TIGHTENING THE BELT

Leslie David provides insight into how taking a different approach can significantly reduce replacement conveyor belt expenditure.

Conveyors continue to remain the most effective method of handling bulk materials. Their durability, reliability, and cost are critical factors in both productivity and cost management. The conveyor belts themselves are often the most vulnerable component because they have to cope with some of the hardest, sharpest, and most abrasive materials imaginable.

Conveyors are the most effective bulk handling method.

Production costs – the labour cost element is very low.

The technology used to manufacture conveyor belts has advanced enormously in recent years and today's operators should expect the belts to provide at least two or three times longer operational lifetime compared to the lifetimes being achieved as recently as just five or ten years ago. However, for a variety of reasons, most operators continue to replace belts much more frequently than they should need to.

What is the cost?

Before talking about the technical aspects of conveyor belts and how to get the best value (save money) the issue of price must be dealt with. Although sales people will always maintain that making a choice based on price rather than the quality of the product is not the best way to make a decision, the fact remains that conveyor belts are costly items, so price does come into it. And, whether they admit it or not, buyers will almost invariably have price as the most important factor in their selection criteria. However, especially in the case of complex components like conveyor belts, knowing the price of something is very rarely an accurate measure of its value.

The economic value of a conveyor belt can only be properly established (or estimated in advance) by calculating the 'whole life' cost. This is simply done by adding the price paid to other known associated costs, such as fitting, repairs, and maintenance. The total is then divided by either its actual (or anticipated) operational lifetime (measured in either weeks, months, years, or running hours), or alternatively by the tonnage carried. It is surprisingly rare to find a conveyor operator who makes such calculations. Some do not even seem to keep records of when new belts were fitted and old ones replaced.

It is not uncommon to encounter buyers of conveyor belts who are absolutely convinced that they are getting a good deal because the price they are paying is significantly lower than other offers. They seem to completely ignore the fact that they will most probably have to use two or three of these 'super value' belts when, in reality, a single, good quality belt would cost considerably less in real terms.

This leads to the 'nitty gritty' where that much-used word 'quality' comes into play. Pretty much every salesperson in the world uses the word quality to describe the products they are selling. No salesperson would ever describe their offerings as poor or low quality. But when it comes to conveyor belts, what exactly is quality and how can it be measured and assessed?

What is quality?

Industrial conveyor belts may simply look like lengths of thick black rubber but the truth is that they can be surprisingly complex. Perhaps the question most often asked is: how can there be such huge differences in price between one supplier/manufacturer and another, for belts of apparently exactly the same specification? The answer to that question lies within the various elements of what it costs to actually produce a conveyor belt in the first place.

The very first thing to appreciate and accept is that, because of fierce competition, the profit margins that manufacturers work with invariably represent less than 10% of the overall selling price. The days of 'paying for the big name' are most definitely long gone. As a general rule of thumb, raw materials can easily represent some 70% of the cost of producing a conveyor belt. General overheads make up no more than around 10%. Thanks to the high level of automation, the labour cost element is very low. One would not expect to see more than three or four people manning a typical production line. This fact certainly shoots down the usual assumption that belts imported from Asia are only lower priced because their labour costs are much lower than those in Europe.

When faced with a huge difference in price and the fact that raw materials make up the vast bulk of the total manufacturing cost, it is perfectly reasonable to conclude that materials of a lower quality have been used to achieve that difference. The pressure to keep costs to an absolute minimum also means that recycled rubber of highly questionable origin may well have been used in the mix. Another cost-saving method is to use cheap 'bulking' fillers to replace part of the rubber polymers in the rubber compound. Fortunately, the tell-tale signs to look for when evaluating the quality of a conveyor belt can be broken down to the two main constituent parts of a conveyor belt.

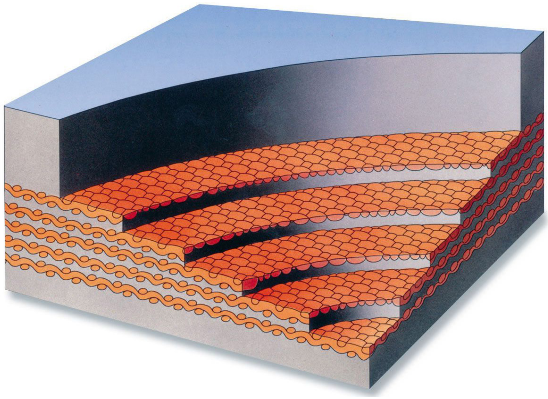
The carcass

Belts with a multi-ply fabric (usually polyester/nylon) reinforced carcass protected by an outer cover of rubber are the most commonly used type. It is the carcass that provides the inherent characteristics of a conveyor belt, such as its tensile strength and elongation (elasticity or 'stretch' under tension). The three key aspects relating to the performance of a carcass are the actual quality of the fabric, the rubber between the plies, and the standard of the production methods.

