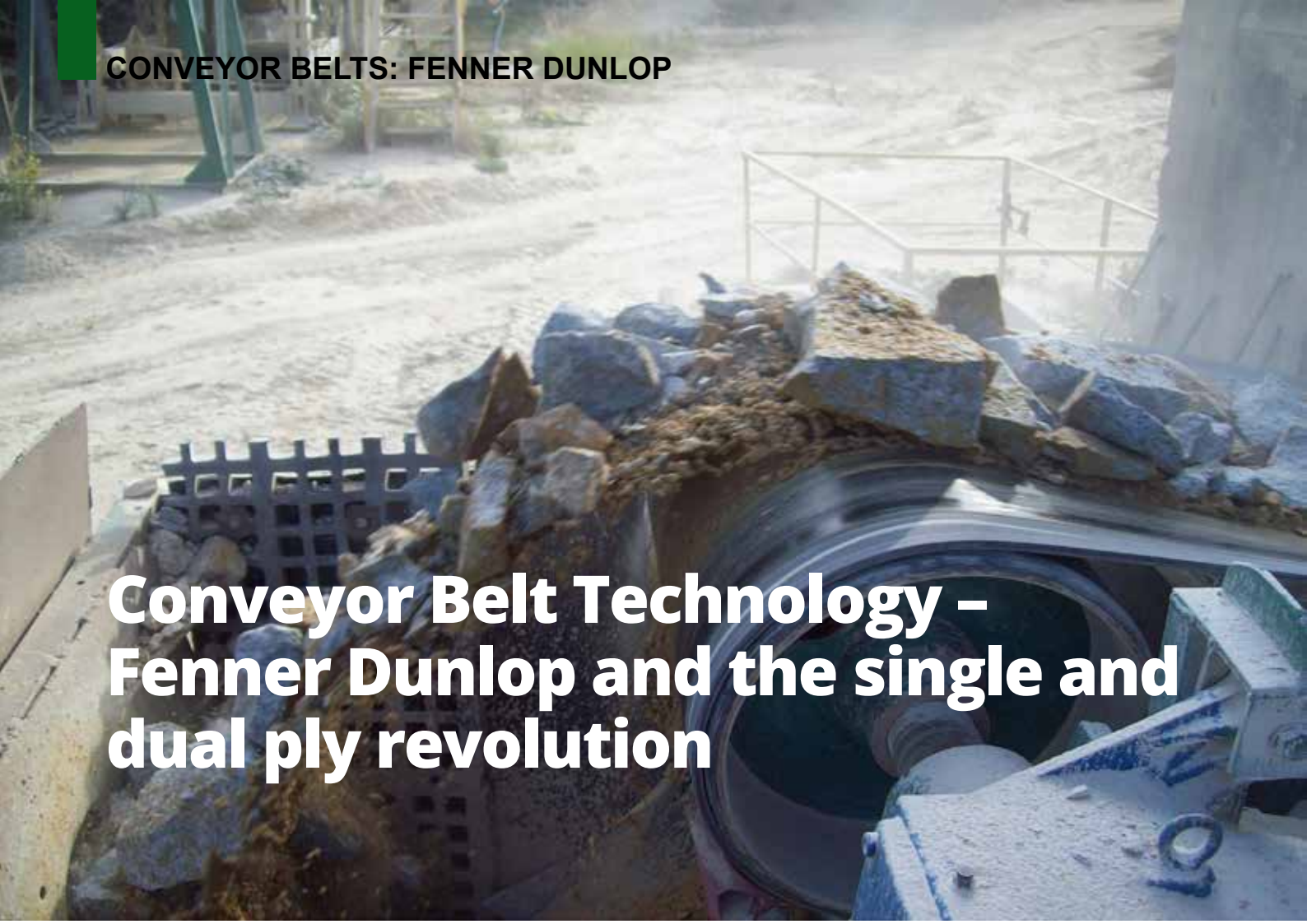


Conveyor Belt Technology – Fenner Dunlop and the single and dual ply revolution

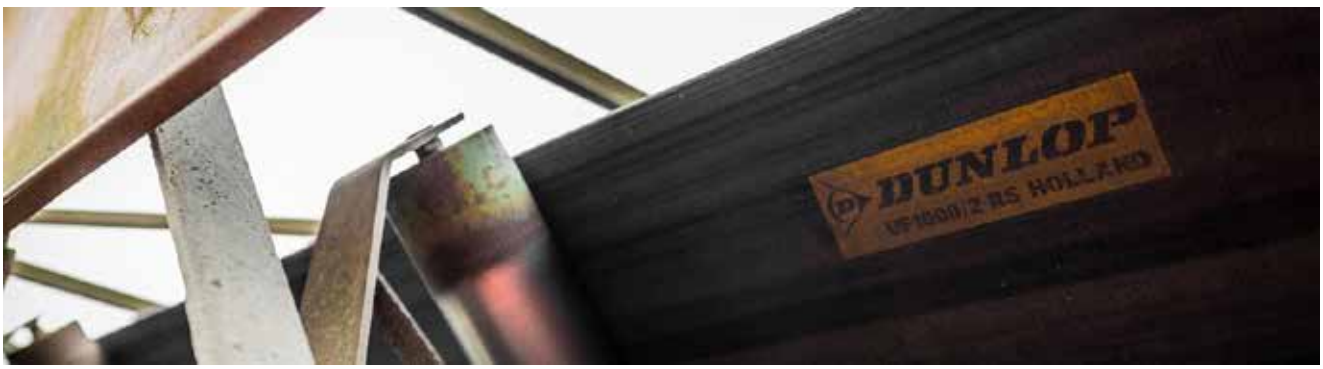
The fundamental design of rubber conveyor belts has remained largely unchanged since 1905, when mining engineer Richard Sutcliffe introduced the first belt constructed from layered cotton and rubber. Over time, the main modifications have been material-based: natural rubber has been almost entirely replaced by synthetic compounds, and the cotton layers have given way to synthetic fabric plies – typically polyester and polyamide – separated by thin rubber skim layers.

The principles of application remain consistent. Heavier loads and more abrasive materials demand belts with multiple plies and thicker outer covers, while lighter, single- or dual-ply belts are reserved for less demanding tasks. However, in recent years, Netherlands-based Fenner Dunlop Conveyor Belting, together with their sister company Fenner Dunlop North America, have challenged these long-standing conventions – ushering in what can only be described as a revolution in conveyor belt technology.

THE STORY SO FAR

More than two decades ago, the highly successful single and dual-ply UsFlex belt was introduced, pioneering the concept of replacing traditional multi-ply belts with stronger, more efficient single and dual-ply alternatives.

Around six years later, the UsFlex line was expanded with the launch of the Ultra X single-ply belt, marking the start of what became known as the X Series. This range was further strengthened by the addition of Nova X, creating a complete portfolio of belts covering tensile strengths from 250 N/mm through to 2000 N/mm.



Building on strong foundations – UsFlex has been extremely successful for Fenner Dunlop

WHY?

Before examining how this was technically achieved, it is first important to understand why the development was considered worthy of significant investment in time and resources. The driver lies in a global conveyor belt market that has become increasingly cut-throat. Over the past two decades, particularly in Europe, the market has been flooded with low-price imports from Southeast Asia, primarily China. In the pursuit of greater market share and the displacement of European competitors, performance and product longevity are often sacrificed to achieve prices that can be more than 50% lower than those offered by established manufacturers committed to quality principles.

With a long-standing brand and a globally trusted reputation for quality, the Dunlop strategy was to compete on overall cost rather than headline price by producing belts capable of withstanding the toughest demands and delivering operational lifetimes previously unheard of. The result: far fewer stoppages for repairs and a much lower frequency of replacements due to damage and wear. At the same time, the company knew it held two decisive technical advantages.

