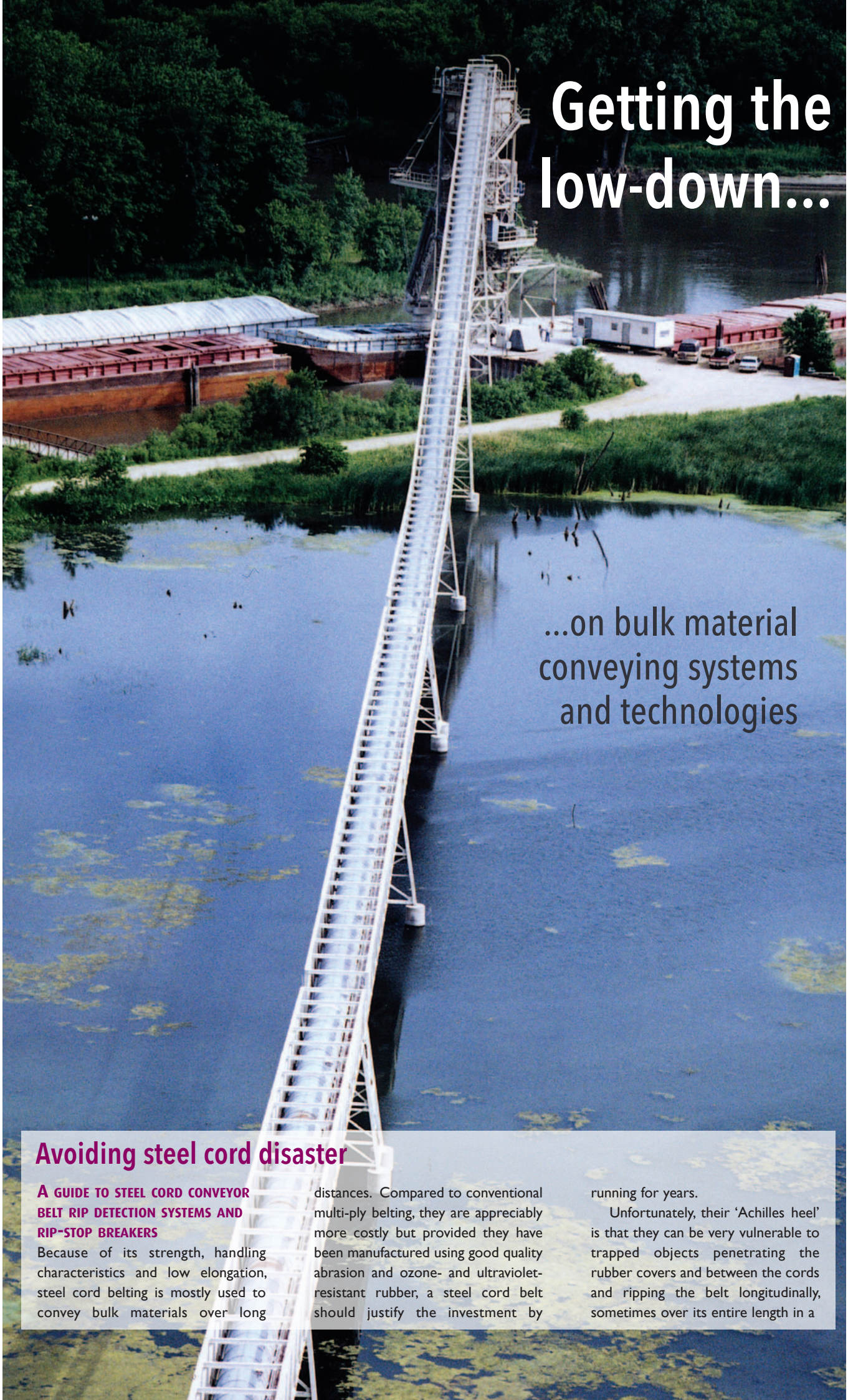


Getting the low-down...

...on bulk material conveying systems and technologies

Avoiding steel cord disaster

A GUIDE TO STEEL CORD CONVEYOR BELT RIP DETECTION SYSTEMS AND RIP-STOP BREAKERS

Because of its strength, handling characteristics and low elongation, steel cord belting is mostly used to convey bulk materials over long distances. Compared to conventional multi-ply belting, they are appreciably more costly but provided they have been manufactured using good quality abrasion and ozone- and ultraviolet-resistant rubber, a steel cord belt should justify the investment by running for years.

