

The three main rock types are igneous, sedimentary, and metamorphic

The Right Belt

Jan Willems of Fenner Dunlop Conveyor Belting explains why conveyor belts need to be matched to the rock types, sizes and characteristics they are required to handle

Many rock types have physical characteristics such as hardness, sharpness, and abrasivity that vary with geological origin. These characteristics directly influence the type and extent of damage to rubber conveyor belts.

Selecting a belt that best balances durability and whole-life cost becomes even more challenging when you consider the material's lump size and weight. A better understanding of rock types is therefore a useful starting point.

Rock types

Rock is generally classified into three main categories: igneous; sedimentary; and metamorphic. Its hardness and sharpness depend on its mineral composition and how it was formed. Hardness is measured using the Mohs Hardness Scale, which ranges from 1 to 10, while sharpness depends on grain size and how the rock fractures.

Igneous rocks form as molten rock cools and solidifies. They are typically dense and lack natural layers, and many types are hard (5–7+) and highly abrasive*. Their sharpness varies: volcanic glass, such as obsidian, can fracture into extremely sharp edges, whereas coarser, abrasive rocks, such as granite, tend to break into rougher, more angular fragments.

Sedimentary rocks form from accumulated material that compresses and cements over millions of years. Their hardness is generally low to medium (1–5), and most have relatively low sharpness, breaking into granular or irregular fragments rather than producing clean fractures. Exceptions include microcrystalline quartz varieties such as flint and chert, which have a hardness of around 7 and can fracture into extremely sharp edges – a property that made them suitable for prehistoric tools and arrowheads.

Metamorphic rocks form when intense heat and pressure alter existing rocks beneath the Earth's surface. Their hardness ranges from medium to extremely hard (3–7+), while sharpness can be moderate to high. Marble is relatively soft, whereas quartzite is extremely hard and resistant to fracture. Rocks such as slate and schist can also split along flat, parallel planes, known as foliation, producing thin, blade-like fragments with relatively sharp edges, though generally less acute than those of glass or flint.

Embracing the new or living in the past?

The types of damage rock can cause to conveyor belts have not changed, but belt technology has advanced significantly over the past 20 years. Much of this progress has stemmed from developments by leading vehicle-tyre OEMs, including Michelin in France, owner of Fenner Dunlop Conveyor Belting, and Continental in Germany, who until recently owned ContiTech Conveyor Belting.

Their continued focus on tyre safety and durability has also driven advances in conveyor belt technology. Today, a wider range of rubber compounds and carcass constructions is available, enabling belts to withstand levels of impact, abrasion and wear that would previously have caused premature failure in traditional belts, regardless of the type of rock handled.

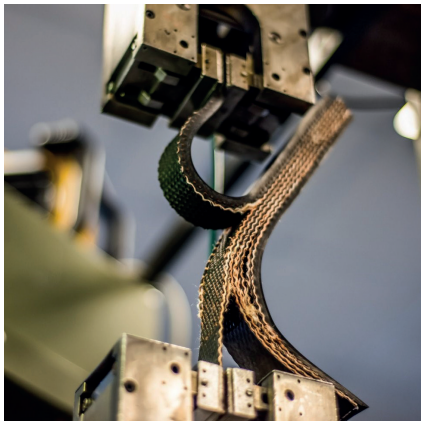
Rubber cover

When selecting a conveyor belt, the type and grade of the rubber cover should be among the first considerations, based on the characteristics of the material being conveyed. Rubber cover durability is typically one of the most significant factors affecting belt service life and, consequently, whole-life cost.

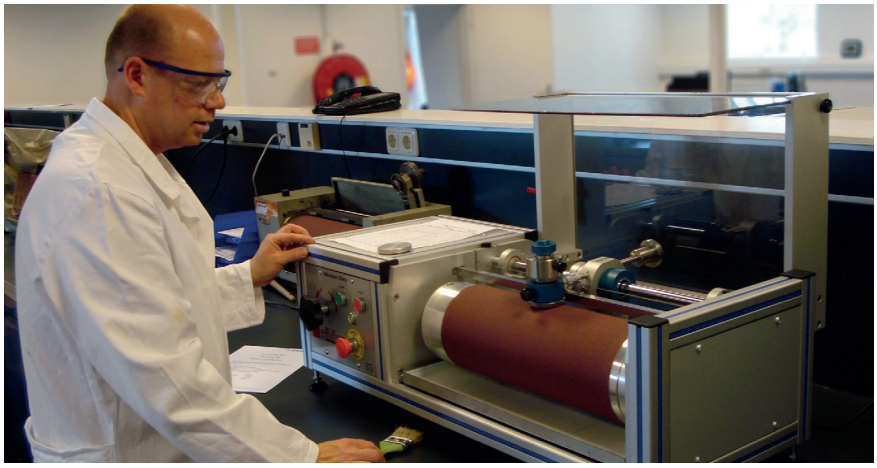
While the low purchase price of imported 'economy' belts can be attractive, cheaper products often rely on lower-grade raw materials. Rubber accounts for around 50% of the cost of manufacturing a conveyor belt, making it a key area where lower-cost materials can compromise performance and durability.

