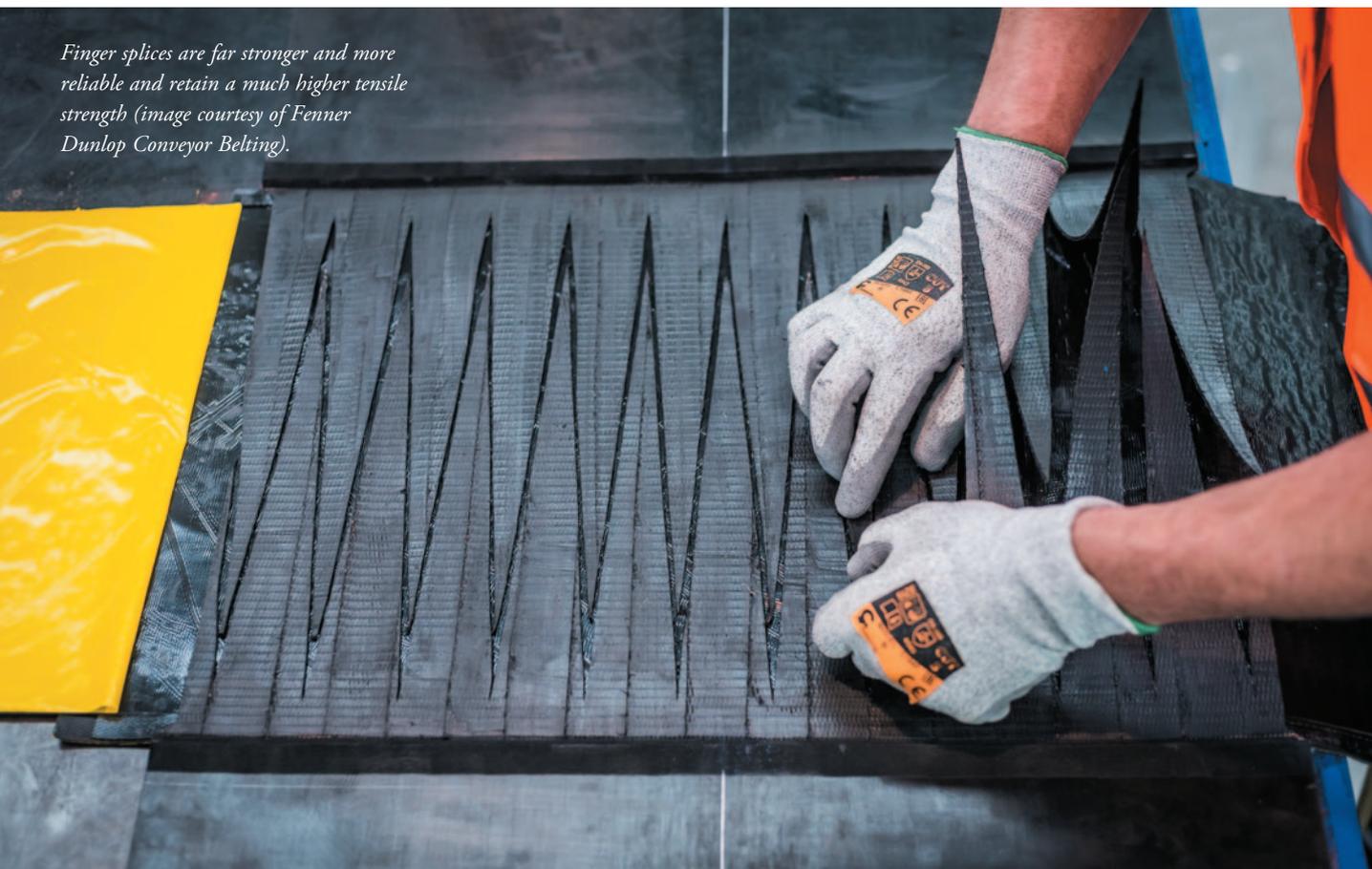


# In it for the long haul

## dry bulk conveying technologies

*Finger splices are far stronger and more reliable and retain a much higher tensile strength (image courtesy of Fenner Dunlop Conveyor Belting).*