Unfortunately, their 'Achilles heel' is that they can be very vulnerable to trapped objects penetrating the rubber covers and between the cords and ripping the belt longitudinally, sometimes over its entire length in a

matter of minutes. Here, *Fenner Dunlop's Rob van Oijen*, provides an insight into early warning systems and how to limit the extent of such a disastrous event.

Rip detection systems

The cost of replacing a steelcord belt, both in monetary terms as well as lost production, can be exceptionally high. Because of the huge variety of different specifications, steel cord belts are normally made to order, with lead-times usually 18 weeks or more. In an effort to minimize the amount of damage, a number of operators use rip detection monitoring systems.

These work by using detection loops embedded at pre-determined intervals in the belt during the manufacturing process. A transmitter and receiver are positioned on the conveyor structure opposite each other on either side of the belt (Diagram 1). This is usually behind the loading position to provide protection in the area where there is the greatest exposure to risk. Multiple detection locations are also possible. The transmitter sends electro-magnetic signals to the receiver at regular intervals. When a signal is not received by the receiver, caused by a damaged detection loop for example, then an alarm is triggered or, depending on the type of system, the conveyor is automatically stopped.

A second method of condition monitoring is to continuously scan the integrity of the steel cords for breaks or damage. This also allows monitoring behaviour of splices, checking anomalies pointing out damages or even upcoming failures. This method of scanning is typically combined with the rip detection.

Having the detection loops fitted during the manufacturing process is, of course, an additional expense and the detection systems themselves can be quite costly. Even if the receiver is linked to the conveyor drive and automatically stops the belt when damage is being indicated, for optimum safety they should still be physically monitored. If someone does not quickly respond to an alarm, then an enormous amount of damage can occur. In some cases, detection systems with an automated stop function can be over-sensitive and prone to raising false alarms. If this happens too frequently then there is a tendency for operators to simply over-ride the system, which defeats the whole objective.

Modern day scanning and rip detection systems however can also be linked to a local LAN network, or even directly to available cellular coverage to allow status information to be transmitted to a centralied cloud-based dashboard. This dashboard can be accessed via the internet and trigger push notifications to relevant people or groups to minimize time between events found by the monitoring equipment and response time. It also allows fine tuning of signals, manually or with the help of AI technology, to reduce the level of false positives.

Early warning rip detection systems can limit the amount of damage being caused.

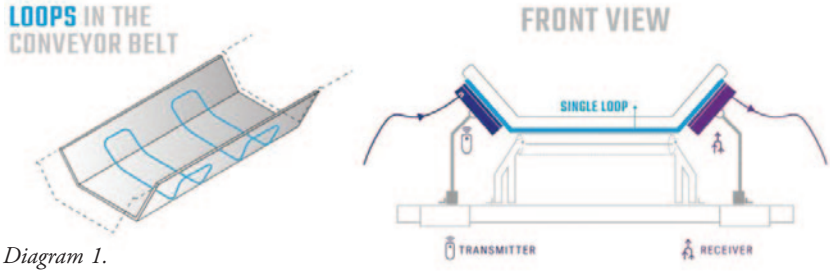


Diagram 1.

Using breaker plies to increase rip resistance

Breaker plies are designed to provide a significantly increased resistance against longitudinal ripping. Ultimately, the use of breakers is one of damage limitation. The

Early warning systems can minimize the extent of the damage.

breaker ply performs two functions — firstly it can help prevent the penetration of the belt by a foreign object. Secondly, it acts as a barrier if an object penetrates between the steel cords and starts to rip the belt. As with detection loops, 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 (commonly referred to as 'Rip Stop' breakers) can actually stop the belt and limit the amount of damage even more effectively.

