CONVEYOR CLINIC

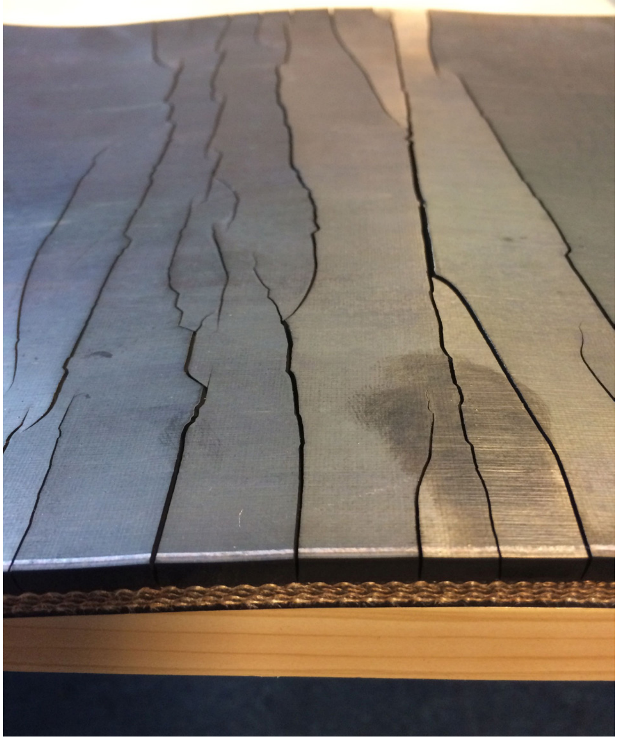
Conveyor operators in the cement industry have to manage a wide ranging, diverse set of challenges, most of which take a particularly heavy toll on the conveyor belts themselves. Here, Rob van Oijen, Fenner Dunlop Conveyor Belting, provides advice for dealing with some of the most common conveying problems.

What can operators do to minimise conveyor belt lifecycle costs?

Rob van Oijen (RvO): The best way to minimise conveyor lifecycle costs is to choose belts based on their durability, suitability and longevity (whole life cost) rather than making a choice based on short-term 'economic' or budgetary motives. It really is as simple as that. Virtually without exception, the price of a belt will be reflected in both its quality of performance and the length of its working life. Experience shows that, although initially more expensive, premium grade European-made belts can out-last cheap imports by as much as three or four times.

Why is there such a wide variation in the operational lifetime of one heat resistant conveyor belt compared to another?

(RvO): In today's conveyor belt market, there are two distinct sources of supply. By far the biggest is the 'pile it high, sell it cheap', low-price, low-grade end of the market, which is totally dominated by Southeast Asian manufacturers. The opposite end of the scale is the premium quality sector. The rubber used for conveyor belts



Some crack earlier than others – not all heat resistant belts perform the same.

Delamination – the layers of the belt detach themselves.

An increase of just 10˚C in core temperature can cause a belt to fall apart.

constitutes up to 70% of the material mass and is the single biggest element of cost. Rubber that provides genuine resistance to heat for the longest possible time is probably the most expensive kind of rubber to produce. Consequently, for manufacturers who want to compete based on price rather than operational longevity, rubber is their biggest opportunity to gain a competitive edge.

Although rubber is obviously not a lifeform, the one thing that it has in common with organic life is that it ages and as it ages, it deteriorates. Heat accelerates the thermal ageing process of the outer rubber covers, causing them to harden and crack. It also has an extremely destructive effect on the inner carcass of the belt by gradually destroying the adhesion between the rubber covers on the top and bottom of the carcass and between the inner plies contained within it. The result, referred to as 'de-lamination', is that the layers of the belt literally become detached from one another.

As the rubber becomes harder and less elastic, the tensile strength and elongation (stretch) can be reduced by as much as 80%. This effectively destroys the operational strength and flexibility of the belt and seriously weakens the splice joints. At the same time, surface cover wear is accelerated because the rubber's resistance to abrasive wear decreases by as much as 40% or more. As the covers become thinner, their ability to act as a heat shield and protect the inner carcass from temperature build-up diminishes, creating a vicious cycle that further accelerates both the de-lamination and ageing processes.

Protecting the carcass is vital because an increase as small as 10˚C in core temperature can reduce the life of the belt by as much as 50%. This is because for every 10˚C increase in temperature the rate of rubber oxidation increases by a factor of eight.

If the core temperature of the carcass becomes too high then the bond between the covers and fabric layers will separate (delaminate) and the belt quite literally begins to fall apart.

It is relatively simple to create a rubber compound that will resist even the most extreme temperatures over a short period. However, as mentioned earlier, the most difficult and costly part is to create a rubber compound that can resist those temperatures and delay the ageing process for the longest possible period. An additional aspect of cost is that the better the rubber delays the thermal ageing process, the longer it takes to manufacture the belt. This is because the vulcanisation process (which involves the application of heat) takes much longer than it takes to vulcanise a less heat resistant rubber. In a nutshell, this is the primary reason why there are such huge variances in performance (and price) between heat resistant belts of supposedly the same specification.

