Conveying advice

Conveyor belts are critical components within the mining and quarry industries. They are surprisingly complex and their reliability and efficiency can make or break an operation. At the same time, they are a very significant overhead. For more than 50 years, Netherlands-based Dunlop Conveyor Belting have been one of the leading and most well respected manufacturers of high-performance conveyor belting in the world. Who better, therefore, to provide a regular feature that helps to unravel the technical complexities and provide some expert advice and guidance? Here, Rob van Oijen, Dunlop's manager of application engineering looks at a common problem affecting mining and quarry belting, which is ripping, tearing and impact.

THE MOST DESTRUCTIVE FORCE

Even the strongest, heaviest multi-ply and steelcord belts can be punctured and ripped by a foreign objects and sharp rocks becoming trapped. A belt can quite easily be ripped apart longitudinally over its entire length in a matter of minutes. In one incident, a wooden broomstick became trapped at the conveyor head, penetrated a steelcord belt and ripped 4 kilometres of belt from end to end. The cost of repairing and replacing belts, both in monetary terms as well as lost production, can have very serious consequences indeed. Despite this, most manufacturers make little or no mention of the rip and tear resistance of their belts.

RIP AND TEAR RESISTANCE – TESTING

The ability to withstand the forces that rip and tear belts is often more important than any other physical attribute. This is especially true when it comes to quarrying and mining. A 'rip' is best described as what happens when a sharp object punctures the belt and cuts the belt lengthwise as it is pulled against the trapped object. In contrast, a 'tear' is what happens when a section of belt is pulled apart in opposing directions, much like when a telephone directory is torn apart by hand as a feat of strength.

Rip and tear strength should be regarded as important KPI's

Surprisingly, despite its significance as a key performance indicator, there are currently no internationally accepted test methods or standards for testing rip resistance, which is perhaps one reason why belt manufacturers rarely mention the subject. However, in Dunlop we regard rip and tear strength as very important KPI's. What our laboratory technicians do is pull sections of belt through a right-angled piece of metal under extreme force and carefully measure and record the level of force exerted. The technicians have nicknamed the specially designed equipment they use for this harsh treatment 'Jack the Ripper'.

Dunlop's 'Jack the Ripper' rip test in action

Unlike rip resistance, an international standard for tear strength does exist. The ISO 505:2017 test method measures the propagation resistance of an initial tear in textile conveyor belts, either in full thickness or of the carcass only. The test is intended for application to multi-ply (fabric) belts in installations where there is a risk of longitudinal tearing.

Although it is a defined method of testing there are no standardised performance requirements. The test, often referred to as the 'trouser test', basically consists of mounting two cut ends of a test piece of belting in the jaws of a tensile testing machine. An initial tear made in a test piece, which is then pulled apart in opposing directions. The force necessary to propagate the tear is then measured. Examination and analysis of the multi-peak tear resistance test traces is made in accordance with ISO 6133.

FINDING THE BEST SOLUTION

Because of the huge disparities between the types of materials being conveyed, the design of the conveyor systems and their working environments, there is no 'silver bullet' answer to the damage caused by ripping, tearing and impact. In my experience, it is probably easier to start with what will almost certainly NOT be the answer to the problem. The most common misconception is that making the belt thicker by increasing the cover thicknesses and/or the number of plies will help. The fact is that belts that are too thick for the design of the application can cause problems such as excessive rigidity (lack of troughability) and steering and handling difficulties. The same applies to increasing the tensile strength. Especially in Eastern Europe for some reason, it is not uncommon to see belt specifications of 1000/6 10+4 or even heavier. Whenever I see specifications like these, I can be pretty confident that there is an underlying problem with ripping and tearing.

To the uninitiated, another answer might seem to replace the multi-ply belt with a steelcord belt, but this is also extremely unlikely to provide the solution. Conveyors using steelcord belts have to specifically designed. Because of their innate tensile strength and low elongation (stretch), steelcord belts are really only suited to conveying over longer distances. In any case, their Achilles heel is that although the actual steel cords themselves are very strong, they cannot prevent a trapped foreign object from penetrating through the rubber covers, between the cords and ripping the belt longitudinally.

ENGINEERED FOR THE TASK

For multi-ply belts on conveyors where ripping and tearing is a problem the only genuinely practical solution is to fit a conveyor belt that has been specifically engineered for the purpose. Such belts can have several times the resistance against ripping and tearing and cope with the impact of heavy objects falling from a high drop height much more effectively compared to belts that use a conventional fabric ply construction.

Belts that have been engineered to resist ripping, tearing and impact use uniquely designed fabric plies that allow the nylon strands to stretch. As the trapped object is being pulled through the belt, the strands of the special ply construction gather together into a bundle that can eventually become strong enough to stop the belt.

Strange as it may seem, special synthetic plies are usually more effective than steel when it comes to actually minimising the length of a rip. I am an engineer, not a salesman, but I can tell you in all honesty that the two best examples that I have ever come across are Dunlop UsFlex and Dunlop Ultra X. They are both totally unique to Dunlop and both belt types have at least three or more times the resistance to ripping and tearing compared to conventional belt. To find out more simply go to: https://www.dunlopcb.com/cover-grades/rip-impact/

USING BREAKER PLIES TO INCREASE RIP RESISTANCE

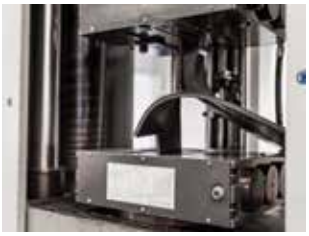
For steelcord belts, the best solution tends to be the use of breaker plies, which provide a significantly increased resistance against longitudinal ripping. Ultimately, the use of breakers is one of damage limitation.

The breaker ply performs two functions – firstly it can help prevent the penetration of the belt by a foreign object. Secondly, the breaker ply acts as a barrier if an object does actually penetrate between the steel cords and starts to rip along the length of the belt. Breaker plies are embedded in the rubber covers during the manufacturing process. There are numerous types and strengths of breaker used. The lighter weight versions are designed to simply absorb and dissipate energy whereas stronger, heavier weight breakers can actually stop the belt and limit the amount of damage stop the belt, thereby limiting the extent of the damage. These are commonly referred to as 'Rip Stop' breakers.

NOT WORTH THE SACRIFICE

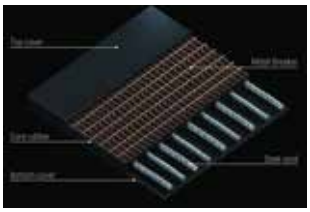
Rather than look for belts that are capable of handing the demands, many operators decide to opt for what they see as the cheaper option by fitting low grade, 'sacrificial' belts that are then repaired and replaced with frightening regularity.

But when you add the cost of incessant repairs, the fitting labour costs and, most of all, the lost production, to the cost of replacement belt after replacement belt, it very rarely proves to make economic sense.



ISO 505 tear testing

Belts that are too thick can cause problems such as excessive rigidity



Steelcord belt cross section with Ripstop breaker ply

Ripping, tearing and impact – the best solution is to fit a conveyor belt specifically engineered for the purpose.

Sacrificial belts rarely make economic sense

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