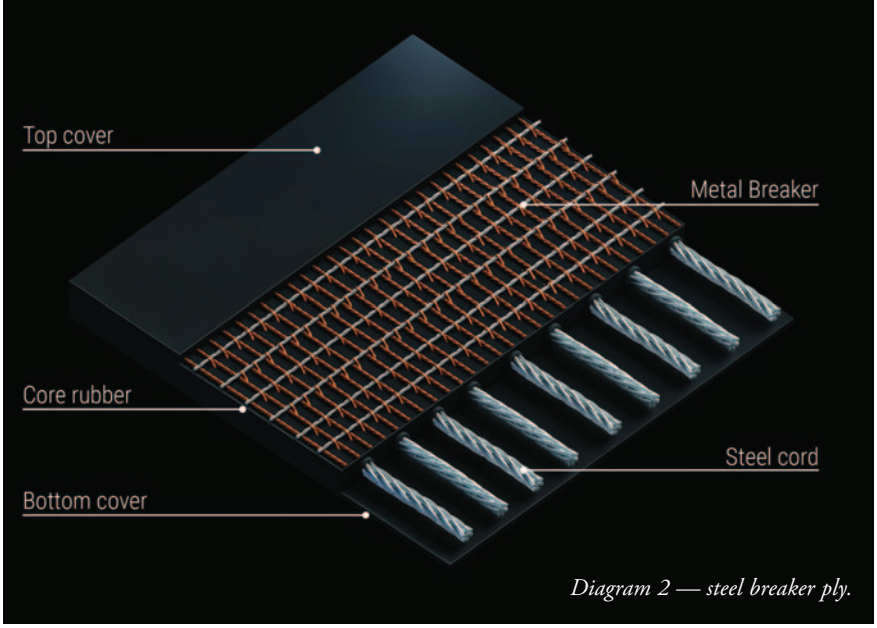
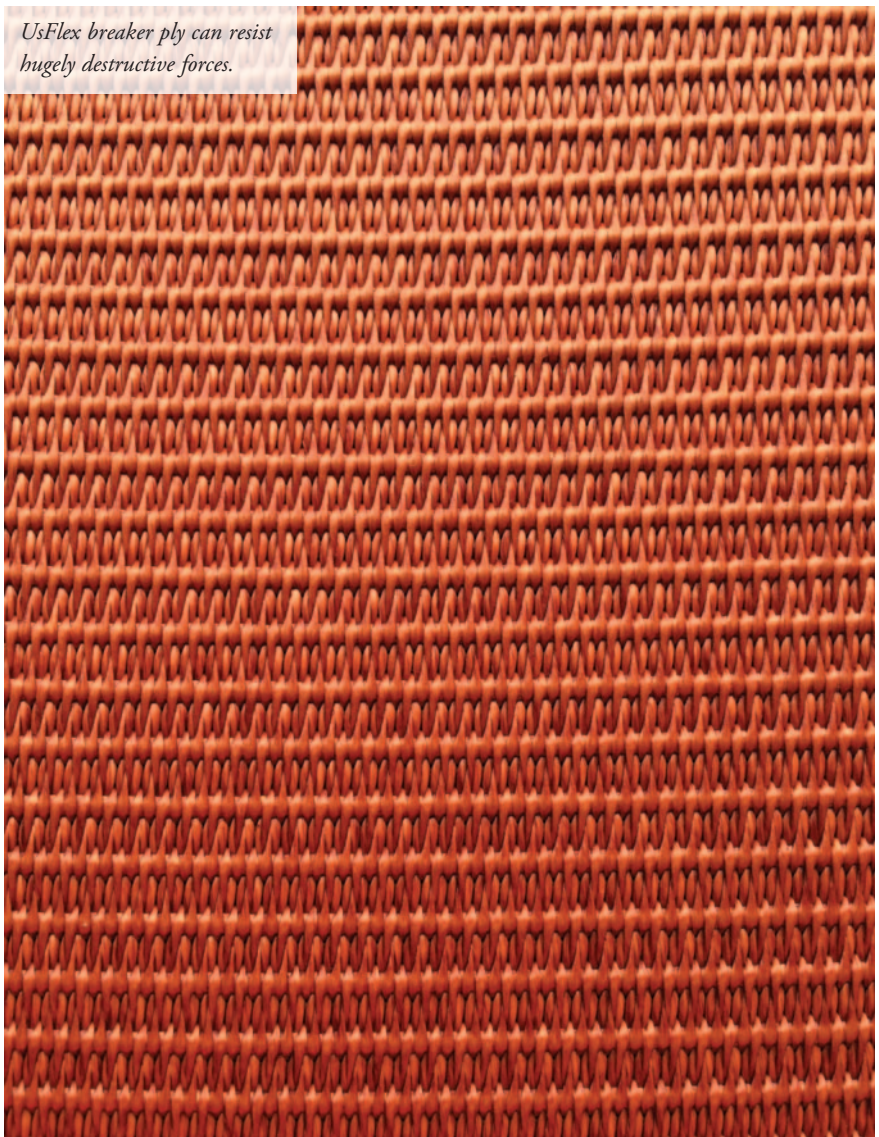


Diagram 2 — steel breaker ply.

Types of breakers

Breakers generally fall into two different categories or types — 'fabric breakers' (also referred to as textile breakers) and 'steel breakers'. Both types are usually embedded in the top cover above the steel cords over the full width and length of the belt, effectively creating a protective layer. It is also possible to have two breaker plies with one located above and the other positioned below the steel cords. However, this can sometimes cause troughing problems in relatively narrow belts because of the increased cross rigidity.