HOW

The first advantage lay in a long history of innovative technology in the development of high-performance rubber. A recent laboratory survey demonstrated that this rubber was, on average, more than 65% more resistant to abrasive wear than competing materials. In effect, the groundwork was already in place. With that strength established, the next logical focus became the synthetic fabrics used in the belt carcass. In this area, the company held a second major advantage, operating its own fabric weaving facility in the USA.

THE OPPORTUNITY

Irreparable carcass damage caused by ripping, tearing and heavy impact has long been a major issue for many operators, especially in mining and quarrying. While some consider such damage to be unavoidable, growing numbers have resorted to fitting increasingly thicker, heavier belts or using low price imported ‘sacrificial’ belts. Unfortunately for those operators, neither provides a practical, cost-effective solution.

In theory, the higher the number of inner plies then the stronger the belt. In multi-ply textile conveyor belts manufactured in accordance with ISO 14890, the declared longitudinal tensile strength is the combined result of the individual fabric plies working together in tension. For example, a belt designated as an EP 630/4 contains four layers of polyester/nylon (EP) fabric reinforcement and has a nominal overall tensile strength of 630 N/mm. Each ply has its own breaking strength, typically around 160 N/mm, and when the plies are bonded together through the rubber skim layers and form the belt’s carcass, their individual strengths effectively ‘join forces’. However, the greatest influence on the strength of a conveyor belt is actually the design and physical properties of the ply material itself.

Using their own textile R&D facilities and the years of experience of the fabrics used in their UsFlex belts, the engineers at Fenner Dunlop were able to develop a range of unique super-strength fabrics for single-ply belts (Ultra X and Nova X).

Fenner Dunlop have their own weaving facilities in North America.

The heart of the matter – individual fibres and yarns of the highest possible quality and strength.

THE HEART OF THE MATTER

The whole working principle of creating advantages from using single and dual-ply carcass belts centres on the fabric. The first priority was to ensure that the individual fibres and yarns were of the highest possible quality and strength. Next came the design of the weave pattern.

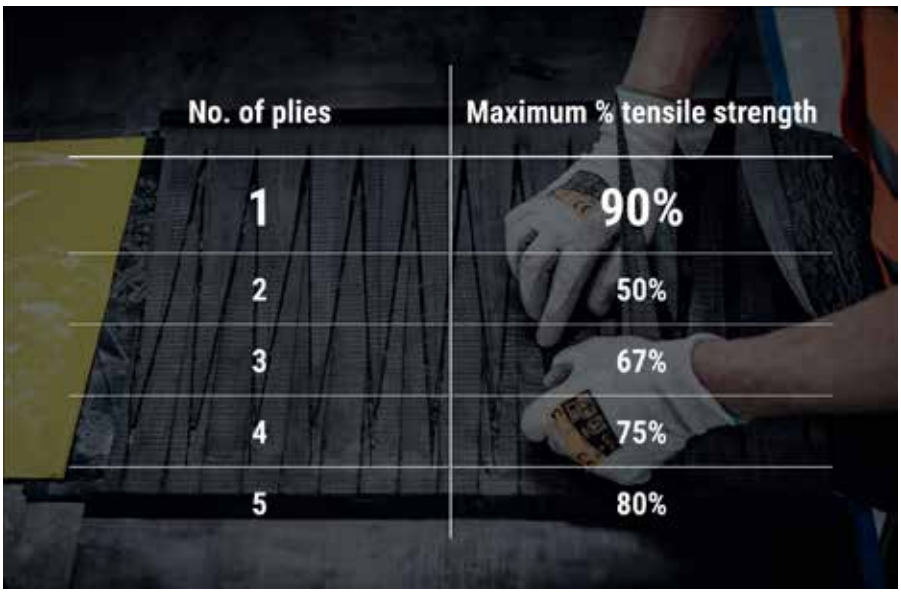
The X Series has three unique versions of fabric. Ultra X features a specially woven “crimped warp” carcass, combining crimped polyester warp yarns with strong binder and filler yarns, creating exceptional strength, stability, and impact resistance. The higher tensile strength Nova-X uses an even stronger crimped warp fabric with binder yarns to lock the carcass, providing excellent rip, tear, and impact resistance under load. For the very toughest applications there is the heavier duty UsFlex, which employs a “straight warp” carcass made of high-tenacity polyester fibres protected by polyamide weft lines.