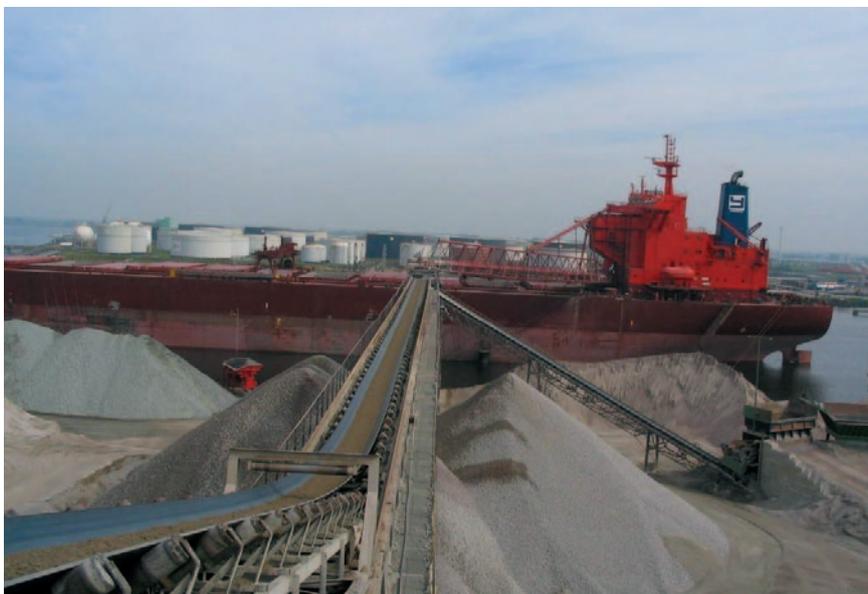


### "Time and tide wait for no man"

*Geoffrey Chaucer. (circa 1335)*

**I**n the dry bulk handling sector, the cost of ships waiting for a berth or having to stay too long in port because of hold-ups in the loading and unloading process extend well beyond demurrage charges and lost time. They can trigger penalties for late deliveries and cause reputational harm. There are, of course, a myriad of influencing factors and causes, with delays caused by conveyor stoppages regularly cited as being one of them. The causes fall into two categories: the conveyor belt and the conveyor itself. In this special feature for Dry Cargo International, conveyor consultant Robin Cole explains how, in both cases, most unplanned stoppages are entirely avoidable.

**The conveyor.** You can have the best conveyor belts in the world (which I will





*On the wrong track – worn drum linings can cause belts to catch on the frame of the conveyor*

return to a little later), but stoppages will still occur unless the conveyor, including all its components, are functioning reliably. The only way to be sure of that is through daily inspection. Regular, preventative maintenance, good quality components and a clean working environment are all key to preventing stoppages and extending conveyor belt life.

Inspection needs to include making sure that any scrapers are correctly adjusted and that any drum linings are in good condition. One extra consideration for conveyors operating in the open is when replacing worn drum padding, it is best to use



*A mis-tracked belt running to one side on the GTU.*

diamond-patterned padding, which is better suited for wet conditions.

Belt tracking is an important factor because a mis-tracked belt can catch on the conveyor framework. Again, cleanliness is important because mis-tracking is often caused by material build-up on the bottom side of the conveyor belt or on drums and pulleys. Tracking and handling problems can also be caused by conveying bulk materials containing oils and resins such as wheat grain or biomass on belts that are insufficiently oil resistant, because when the oils and resins penetrate rubber it causes it to swell, distort and soften, as well as accelerating surface wear.

Another cause of stoppages is the need to repair damage to conveyor belts caused by trapped material. When jammed in parts of the conveyor mechanism or simply lodged between the belt and the drum, even small, sharp stones can puncture the belt cover. Larger objects can penetrate

through to the carcass and, in some cases, cut the belt lengthwise. The first step in reducing the risk is to identify where foreign objects and rogue materials are most likely to become trapped and take preventative measures such as installing skirts or screening.