The purchase price, however, accounts for only part of a belt's total lifecycle cost. Repair-related stoppages, maintenance requirements, and premature replacement can all significantly increase the overall cost of ownership. ➤

Abrasivity describes a rock or mineral's ability to wear the surface of solid materials, such as rubber and steel, through friction.



Conveyor belt technology has advanced significantly over the past 20 years, improving resistance to abrasion, impact and mechanical damage



DIN 53516/ISO 4649 abrasion resistance testing

Quality standards

Two internationally recognized sets of standards cover conveyor belt abrasion resistance: ISO 14890, covering H, D, and L grades; and DIN 22102, covering Z, Y, W, and X grades. The longer-established DIN standards are generally preferred in Europe.

DIN Y (ISO 14890 L) is the most widely used grade, with a maximum volume loss of 150mm^3 under DIN 53516/ISO 4649 abrasion testing. However, ISO 14890 L is not a direct equivalent to DIN Y and represents a lower cover class in several respects, including abrasion resistance, tensile strength and elongation.

DIN X (ISO 14890 H) has a maximum volume loss of 120mm^3 and offers greater resistance to cutting, impact and gouging, making it suitable for applications involving heavy, sharp or abrasive rock.

DIN W (ISO 14890 D) is widely regarded as the highest-performance cover grade for severe abrasive and mechanical wear. It is designed for demanding applications involving cutting, gouging, ripping, tearing and impact, with a maximum volume loss of 90mm^3. Lower volume-loss figures indicate greater resistance to abrasive wear.

A conveyor belt with good abrasion resistance can, therefore, deliver a significantly longer service life than lower-grade alternatives, potentially reducing belt replacement frequency and associated downtime.

DIN and ISO abrasion standards also specify minimum requirements for tensile strength and elongation at break. To qualify for a particular grade, rubber covers must meet all three specified physical properties. However, these standards should be viewed as minimum benchmarks, not performance guarantees. Fenner Dunlop note that laboratory testing has consistently found that more than 50% of tested conveyor belts fall significantly below the minimum requirements for their claimed grade.

Meeting a particular standard does not necessarily mean that two belts will perform to the same level. Manufacturers using higher-quality rubber compounds can achieve significantly greater resilience, so one manufacturer's DIN Y belt can outperform another manufacturer's DIN X belt by a considerable margin.

Therefore, no single quality standard applies to each rock type. Physical characteristics can vary considerably within the same broad category, so belt selection should be based on the properties of the material being handled rather than on an 'umbrella' rock classification.

For example, flint is a sedimentary rock that can fracture into extremely sharp, abrasive edges, requiring different rubber properties from those used with finer sedimentary materials such as aggregate, sand, and gravel. In such applications, a DIN X (ISO 14890 H) cover may be more appropriate, whereas DIN Y (ISO 14890 L) could be a more cost-effective solution for less demanding materials.

Where the material is particularly hard, abrasive, sharp or heavy, a high-quality DIN W (ISO 14890 D) cover is likely to offer the greatest resistance to the combined effects of abrasion, impact and mechanical damage.

The inner carcass

The inner carcass forms the backbone of a conveyor belt, providing the strength and support needed to withstand operating loads and impact. Fenner Dunlop estimate that around 80% of belts are replaced prematurely due to catastrophic damage from impact or trapped material, such as large, sharp rocks.

In these conditions, it can be tempting to specify a thicker, heavier belt with more plies. However, simply adding more material is rarely the most effective solution. A more cost-effective approach is to select a belt engineered to withstand the impact and mechanical stresses of demanding, long-term applications.

The best examples use super-strength nylon strands woven into a unique weave pattern that allows the strands to stretch. As a trapped object is pulled through the belt, the strands gather into a bundle that eventually becomes strong enough to stop the belt in its tracks, rather than propagate over a much longer distance. The fabric's design also lets energy from heavy impacts dissipate over a much wider area.

While many manufacturers worldwide focus primarily on standard conveyor belts, Fenner Dunlop specialize in heavier-duty applications, with manufacturing operations in Europe and North America.

Believing that more material does not necessarily mean greater durability, the company has developed the X Series of single- and dual-ply belts. Compared with conventional multi-ply belts of equivalent tensile strength, the X Series is claimed to offer an average 65% increase in abrasive wear resistance, up to 300% greater resistance to ripping and impact, and up to 500% greater tear resistance.

Selecting the correct rubber cover is critical to achieving the required balance of belt performance, durability and whole-life cost



Conclusion

Different rock types place different demands on conveyor belts, but the latest advances in belt technology have made it easier to identify rubber compounds and belt constructions suited to specific applications. The right combination can provide a more durable, long-term solution rather than relying on repeated belt replacements.

Although higher-performance belts may require a greater initial investment, their longer service life can reduce the frequency of replacements, maintenance requirements, and associated downtime. By contrast, continued reliance on short-term or 'sacrificial' belts can lead to significantly higher costs over the longer term. ***QM***