Volume 23 | Issue 3 | June 2026

MINING & QUARRY WORLD

Conveyor Belts – The Invisible Destroyer

When you consider the millions, indeed billions, that mines and quarries spend on conveyor belts each year, I find it absolutely amazing how the vast majority of manufacturers and suppliers are selling belts that effectively have an inbuilt weakness that seriously restricts performance and the length of working life.

PERISH THE THOUGHT

The weakness I refer to is the almost non-existent resistance to ground level ozone (O3) ultraviolet light (UV). Exposure to light and air begins from the moment the rubber is vulcanised during the production process and not, as some wrongly believe, occurs slowly over the years. The damage it causes is considerable. The early signs are small cracks appearing in the rubber surface, in some cases within weeks of first being fitted with much worse to come as the rubber becomes increasingly brittle and inflexible. This is sometimes referred to as 'dry rotting'. Further attacks occur inside the newly exposed cracks, which grow steadily until they complete a 'circuit' and the rubber fails.

It is not a new phenomenon; in fact, the problem has been scientifically recognised since the late 19th and early 20th centuries. In the past, the phrase 'perished' was used when referring to rubber that was disintegrating but this term has mostly been replaced by 'degradation' and oxidation. Whichever term you prefer to use, ozone and UV exposure is the prime cause, resulting in premature, excessive wear damage and a major decline in the performance and functional lifetime of rubber conveyor belts. The short-term and long-term effects are something that all conveyor operators need to understand but most usually do not and consequently do not incorporate in the specification when buying belts.

ENTIRELY PREVENTABLE

The most annoying and frustrating part is that the damage is entirely preventable thanks to the use of a range of special antioxidants such as 2,2,4-Trimethyl-1,2-dihydroquinoline polymer (MQ), anti- degradants, antifatigue agents and antiozonants, which when included in sufficient quantities during the creation of the rubber compound. Despite this, surveys of the results of EN/ISO 1431 international testing standards continue to show that more than 80%

Disintegrated – the effects of ozone and ultraviolet exposure

Prevention is achieved by including antioxidants and anti-degradants when making the rubber compound

of rubber conveyor belts sold in Europe, Africa and the Middle East have no protection.

Somewhat reassuringly, this is definitely not a failing you would find in vehicle tires, simply because they would otherwise be highly prone to catastrophic failure. So, why is most of the rubber used to make industrial conveyor belts not similarly protected? The answer boils down to two words – price competition.

AN AVOIDABLE COST

Rubber makes up some 50% of the production cost of a conveyor belt and some 70% of its mass. In today's highly competitive conveyor belt market, it is therefore the number one target for cost-cutting. Good quality antioxidants and antiozonants generally cost between €2.50/kg and €3.50/kg. A standard 400/3 4+2 abrasion belt of 200 meters and 1000 mm width typically consists of around 1700 kg of rubber compound. Not using antioxidants/antiozonants, anti-degradants and anti-fatigue agents generally gives a 3% or more reduction in compound cost.

This may sound like a marginal saving, but it is actually very significant to those competing at the *'pile it high, sell it cheap'* end of the market. In addition to the cost saving is the more sinister aspect of not using protective agents because anything that prolongs the working life of belts is not good for business. The more frequently belts need to be replaced, especially for the service companies trading and fitting them, the better. Distasteful as it may be, the two factors added together provide a very strong case for the widespread absence of protection.

TOP TIP: Always insist on written confirmation that the belt you are being offered is fully resistant to the effects of ozone (O_3) in accordance with the EN ISO 1431 test method and ultraviolet light (UV). Without this essential protection your belts will be more problematic and need to be replaced far sooner than they should be.

WHAT TO LOOK FOR

Ground-level ozone (O_3), also known as tropospheric ozone, is a trace gas in the troposphere (the lowest level of the Earth's atmosphere) created by the photolysis of nitrogen dioxide (NO_2) from sources such as automobile exhaust and industrial discharges. The scientific name is ozonolysis, To the naked eye, rubber that has been degraded by ozone looks like there is a "cloudy" silver-grey film on the surface of the rubber, commonly referred to as "frosting". This film is often mistaken for "bloom". However, a chemical that blooms to the surface, producing a cloudy film, can be washed or rubbed off whereas surface degradation due to attack from either ozone or ultraviolet cannot.

As mentioned earlier, the first signs are cracks appearing in the surface of the rubber. Ozone exposure is unavoidable because even tiny traces of ozone in the air will attack the molecular structure of rubber. It increases the acidity of carbon black surfaces with polybutadiene, styrene-butadiene rubber, nitrile rubber and natural rubber being the most sensitive to degradation.

Ozone cracks form in rubber that is under tension. It is important to bear in mind that the amount of tension (critical strain) needed is extremely small. Even a belt in storage has a certain amount of intrinsic tension. The cracks are always oriented at right angles to the strain axis. The dynamic stress that a conveyor belt undergoes while in operation is considerable. Ozone attack occurs at the points where the strain is greatest.

ULTRAVIOLET DAMAGE

Ultraviolet light from sunlight and artificial (fluorescent) lighting also has a seriously detrimental effect on rubber. Ultraviolet accelerates rubber deterioration because it produces photochemical reactions that promote the oxidation of the rubber surface resulting in a loss in mechanical strength, known as 'UV degradation'.

Ozone cracks are always oriented at right angles to the strain axis.

The ‘longer term’ effects of ozone & UV can occur within a few months

Cracks deepen under the repeated stress of passing over the pulleys and drums.

EN/ISO 1431 TESTING

Ozone resistance is measured in accordance with the EN/ISO 1431 test method in which samples of rubber are placed under tension (20% strain) inside an ozone testing cabinet and exposed to highly concentrated levels of ozone for a period of up to 96 hours (@ 40°C, 50 pphm).

Samples are examined for evidence of cracking at two-hourly intervals and the results carefully measured and recorded. Experience has determined that in order for the rubber to be regarded as adequately resistant, the pass criteria needs to be that the rubber sample does not show any signs of cracking within the 96-hour period. The vast majority of samples tested, however, crack within less than 8 hours, which experience shows can equate to be as short as three working months in real time.

80% of samples tested typically fail within 8 hours

HIDDEN EFFECTS

The repeated action of the mechanical stress of the conveyor belt and the frictional process from the idlers trigger an oxidative chain reaction that forms a chemical process that breaks the molecular chain and activates the oxidation process This in turn magnifies a whole range of problems. Over a surprisingly short time, (literally months or even weeks without built in protection), the rubber becomes increasingly brittle and less able to stretch and contort as it should; wear resistance diminishes while transversal cracks steadily deepen and grow under the stress of passing over the pulleys and drums until catastrophic failure occurs.

Cracks present other potential risks such as scrapers catching on them and tearing off parts of the cover. Re-splicing also becomes increasingly difficult as the adhesion properties of the rubber diminish. Environmentally, dust enters the cracks and is then shaken out on the return (underside) run causing a polluted working environment.

CONCLUSION

Rubber degradation and decomposition caused by exposure to ozone and ultraviolet light is far more damaging and costly than most manufacturers would have you believe. In fact, it is very rare to see any manufacturer or supplier/service company even mention the subject because they do not want you asking awkward questions. Please do not make the mistake of ignoring the subject yourself because in this case, ignorance is definitely not bliss!

AUTHOR

Bob Nelson