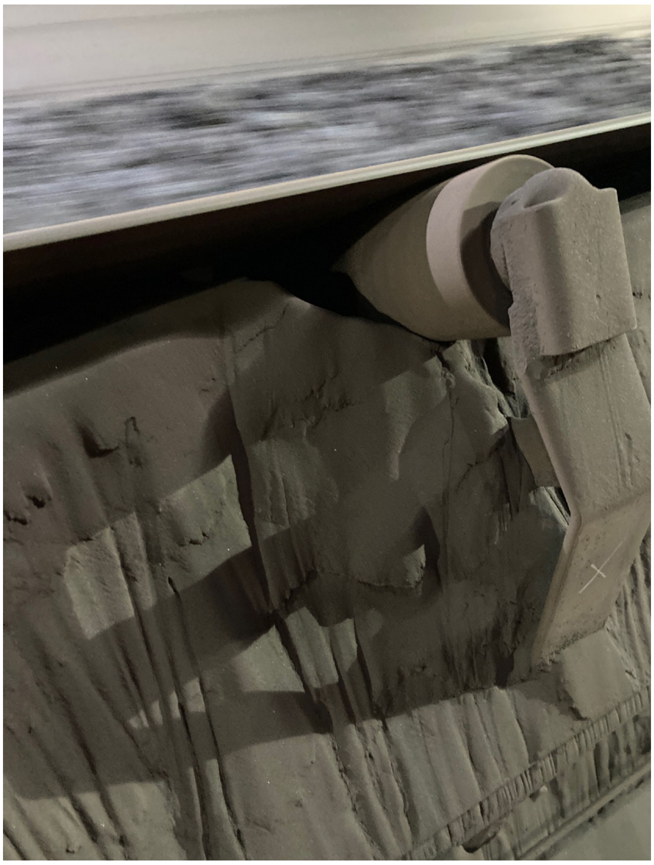
What steps can conveyor operators take to extend conveyor belt life?

RvO: Assuming that a good quality conveyor belt is in place, the standard of maintenance becomes the key influencer. Regular, preventive maintenance, good quality components such as idlers and rollers and a clean working environment are all essential factors that help to extend conveyor belt life.

From an operational view, most good quality belts can be left to do their job once installed. However, it is still vital to 'walk the conveyor' on a regular basis, checking for broken parts or other irregularities. Very often, external influences like broken idlers or scrapers, material buildup on pulleys, or belt becoming lodged behind skirting cause stoppages that could have been anticipated and avoided by regular inspections. Belts that suddenly stop whilst loaded with hot materials such as clinker can be irreparably damaged because the loaded part of the belt cannot cool down. As mentioned in the previous answer, an increase in core temperature as small as 10˚C can quite easily reduce the life of the belt by as much as 50%.

Other factors include making sure that any scrapers that are fitted are correctly adjusted and drum linings (where applicable) are in good condition. Belt tracking is also important because a mis-tracked belt can limit belt life and contribute to uneven wear. The primary cause of mis-tracking is often found to be material buildup on the bottom side of the conveyor or drums and pulleys.

Another key element is to have the correct belt specification matching the conveyor design. Unsuitable belt types such as those that have excessively high tensile strength or are too thick may behave badly and have a limited life span. Quality belt suppliers will have engineers to verify belt selection when provided with sufficient information on the conveyor design and material properties.



Material buildup accelerates wear of the belt and other components.

The cost of splice repairs and lost output is considerable.

What can be done to minimise dust emissions?

RvO: Dust emissions occur at the loading point, at the discharge or due to dust emissions from cracks in the rubber covers of the conveyor belt caused by exposure to ozone pollution and ultraviolet light. As for the latter, at low altitude, ozone becomes a pollutant that is created by the photolysis of nitrogen dioxide (NO_2). Exposure is unavoidable because even tiny traces of ozone in the air will attack the molecular structure of rubber, increasing the acidity of carbon black surfaces.

Small transversal cracks begin to appear in the surface of unprotected rubber at a surprisingly early stage. Although the cracks may not seem to be a big problem, the rubber quickly becomes increasingly brittle and the cracks deepen under the repeated stress of passing over the pulleys and drums. Ultraviolet light also accelerates the deterioration of rubber. Fine dust penetrates the cracks caused by the effects of ozone and UV and is then discharged (shaken out) on the return (underside) run.

Ozone and ultraviolet damage is relatively easy to prevent by including antioxidants within the rubber compound mixing process. Unfortunately, some 90% of belts sold in Europe, Asia and Africa have virtually no in-built protection. This is because antioxidants are seen as an avoidable cost. My advice is to always make ozone and UV resistance an obligatory requirement when selecting any rubber conveyor belt.

Dust emissions often occur at the discharge point. This is caused by the agitation of the material, which can usually be controlled with proper chute design with dedusting equipment and limiting the 'free' movement of material. Emissions at belt loading areas can be reduced by better chute design, projecting material flow in the belt movement direction and limiting free-fall height and velocity as much as possible.

Pollution problems – fine particles of dust penetrate the cracks and are then shaken out on the return run.

What are the best ways to prevent repeated splice joint failures?

RvO: It is estimated that splice joint problems account for some 80% of unplanned stoppages to carry out repairs, which is a statistic that does not surprise me. The cost of repairing splice joints and the cost of lost output is considerable but should not be necessary at all. In my experience, the biggest causes of splice problems are shortcomings in the quality of the conveyor belt itself, the materials used to join the belt and the quality of the workmanship.

Low-grade rubber and poor adhesion between the inner plies are both faults commonly found in the low-grade 'economy' belts referred to in an earlier answer and make the job difficult even for the most skilled splicer. The cost of splice joint repairs and the associated lost output should both be included when calculating the whole life cost of a conveyor belt. As the old saying goes: price is what you pay, but cost is what you spend.

About the author

Rob van Oijen has specialised in conveyors for over 17 years, supporting businesses throughout Europe, Africa, the Middle East and South America and is widely regarded as being one of the best application engineers in the conveyor belt industry. ■