TIGHTENING THE BELT

Leslie David, Conveyor Belt Specialist, provides an 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. Especially in the mining industry, the conveyor belts themselves are often the most vulnerable component because they have to cope with extremely hard, sharp and some of the most abrasive materials.

The technology used to manufacture conveyor belts has increasingly advanced in recent years, and belts today should be expected to provide an operation lifetime of at least two or three times longer compared to the lifetimes being achieved as recently as 5 – 10 years ago. However, for a variety of reasons, most operators continue to replace belts much more frequently than it should be needed.

What is the cost?

First, there is the issue of price. 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 and so price is an important factor. Whether they admit it or not, buyers will almost invariably have price as the most important factor in their selection criteria. However, knowing the price of something is very rarely an accurate measure of its true value, especially in the case of complex components like conveyor belts.

The true economic value of a conveyor belt can only be properly established by calculating the 'whole life' cost. This is simply done by adding the price paid for the belt 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 either in weeks, months, years or running hours) or alternatively by the tonnage carried. Surprisingly, it is very rare to find a conveyor operator who makes such calculations. Some do not even seem to keep records of when worn out or damaged belts were replaced by new ones.

Over the years, buyers of conveyor belts have been 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.

Figure 1. One good quality belt can outlast three low price belts.

Figure 2. Conveyor belts are costly items, so price does come into it.

Figure 3. The labour cost element is very low for production costs.

This is 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. 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 there can be such huge differences in price between one belt supplier/manufacturer and another for belts that appear to be of exactly the same specification. The answer to that question lies in the cost make-up of producing a conveyor belt.

There can never be a fixed formula due to the wide variety of individual belt specifications, but the influence of raw material costs on the final selling price is hugely significant. 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%. Due to the high level of automation, the labour cost element is very low; it is not expected to see more than three or four people manning a typical production line. This fact certainly contradicts the usual assumption that belts imported from Asia are only cheaper 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 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. 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 costs.

While the required tensile strength might be achieved, albeit with a low safety factor, rip and tear resistance is reduced

and elongation is low. Low elongation may sound good in principle, but if the elongation is too low then this can cause problems with transition distances. It can also cause a general inability to accommodate the contours of the conveyor and its drums and pulleys, ultimately leading to the premature failure of the belt. Laboratory testing of belting imported from Southeast Asia (primarily from China) is revealing other deceptions such as using fabric plies that are not polyester/nylon as specified but actually fully polyester, which costs some 30% less than nylon.

The amount of rubber used between the plies is also very sensitive because it can have a significant effect on the behaviour of the belt. If the rubber layer is too thin then 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 then inconsistencies in the tension of the belt carcass can occur, possibly leading to handling and steering problems. Unfortunately, in all three elements of carcass quality, the rubber between the 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 either by using a big price variation as a warning sign or by learning from experience.

The covers

The rubber used for the outer covers is the single largest element of cost when manufacturing a conveyor belt, therefore making it the single greatest opportunity for manufacturers to economise. Having a micrometre available to measure the cover thicknesses of new belts as soon as they arrive on site is a good idea. It is not unusual to find that covers that are specified as being 6 + 2 mm are only 4 + 1.5 mm thick, and 4 + 2 mm specification covers measuring only 3 + 1.5 mm. It means that 25% or more of the belt's wear life is gone before the belt has even been fitted, most likely due to trying to achieve an unbeatable price.

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 referred to as 'cover grades' or 'cover qualities'. Most of the rubber used in conveyor belting is synthetic.

There are 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 the production methods used. Not only is abrasion resistant the most commonly used type of cover grade, it is the level of abrasion resistance of any rubber cover that will almost certainly 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.

Abrasive wear testing

Abrasion resistance 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. The most important 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. Quite simply, the lower the figure, the better the wear resistance.

Comparing one offer from another is made very 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. If it is deemed necessary to increase the cover thickness in an effort to compensate for premature wear, then that is a 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).

Ozone and UV qualities

It is undeniable that all rubber conveyor belts should be fully resistant to the damaging effects of ozone and UV light ozone

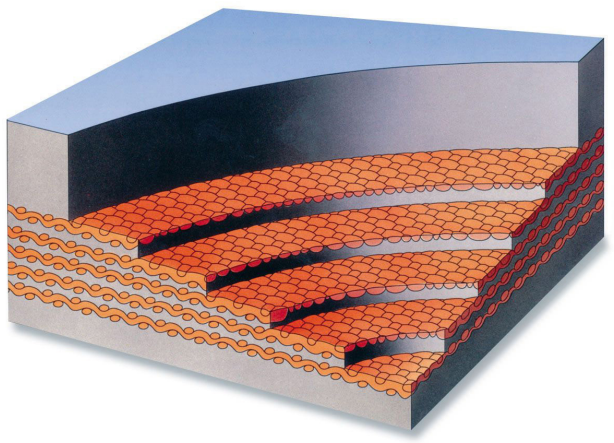

Figure 4. The thickness of rubber between the piles affects handling.

becomes a pollutant at ground level and exposure to it 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 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. Ozone and UV resistance should always be a required part of the specification when selecting any rubber conveyor belt.

Figure 5. Harder wearing covers are more cost-effective.

Figure 6. ISO 4649/DIN 53516 abrasion testing.

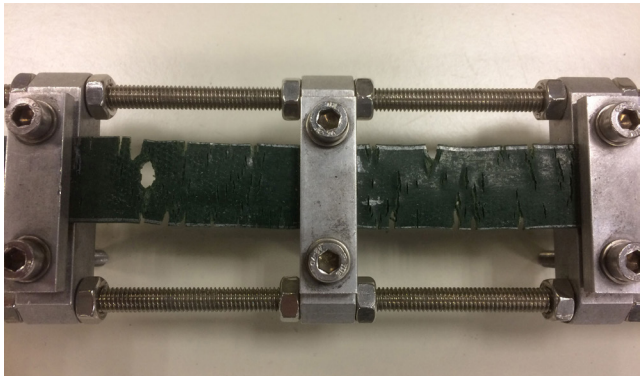

Figure 7. Ozone and UV can rapidly destroy a rubber belt.

Safe to handle?

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 European Union's (EU) Registration, Evaluation and Authorisation of Chemical substances (REACH) 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 chemicals can pose. 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 of the EU are responsible for the application of REACH regulation. The advice is to always ask for written confirmation from the belt manufacturer or supplier that the product they are offering will be produced in compliance with REACH EC 1907/2006 regulations.

Do not accept the inevitable

On conveyors where belts are frequently having to be repaired and replaced due to impact and tearing there is often the temptation to accept the inevitable and repeatedly fit 'sacrificial' belts. Great expense can be incurred by frequent repairs.

In the desperate search for a longer working life the tensile strength and cover thickness of such belts are often increased, but this is almost invariably both expensive and ineffective. The only answer is to fit belts that have a carcass and covers designed and engineered specifically for such treatment. They may initially appear to cost more than the norm, but in reality they are more productive and economically efficient.

Seek advice

There is a lot more to conveyor belts than meets the eye, and the only way to assess value for money is to know the true cost. Fitting and replacing multiple 'economically priced' belts rather than looking at the performance quality and longer operational lifetime provided by a good quality belt is invariably a false economy and much more problematic 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. Best of all, make sure the manufacturer can be held accountable if there is a problem with the belt. Guarantees and promises are worthless unless there is someone there to honour them. GMR