Waste build-up is also a common cause of damage to idlers and drums, which can lead to collateral belt damage. A significant proportion of belt damage is caused by incorrect installation of auxiliary equipment, damaged, protruding steelwork and components vibrating loose and ultimately becoming detached, all of which can be identified and rectified through regular inspection.

The false economy of 'good enough' components. A great many operators choose cheaper, lower-quality components to reduce outlay while some conveyor service providers often prefer to use 'economy' components because the profit margins are much higher and the replacement cycles much shorter.

Whatever the reason, placing a higher importance on the headline price of a component rather than its whole life cost is invariably a false economy because the apparent savings are quickly lost in unexpected failures, frequent repairs, and premature replacement. Apart from the conveyor belt itself, the components that most commonly cause stoppage delays are rollers/idlers.

Low-grade bearings and rollers are prone to premature wear and when they fail, they can seize up or disintegrate, causing significant friction that can lead to motor burnout or extremely expensive belt damage, stopping the entire line in its tracks. In all cases, the solution is to only use premium quality rollers. Precision-engineered bearings and robust rollers



*False economy — apparent 'savings' are quickly swallowed up by the cost of repairs.*



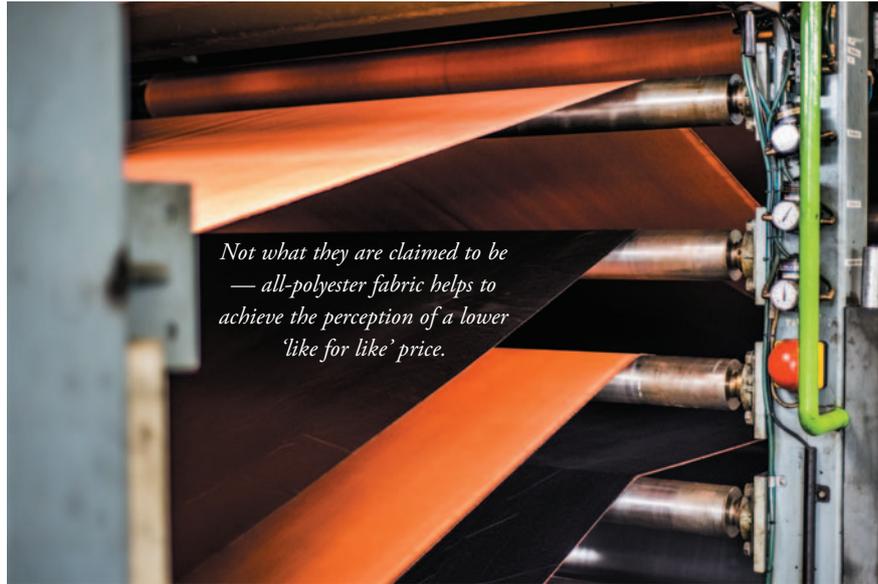
*'Cheap' rollers cause expensive stoppages.*

minimize friction and heat, extending their lifespan. They are specifically designed for prolonged use, providing the fundamental reliability needed for high-throughput bulk handling.

The two most common types are made from either steel or nylon, with steel being the most regularly used, but the quality can vary enormously. Steel rollers with high quality seals and bearings are generally the most durable and longer lasting.

Stoppage/reliability problems regarding conveyor belts fall into three categories — carcass related, cover related and splice related.

**The conveyor belt — carcass related stoppages.** The inner carcass is the core of every conveyor belt, tasked with supporting



*Not what they are claimed to be  
— all-polyester fabric helps to  
achieve the perception of a lower  
'like for like' price.*

the materials being conveyed, and providing inherent characteristics such as tensile strength and elongation (elasticity or 'stretch' under tension). There can be enormous differences in the strength and quality of the synthetic fabric used to create the carcass. This is entirely dictated by whether the belt manufacturer is at the 'quality end' of the market or the 'cut-price' end.