Although they may be the same basic specification, there are often huge differences in the actual quality of the fabric plies. Unlike the past, it is unusual nowadays to find a fabric that has inadequate tensile strength, so simply comparing tensile strength data will not help. In lower quality (lower cost) fabrics, although the amount of material used in the longitudinal strands of the fabric may be adequate, the amount of transversal weft material is kept to an absolute minimum in order to reduce cost. Although the required tensile strength is achieved, albeit with a low safety factor, rip and tear resistance is reduced and elongation (stretch) is low. Low elongation may sound good in principle but if the elongation is too low then this can cause problems with transition distances and a general inability to accommodate the contours of the conveyor and its drums and pulleys. This will ultimately lead to the premature failure of the belt.

The amount of rubber used between the plies (known as the skim) is also very sensitive because it can have a significant effect on the behaviour of the belt. If the rubber layer is too thin that has a number of consequences – firstly, the belt will not be rigid enough in the transverse direction, causing tracking problems. The belt will also not trough or bend sufficiently. Last but not least, thinner skims reduce the ability of the belt to absorb impact.

Finally, if production processes are rushed and there is a lack of quality control, inconsistencies in the tension of the belt carcass can occur, which can lead to handling and steering problems.



The thickness of rubber between the plies affects handling.

Harder wearing covers are more cost-effective.

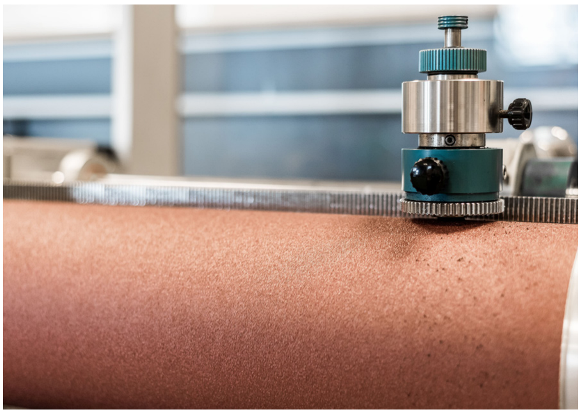
Unfortunately, in all three elements of carcass quality – fabric quality, the rubber plies, and the quality of production, there is no data available to the potential buyer. Apart from using a significant difference in price as an early warning sign, the only way to distinguish between good and poor quality is, unfortunately, by learning the hard way.

The covers

The rubber used for the outer covers is the single biggest cost when manufacturing a conveyor belt, so it is consequently the single biggest opportunity for manufacturers to economise. 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 much more. These cover compounds are commonly known as cover grades or cover qualities. Most of the rubber used in conveyor belting is synthetic.

There are literally hundreds of different chemical components and substances that are needed to create the synthetic rubber compounds that, once vulcanised, are able to meet the specific physical performance and safety requirements. There are four basic aspects that most determine the quality of performance of all cover grades. These are wear (abrasion) resistance; tear strength; ozone and ultraviolet (UV) resistance, and production methods. Not only is abrasion resistant the most commonly used type of cover grade, it is also the level of abrasion (wear) resistance of any rubber cover that is likely to have the greatest influence on the operational lifetime of a conveyor belt. Longer working life equals greater economy.

There are two internationally recognised sets of standards for abrasion, 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. Generally speaking, DIN Y (ISO 14890 L) 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.



ISO 4649/DIN 53516 abrasion testing.

Ozone & UV can rapidly destroy a rubber belt.

Abrasive wear testing

Abrasion resistance (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. It is expressed as volume loss in cubic millimetres, for instance 150 mm³. The most important thing to remember when comparing abrasion test results (or promises!) is that higher figures represent a greater loss of surface rubber, which means that there is a lower resistance to abrasion. The lower the figure the better the wear resistance.

Comparing (evaluating) one offer to another is made difficult by virtue of the fact that the technical datasheets provided by manufacturers and traders almost invariably only show the minimum requirement of a particular test method or quality standard, rather than the actual performance that the belt being offered would be expected to achieve.

