Tightening the belt

A guide to reducing conveyor belt expenditure

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

Conveyors continue to play a vital role in the mining and quarrying industries. 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. Their durability, reliability and cost are therefore critical factors in both productivity and cost management.

The technology used to manufacture conveyor belts has advanced enormously in recent years and today's users of belts 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 we talk about the technical aspects of conveyor belts and how to get the best value (save money) let us first deal with 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 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. In my experience 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.

Over the years I have often found myself shaking my head in disbelief when I come across 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 harder-wearing belt would ultimately cost considerably less in real terms.

This brings us 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. You would surely never find a salesperson describing 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?

Production costs – the labour cost element is very low

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 I am most often asked is how there can be such huge differences in price between one belt supplier/manufacturer and another for belts of apparently the exact same specification. The answer to that question lies in the cost make-up of producing a conveyor belt.

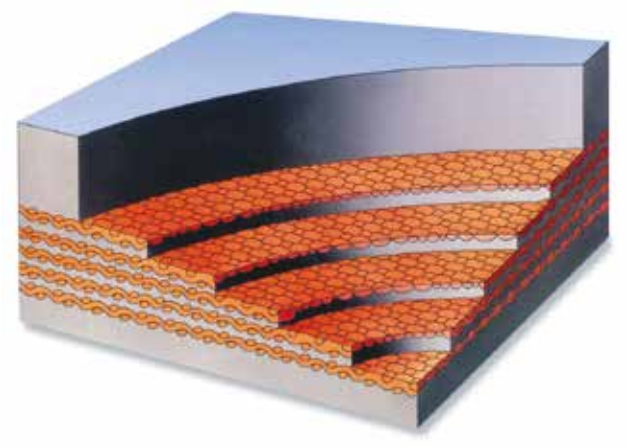
There can never be a fixed formula due to the wide variety of individual belt specifications but the influence of raw material costs on the selling price is hugely significant. As a general 'rule of thumb', raw materials can easily represent some 70% of the cost of producing a conveyor belt. General overheads make up no more than around 10%. Thanks to the high level of automation, the labour cost element is very low. You 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



The thickness of rubber between the plies affects handling

Harder wearing covers are more cost effective

then this can cause problems with transition distances and a general inability to accommodate the contours of the conveyor and its drums and pulleys and ultimately lead to the premature failure of the belt.

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, in the pursuit of economy, the rubber layer is too thin then 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 and last but not least, thinner skims reduce the ability of the belt to absorb impact.

In terms of production processes, if they are rushed and there is insufficient quality control on the actual production lines then inconsistencies in the tension of the belt carcass can occur, which can lead to handling and steering problems. 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, sorry to say, by learning the hard way.

THE COVERS

The rubber used for the outer covers is the single biggest element of 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 referred to and 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 vulcanized, 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 & UV resistance and production methods. Not only is abrasion resistant the most commonly used type of cover grade it is the level of abrasion (wear) 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 (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 millimeters, for instance 150 mm³. The most important thing to remember when comparing abrasion test results (or promises!) is

ISO: 4649/DIN 53526 abrasion testing

Ozone & UV can rapidly destroy a rubber belt

that higher figures represent a greater loss of surface rubber, which means that there is a lower resistance to abrasion. The lower the figure then the better the wear resistance.

Comparing (evaluating) one offer from another is made very difficult by virtue of the fact that (with only one exception that I know of) 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 meters) 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 then 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/mm2 or MPa) or, in other words, have the physical ability to resist tear propogation.

OZONE & 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, ultraviolet 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. My advice is to always make ozone & UV resistance a required part of the specification when selecting any rubber conveyor belt.

SOMETHING SMELLS WRONG!

The pressure to minimize 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 vulcanization process. When the European Union'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

Always insist on REACH EC 1907/ 2006 compliance

of cancer) that are listed within the regulations with ECHA (European Chemical Agency).

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, you can literally smell the difference! My advice here 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.

DON'T ACCEPT THE INEVITABLE

For demanding applications where belts are frequently having to be repaired and replaced due to impact and tearing caused by heavy, sharp materials there is often the temptation to accept the inevitable and repeatedly fit 'sacrificial' belts. Great expense can be incurred by frequent repairs. I have seen belts that have so many clip repairs they end up looking like some kind of badly stitched Frankenstein monster.

In the desperate search for a longer working life the tensile strength and cover thickness of such belts are often increased but this course of action is almost invariably both unnecessarily expensive and ineffective. The only real answer is to fit belts that have a carcass and covers that have been specifically designed and engineered for such conditions. They may appear to be cost perhaps two or three times the norm but in reality they are proven to run for years where conventional belts only last a few weeks or months.

SEEK ADVICE

There is a lot more to conveyor belts than meets the eye. As I 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.

Sacrificial belts are a false economy

HOW MUCH ARE YOUR CONVEYOR BELTS **REALLY** COSTING YOU?

Buying cost of belt

+

Fitting cost

+

Repair cost

+

Maintenance cost

+

Downtime (Loss of production)

Duration of operational life or tonnage carried

= WHOLE LIFE COST

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