded by a particular test method or quality standard rather than the actual performance that the belt they are offering should be expected to achieve. The only exception to this is Netherlands-based Fenner Dunlop which shows the average results achieved during the strict quality testing regime carried out in its laboratories on every batch of rubber that it produces.

Thicker is not normally the answer

Although the thickness of the cover can be an important consideration, the actual wear-resistant properties of the rubber are much more important. If it is felt necessary to increase the cover thickness to compensate for premature wear, then that is a sure sign that the level of abrasion resistance is inadequate. As well as good abrasion resistance, good quality rubber will also have superior tear strength (measured as either N/mm² or MPa) so that it can better resist rip and tear propagation.

Crucially, wear and tear caused by abrasive action, cutting and gouging, is significantly accelerated due to degradation caused by the unavoidable exposure to ground level ozone and ultraviolet light.

Accelerating the wear process

Contrary to popular belief, the damage caused by ozone (O_3) and ultraviolet light (UV) is not limited to high altitudes or sunny climates. Ground level, 'harmful' ozone, is created by the photolysis of nitrogen dioxide (NO_2) from automobile exhaust and industrial discharges. The reaction is known as ozonolysis.

Tiny traces of ozone in the air attack the molecular structure of rubber. It increases the acidity of carbon black surfaces with polybutadiene, styrene-butadiene, nitrile and natural rubber the most sensitive to degradation. The first signs are cracks that appear on the surface of the rubber. Further attacks occur inside the freshly exposed cracks, which continue to steadily grow until they complete a 'circuit' and the product separates or fails.

Ultraviolet light from daylight and fluorescent lighting also has a seriously detrimental effect because it accelerates rubber deterioration by producing photochemical reactions that promote the oxidation of the rubber surface resulting in a loss in mechanical strength. This is known as 'UV degradation'. Rubber belts that are not fully protected against ozone and UV can start to degrade as soon as they leave the production line. Despite its crucial importance, ozone and UV resistance is very rarely, if ever, mentioned by traders or manufacturers.

Ozone and ultraviolet damage is entirely preventable simply by the addition of antioxidants to the rubber compound mix. Despite this, tests show that more than 85% of belts sold in Europe fail within only 6 to 8 hours of the 96-hour EN ISO 1431

Ozone & UV damage considerably shorten belt life.

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test because are seen by most manufacturers see antioxidants not only as an avoidable cost but something that delays the replacement cycle. My advice is to always make ozone & UV resistance a required part of the specification when selecting any rubber conveyor belt.

Buying criteria

Although making a choice based on lowest price is very rarely the best approach, the fact remains that conveyor belts are usually big budget items. As a result, although they will not admit it, most buyers will invariably have price at the top of their selection criteria. However, certainly in the case of complex components such as conveyor belts, the cost can only truly be measured over the lifetime of the belt. As the old saying goes, price is what you pay but the cost is what you actually spend.

The conveyor belt market is hugely competitive and the reason for this has been the growing market dominance of Southeast Asian manufacturers over the past twenty years, primarily China, who are offering apparently the same specification products at less than half the price of the top European and North American manufacturers. The common explanation for this disparity is the much lower wage costs in Asia, but this is a huge misconception. Thanks to the ever-increasing level of automation, the labour cost element is actually less than 7% of the cost of producing a conveyor belt whereas raw materials represent some 70% of the cost. It is these two crucial facts of life that are the reason why so many operators are wasting huge amounts of money replacing belts far more frequently than necessary.

It's all about the rubber.

Rubber represents some 70% of the mass and 50% of the raw materials cost of a conveyor belt. Consequently, it is by far the biggest opportunity for manufacturers to cut costs and improve their price competitiveness. Methods include the use of unregulated, low-grade raw materials, the use of bulking agents such as chalk and clay, the use of increasingly larger proportions of recycled scrap rubber of highly questionable origin and the substitution of essential polymers such as carbon black with low-grade versions created by various means including the burning of scrap vehicle tyres.

Another common method is reduced quantities and often the total omission of key ingredients such as the antioxidants needed to resist the premature degradation caused by exposure to ozone (O_3) and ultraviolet light. Such practices allow unscrupulous manufacturers to massively undercut the prices of the few remaining manufacturers at the quality end of the market.

One for the price of three

Fitting and replacing two or three 'economically priced' belts rather than buying a single, good quality belt is invariably a false economy. Helpfully, the quality of a belt is usually best indicated by its price. The lower the price, the lower its resilience and longevity, so it is always worth being suspicious and checking the original manufacturer's specifications very carefully as well as asking for documented evidence of compliance and performance.