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 where the material is effectively accelerated by the belt surface. Short belts (below 50 m) usually wear at a faster rate because they pass the loading points more frequently compared to longer belts. For this reason, the quality of abrasion resistance needed for shorter length belts is even more crucial than normal.

Although the thickness of the cover is an important consideration, in reality the actual wear resistant properties of the rubber are much more important than the thickness. If it is felt necessary to increase the cover thickness in an effort to compensate for premature wear, that is a sure sign that the quality of abrasion resistance is inadequate. Good quality rubber will also have superior tear strength (measured as either N/mm^2 or MPa) or, in other words, it will have the physical ability to resist tear propagation.

One final thing to watch for is the measured thickness of the covers of the belt when it arrives onsite, compared to the specification. One of the oldest tricks in the book is to deliver a thickness that can be as much as 1 mm (or more) less than the specification. This may not sound much but it can easily represent as much as 20% less wear life.

Ozone and UV qualities

There is absolutely no question that all rubber conveyor belts should be fully resistant to the damaging effects of ozone and ultra violet light. This is because ozone becomes a pollutant at ground level. Exposure increases the acidity of carbon black surfaces and causes reactions to take place within the molecular structure of the rubber. This has several consequences, such as a surface cracking and a marked decrease in the tensile strength of the rubber. Likewise, UV light from sunlight and fluorescent lighting also accelerates deterioration because it produces photochemical reactions that promote the oxidation of the surface of the rubber, resulting in a loss in mechanical strength.

Rubber belts that are not fully resistant to ozone and UV can start to show signs of degradation before they have even been fitted to a conveyor. Despite its crucial importance, ozone and UV resistance is very rarely, if ever, mentioned by traders or manufacturers. This is almost certainly because anti-ozonants need to be used during the mixing process of the rubber compounds and that, of course, makes the belt less competitive on price. It is important to always make ozone and UV resistance a required part of the specification when selecting any rubber conveyor belt.

Something smells wrong!

The pressure to minimise the cost of the production in order to compete on price has increasingly led to the use of potentially dangerous chemical substances to artificially accelerate the vulcanisation process. When the EU's REACH (Registration, Evaluation and Authorisation of Chemical substances) regulation EC 1907/2006 came into force in June 2007 such concerns should have largely been dispelled. The regulations were introduced to improve the protection of human health and the environment from the risks that can be posed by chemicals. All European manufacturers became legally obliged to register the use of "substances of very high concern" (including those believed to cause various forms of cancer) that are listed within the regulations with European Chemical Agency (ECHA).

Unfortunately, manufacturers located outside of EU member states are not subject to the regulations and are, therefore, free to use unregulated raw materials. However, it is important to note that those who import belts from outside the EU are responsible for the application of REACH regulation.

Somewhat ironically, the very use of these banned and restricted chemicals often provides a good indicator as to the overall quality of the belt. According to highly experienced rubber compound technicians, good quality rubber usually has very little smell, whereas low quality rubber often has a highly pungent aroma. In other words, it is possible to literally smell the difference. It is important to always ask for written confirmation from the belt manufacturer or supplier that the product it is offering will be produced in compliance with REACH EC 1907/2006 regulations.

Sacrificial belts are a false economy.

Do not accept the inevitable

For demanding applications where belts frequently require repair and replacement due to impact and tearing caused by heavy, sharp materials, there is often the temptation to accept the inevitable and fit 'sacrificial' belts. However, repairing and replacing belts entails a lot of cost. Added to that, there is also the not to be under-estimated cost of lost production. All of which almost always goes to make the use of sacrificial belts an expensive misconception.

The only answer is to fit belts that have a carcass and covers designed and engineered specifically for such conditions. They may appear to cost perhaps two or three times the norm but, in reality, they are proven to run for years where conventional belts only last for weeks or months.

Seek advice

There is a lot more to conveyor belts than meets the eye. As mentioned earlier, the only way to assess value for money is to know the true cost. Fitting and replacing two or three economically priced belts rather than looking more closely at the performance quality and longer operational lifetime provided by one good quality belt is invariably a false economy and much more hassle in the long run.

As often as not, the quality of a belt is reflected by its price, so it is always worth the effort to check and compare the original manufacturer's specifications very carefully and ask for documented evidence of compliance and performance. ■

About the author

After spending 23 years in logistics management, Leslie David has specialised in conveyor belting for over 13 years. During that time, he has written numerous technical guidance bulletins and is one of the most published authors on conveyor belt technology in Europe.