Stretching the limits – conveyor belt elongation

Elongation is a commonly used but often misunderstood technical term applied to rubber conveyor belts, *writes Rob van Oijen*. The elongation (stretch properties) of a carcass is a more important influence on performance and longevity than many people may realise. Conveyor belt elongation properties are critical in determining how belts will react when subjected to varying stress levels. These stresses change along the length of the conveyor and across the width of the belt due to system influences such as tension, transitions, vertical and horizontal curves, turnovers, and crowned pulleys.

Elongation – what is it and why is it important?

Elongation is best defined as the change in length (stretch) of a belt when subjected to tensile stress. A distinction is made between elastic elongation, permanent elongation, and elongation at break. With each tensile stress below break load, the belt is subject to an elongation which, when the stress is relieved, partly recovers (elastic elongation) and partly remains (permanent elongation). The elongation at break is the amount of elongation at the moment the belt breaks.

Using test method ISO 283, the amount of elongation is measured by placing a test piece under increasing tension. Elongation at the equivalent of 10% of the belt's stated tensile strength is measured, as well as the elongation at breaking load. Another test per ISO 9856 places a belt sample under a sinusoidal cyclic load that varies from 2 to 10% of the belt's nominal breaking strength. This tension range is a typical operating range for conveyor belts. After 200 cycles, the amount of permanent elongation and the amount of elastic elongation produced by the force can be established.

It is important that a balance is achieved because the belt needs to be able to accommodate geometric changes such as pulleys and transitions. Provided that it is not excessive, a limited amount of elastic elongation is a requirement to accommodate strain differences. Permanent elongation is often unavoidable due to the nature of the reinforcement materials being

used and the type of weave. Higher tensile yarns and weaves will need to 'settle' more than low tensile variants, and therefore typically elongation values increase with increasing tensile ratings.

On multi-ply belts, insufficient elongation is mostly an issue in areas where the belt needs to stretch, such as troughing and bending round pulleys for example. It can cause local tension build-up, which can have an especially negative effect on the splice joint. In addition, low elongation can lead to shear stresses that may in turn cause delamination (ply separation) issues. However, too much elongation can result in insufficient tension, which can lead to premature wear and tear, which is why quality control during the production process is essential in achieving a consistent balance.

According to DIN 22102, the maximum elongation (at maximum operational tension, being 10% of the nominal belt breaking strength) for multi-ply belts is 1.5% for tensile belts up to 500N/mm, a maximum of 2.5% for strengths of 630 to 1,250N/mm and 3% for very high-tension belts of 1,600N/mm and above. However, in my experience, I would not expect to see much more than 1% in the lower range and 2% in the high-tension classes.

All three forms of elongation are effectively determined by the properties engineered into the belt during its manufacture. The primary influence on those properties is the quality, type and weave design of the fabric plies used within the carcass and secondly, the elongation characteristics of the rubber outer covers. The most popular type of fabric used in

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Low elongation can cause stress that leads to delamination.

multi-ply belts is a mix of polyester and nylon fabric (EP). This is because it has the best balance of mechanical properties including allowing a conveyor belt to stay central and stable when running, to trough, flex round pulleys and drums, stretch, provide sufficient transversal rigidity, longitudinal strength and much more besides.

There can, however, be huge differences in the quality of the fabric plies between one belt and another. This is because cheaper, lower quality fabrics are used to make so-called 'economy' belts where the more costly nylon transversal weft material is kept to a minimum. Although the required longitudinal tensile strength may be achieved, rip and tear resistance are noticeably reduced and the elongation (elasticity) is too low. Sadly, in an effort to reduce costs, some manufacturers, especially those in Southeast Asia, use inadequate totally polyester (EE) fabric ply carcass in a belt that they claim to have an EP carcass construction.

Although the use of fabric plies made entirely of polyester does have its place in certain belt types and constructions, such as single-ply constructions for example, for most applications its use compromises a range of essential mechanical properties. The biggest danger is that a polyester weft can cause low transverse elongation, which reduces both the troughability and impact resistance of the belt as well as causing tracking issues. This if often compensated by eliminating a fair share of weft material in the weave. This leads to very flat fabrics, reducing the required longitudinal elongation properties. In addition, less weft in the belt can also reduce rip resistance, fastener strength and the ability to cope with smaller pulley sizes.

Running straight and true - polyester and nylon fabric (EP) in multi-ply belts usually has the best balance of mechanical properties.

Significant influence

Despite its significant influence on conveyor belt behaviour, performance and longevity, it is hard to find any manufacturer or supplier making anything more than a passing mention of elongation. As with so many aspects of conveyor belting where awkward questions seem be avoided, the subject seems to be ignored. Ozone and ultraviolet resistance, rip & tear resistance, longevity and REACH compliance all fit into the same category. Elongation is important so it is worth asking a potential supplier to provide a technical datasheet that shows the levels of expected elongation.

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.

Not what they seem — the use of totally polyester (EE) fabric instead of polyester/nylon mix (EP) to reduce costs can cause significant problems.