Most rubber multi-ply belts carcasses

use a combination of polyester and nylon (polyamide) synthetic fabrics, referred to as 'EP' because it has the best balance of mechanical properties. Unfortunately, an increasingly common deception employed by the unscrupulous manufacturers is to supply belts that have totally polyester (EE) fabric plies while claiming it to be EP (polyester/nylon). This is because polyester costs some 30% less than nylon. As the second highest cost component, using all

*Surface cuts in low grade rubber propagate more quickly and link up with other areas of damage.*



*Splice joint problems are a major cause of stoppages.*

polyester fabric helps to achieve the perception of a lower 'like for like' price.

Although it may be sufficient to achieve the required tensile strength, the strength under load both longitudinally and transversely can be inconsistent. Rip and tear resistance are also reduced, leading to stoppages to carry out patch and clip repairs and, in more serious cases, inserts or whole belt replacement.

**The conveyor belt – cover related problems.** The physical properties of the rubber are the single biggest influence on the length of a belt's operational lifetime and plays a critical role in minimizing the need to intervene and carry out repairs. It is also the primary influence on the price of a conveyor belt because rubber constitutes some 70% of the material volume and up to 50% of the raw material cost, making it the prime target in the manufacturers' drive to offer irresistible prices that vastly undercut the competition. The primary cause of cover damage is rubber with an inadequate resistance to wear & tear, ripping, cutting and gouging rather than rubber that is engineered to provide the longest possible wear life.

Much also depends on the overall strength of the rubber and its resistance to cut and tear propagation where even a seemingly insignificant area of damage can easily increase in size due to the continuous material loading and the flexing around the drums and pulleys. In time, this links up with another area of damage causing pieces of rubber to be cut out from the surface and becoming yet another reason to stop and carry out running repairs.

**Delays caused by splice joint failure.** Splice joints are the weakest point of any conveyor belt, and their failures are widely regarded as one of the most common causes of conveyor stoppages. The resulting loss of output means that it is critically important to maximize their strength and long-term durability.

Apart from poor workmanship, joint problems are prevalent in low-grade, imported belting. Within that, the two most common causes are poor adhesion within the belt or between belt and splicing materials, and insufficient elongation of the belt. Having the optimum level of adhesion has an enormous impact on the creation

and ongoing reliability of splice joints. Adhesion levels that are too high can cause significant difficulties and delay when making both hot and cold vulcanized joints.

At the opposite end of the scale, and far more commonplace, is that an inadequate level of adhesion compromises the strength of the joint, the root cause of which is low-grade raw materials such as polymers, fillers such as carbon black, vulcanizing agents and curatives and poor-quality rubber, which all have a negative impact on adhesion levels. In addition, low elongation can lead to shear stresses that may in turn cause delamination issues.

**Improving splice joint reliability.** The most common method of making a splice joint is the step splice by removing of one of the layers of fabric plies and overlapping the belt ends and either cold gluing or hot vulcanizing them together. However, a far stronger and more reliable joint is achieved using the finger splice jointing method (see picture on pxx), where a zigzag pattern is cut into both sides of the belt ends, creating several interlocking 'fingers'. These are then aligned, interlocked and finally bonded using a hot vulcanizing press to make a splice that is not only very strong but also very flat, making it almost impossible for the joint to be damaged by scrapers.

Crucially, when the belt is working under load, the finger splice is vastly superior to a stepped splice in terms of resistance to dynamic failure. The superior strength and durability of finger splices therefore reduce stoppages to re-splice.

### **No excuse**

Avoiding delays caused by conveyor stoppages simply requires a change of mindset because the vast majority can be traced back to the use of components of inadequate quality, made worse by a lack of regular inspection and pre-emptive maintenance. Try explaining that to the ship's captain who is waiting to depart!



*Insufficient adhesion and/or elongation can cause delamination.*