Various strengths and densities of fabric (mostly nylon) are used to make fabric breakers whereas steel breaker plies consist of transversal steel wires held in position by longitudinal binder wires. As with the fabric versions, there are a wide range of strengths based on the size and pitch of the steel wires. Although having a steel wire breaker would logically seem to imply a much greater strength compared to a fabric breaker ply, this is not necessarily the case. The steel breaker wires do not stretch and gather together to create a barrier in the same way that fabric plies can. However, the advantage of a steel breaker is that very sharp trapped objects do not cut through the steel wires as easily as they can through conventional fabrics.


UsFlex breaker ply can resist hugely destructive forces.

Positioning of the breaker ply

According to ISO 15236-1, a breaker ply should be positioned at a distance of at least 1mm from the longitudinal cords. The width of the breaker ply should be at least 10mm from the belt edge but no more than 100mm less than the width of the belt. On this basis, the breaker ply is regarded as part of the cover, which means that the cover thickness is measured from the steelcords. However, if the ply is less than 1mm distance from the longitudinal cords then it is considered to be a weft transversal reinforcement and therefore part of the actual carcass. This means that the cover thickness is measured outwards from the surface of the ply.

It is generally advisable to position the breaker as close to the actual steel cords as possible because it maximizes the amount of rubber that would have to be worn away by abrasion before the breaker ply is reached. When requesting quotations, it is important to specify very clearly if the total thickness of the top cover should include the thickness of the breaker or not.

Clear and precise belt specifications

It is vitally important that the specifications provided to potential suppliers could not be subject to interpretation or misunderstanding. This especially includes whether or not the thickness of the breaker ply is included in the measurement of the thickness of the top cover. This is essential not only in terms of the anticipated operational lifetime of the belt but also, very importantly, it is needed to

The transversal strands gather together that can eventually become strong enough to stop the belt (enhanced image).

ensure that all potential suppliers are providing quotations based on exactly the same specifications.

'Straight-warp' fabric breakers

A third 'super-strength' type of breaker ply is also available. This is a specially adapted version of the unique Dunlop UsFlex woven 'straight-warp' polyester/nylon fabric. UsFlex single and two-ply belts have a long and highly successful track record for handling some of the toughest working conditions imaginable. Laboratory testing and many years of practical experience has proved that the rip resistance of UsFlex fabric is up to five times greater than conventional fabric ply material, which makes it an exceptionally strong and effective breaker ply.

What creates these strengths is a very cleverly engineered ply construction that consists of extremely strong strands of polyester running longitudinally and heavy-duty nylon transverse strands held in position by a strong yarn. The strands are completely straight in both directions and are not interlocked in the conventional manner. As with conventional breaker plies, the UsFlex fabric layer is embedded just above the steel cords. This also provides extremely effective impact protection of the steel cords because the fabric dissipates the peak point of impact energy over a much wider area.

The best of both worlds?

Some operators, including some of the biggest users of steel cord belting in the world, choose to have fabric breakers and rip detection systems. The fabric breakers are fitted in the top cover and the detection loops are fitted in the bottom cover below the cords. It is important to remember that rip detection systems use electro-magnetic signals so they cannot function properly if a steel breaker ply is fitted. If you want an early warning detection system backed up by rip breakers then fabric breaker plies are the only option.

Choosing the best type of breaker for you

The primary factor to take into consideration when deciding on which type of breaker to use is the type of material being carried and how it is loaded on to the belt. Unless the materials being conveyed are particularly sharp or there is a likelihood that it may contain sharp foreign objects (mining tools for example) then my recommendation is to use either conventional fabric breakers or the special UsFlex breaker ply. This is based on extensive laboratory comparison tests and field experience, which show that transverse reinforcement with textile is more efficient in preventing longitudinal rip damage. Fabric breakers are also longer lasting than steel transverse reinforcement. If heavy materials are being dropped onto the belt surface then a full UsFlex breaker-ply layer is recommended.

Balancing the risk

Choosing whether or not to have rip detection or rip breakers is usually a question of balancing the added cost against the risk of damage and the potentially huge financial consequences of replacing the belt and the loss of production. I do believe that it is better to have some form of 'insurance' rather than none at all. If you can convince those who hold the purse strings, rip stop breakers will at least minimize the risk of steel cord disaster.

About the author

Rob van Oijen is Manager Application Engineering for Fenner Dunlop Conveyor Belting in The Netherlands. He has specialized in conveyors for over 15 years, supporting businesses throughout Europe, Africa, the Middle East and South America and is one of the most highly respected application engineers in the industry.