All of the fabrics consist of longitudinal strands lengthwise and heavy strands running crosswise, held in position by a strong yarn. The strands are completely straight in both directions and not interlocked as in conventional fabric, allowing the weft to float free from the warp. This creates a shock absorber effect by dissipating impact energy over a larger area, enabling the belt to withstand the kind of punishment that would destroy a normal multi-ply belt. Arguably even more important is the ability to resist rip and tear damage.

When penetrated and being pulled through a strong, sharp, trapped object such as a rock, the unique weave design allows the strands to gather in a bundle that eventually become strong enough to stop the belt altogether or even expel the object causing the damage.

Weft strands bundle together to stop belt or expel penetrating object. *(Source: Graphically enhanced image supplied by Fenner Dunlop).*

Synthetic plies are generally more effective than steel in reducing the length of a rip. The UsFlex fabric is so robust that it is also employed as a breaker ply in steel cord belts. The outcome of this development was the creation of carcasses with longitudinal rip resistance exceeding that of multi-ply belts of equivalent tensile strength rating by more than 500%, and impact resistance up to 300% greater than conventional belting.



Much stronger – a finger splice retains up to 90% of the tensile strength.

GREATER SPLICE EFFICIENCY

The concept that a single- or dual-ply belt can deliver the tensile strength required to replace a multi-ply construction, while also offering superior resilience and durability, may seem counterintuitive. The explanation lies in the exceptional strength of the fabrics combined with far greater splice efficiency. While a conventional step splice can be applied to dual-ply UsFlex belts, single-ply designs require the use of a finger splice. The major advantage of finger splicing is its ability to retain up to 90% of the belt's original tensile strength.

By contrast, a four-ply step splice achieves a maximum of only 75% tensile strength, and a three-ply step splice retains no more than 67%. To illustrate, a 630/4 designated belt incorporates four layers of fabric reinforcement, each with a breaking strength of approximately 160 N/mm. When one ply is lost during step splicing, the effective tensile strength falls below 500 N/mm, highlighting the significant efficiency gap compared to finger-spliced single-ply constructions.

Finger splice joints are stronger and more durable

This is why the X Series single-ply belts deliver tensile strengths and safety factors fully comparable to conventional belting constructed with three or four layers. For instance, an Ultra X3 single-ply belt is capable of handling loads of up to 56 tonnes. An important additional benefit of this design is that finger splice joints are significantly stronger and more durable, reducing the frequency of repairs and re-splicing.

Another key advantage is the enhanced flexibility of single and dual-ply belts, making them particularly well suited for mobile conveyors, which often operate with small-diameter pulleys. Continuous flexing in such systems places considerable dynamic stress on both the carcass and splice joints, typically restricting the strength of belts that can be installed. The X Series design overcomes this limitation, ensuring reliable performance under demanding conditions.

WEAPONISING THE COST FACTOR.

Although a wide range of conventional, premium-quality multi-ply and steel cord belting continues to be produced, the X Series single-ply and dual-ply designs are regarded as the future of industrial conveying. By effectively reversing the traditional economic argument – and demonstrating to a price-driven market that overall cost matters far more than headline price – conveyor belt technology can now be seen as having truly entered the 21st century.

AUTHOR

Leslie David

Leslie David has specialised in conveyor belting for over 20 years and is one of the most published authors on conveyor belt technology in the world.