Bigger is not always better

When operators are experiencing problems with their conveyor belts, or even when they simply want to increase their operational lifetime, increasing the belt specification is often seen as the best way to solving the problem. More often than not, 'going bigger' by increasing the tensile strength, the number of plies or the thickness of the covers, has the opposite effect and actually makes matters even worse. Here, Dunlop Conveyor Belting's head of application engineering, Rob van Oijen, explains why bigger is not always better.

IDENTIFYING THE TRUE CAUSE

The majority of problems involving rubber conveyor belts seem to have quite an obvious cause. As a result, the solution appears to be equally as obvious. But if the diagnosis of the cause is incorrect then so will be the solution. The most common example of this is rapid wear of the covers of the belt, especially the top cover because proportionately it wears four times faster than the bottom cover. The most obvious cause of rapid wear would logically be the abrasive nature of the materials being conveyed, which is true up to a point. To improve belt life the logical answer would therefore seem to increase the thickness of the covers. However, experience proves that this is rarely the best course of action.

QUALITY NOT QUANTITY

Without a shadow of a doubt, the biggest single cause of rapid belt cover wear is due to the rubber having insufficient resistance to wear. In other words, the rubber compound used by the manufacturer has not been engineered to provide the level of wear resistance needed for the job. It is important to bear in mind at this stage that when comparing abrasion test results, higher figures represent a greater loss of surface rubber, which means that there is a lower resistance to abrasion. Conversely, the lower the figure the better the wear resistance.

The manufacturer may claim that the rubber meets DIN Y (ISO 14890 L) standards for abrasion resistance (maximum volume loss in cubic millimeters of 150 mm^3 under ISO 4649 / DIN 53516 test methods). However, in reality, the wear resistance may only be borderline at best or, as we regularly find during laboratory testing, have totally inadequate resistance. One example we found only recently was a steelcord belt with an abrasion resistance of 264 mm^3. Not only is that more than 50% higher than the maximum level for DIN Y compliance, the manufacturer had sold the belt as being a *DIN W specification*, which demands a maximum of 90 mm^3, so the belt actually had an abrasion resistance level that was more than three times less than it should have been.

NOT JUST ABRASION

As mentioned previously, the most logical solution to rapid wear would seem to be to install a belt with even thicker cover rubber. Thicker covers will certainly endure more wear but on the downside, the added weight will increase the absorbed motor power of the system. Over the whole lifetime of the belt, this can amount to significant added cost. It is also important to bear in mind that the ability of a belt cover to withstand wear is not due to its 'abrasion resistance' alone. The resistance to wear of the rubber is a combination of its overall strength, its resistance to abrasion and its resistance to tear propagation. If the latter is very low then a small, seemingly insignificant area of damage in the extra thick cover can easily increase due to the continuous material loading and the relentless flexing of the rubber around the drums and pulleys. In time, this damage will connect to another area of damage and consequently a small piece of rubber will effectively be cut out and lost rather than simply worn off. In reality, although doubling the cover thickness will add some lifetime it will certainly not double the lifetime of the belt. Invariably, the only real solution lies with improved quality rather than increased quantity and only buying belts where you are confident of their provenance (manufacturer's origin) and where the manufacturer clearly states the level of anticipated performance rather than simply claiming to be of a certain DIN or ISO standard.

INCREASING THE TENSILE STRENGTH

When problems are being caused by impact damage and/or ripping and tearing, there is often the temptation to fit a belt with a higher tensile strength and/or a belt with an increased number of plies. The same 'solution' is often tried when there are problems such as too much elongation (stretch), repeated splice failure or where mechanical fastener retention is poor. To be fair, increasing the tensile strength is worthwhile if the current belt damage is due to a too little load support, provided that the design of the conveyor allows it. The same applies to belts that are obviously under-specified in the first place.

THE NEGATIVE EFFECTS OF INCREASING THE TENSILE STRENGTH

Simply increasing the tensile strength or the number of plies can cause more problems than it solves. First of all, the belt becomes heavier and less flexible in both length and width. Reduced longitudinal flexibility usually necessitates an increase in the diameter of the drive pulley. Increasing tensile strength by just one step usually means an increase in diameter of 25% or more. Failure to increase the pulley (drum) diameter can lead to dynamic stress failure, especially in splice areas. Reduced horizontal flexibility causes a decrease in troughability. Last but not least, and as mentioned with increasing the thickness of the covers, there is also a price to pay in terms of increased power consumption, which can be quite marked.

TEST IT FIRST

In all cases, before any change of belt is considered, I would strongly advise getting a completely new belt calculation using a professional belt calculation program. And if you have a piece of spare belt available then it is often a good idea to send a square meter of it for laboratory testing to measure its true tensile strength. There are two reasons why this is advisable. In belts that have low quality (low cost) fabrics, it is unusual to find a fabric that has inadequate tensile strength. However, although the amount of material used in the longitudinal strands of the fabric may be adequate, the amount of transversal weft material is often kept to an absolute minimum in order to reduce cost. Although the required tensile strength might be achieved, rip and tear resistance is reduced and elongation (stretch) is low. Low elongation may sound good in principle but if the elongation is too low then this can cause problems

Not what they seem – The use of totally polyester (EE) plies rather than a combination of polyester and nylon.

with transition distances and a general inability to accommodate the contours of the conveyor and its drums and pulleys. Ultimately, this can lead to the premature failure of the belt.

NOT WHAT THEY SEEM

The second reason for checking the true tensile strength of a belt before replacing it is that it is becoming increasingly common for some manufacturers, traders and importers to supply belts that have totally polyester (EE) fabric plies in a carcass that is declared as being an EP (polyester/nylon mix) carcass construction. The simple reason for this deception is that EE fabric costs some 30% less than EP fabric. In itself, this may not seem like a great deal but the fabric plies are a major cost component in any multiple ply conveyor belt so using the much cheaper polyester fabric is a big help when trying to achieve the perception of a lower 'like for like' price. The whole basis of using a mix of polyester and nylon fabric is that it has the best balance of mechanical properties including allowing a conveyor belt to run straight and true, to trough, to flex round pulleys and drums, stretch, transversal rigidity, longitudinal strength and much more besides.

The use of totally polyester (EE) fabric compromises a whole range of essential mechanical properties. The biggest danger is that a polyester weft can cause low transverse elasticity, which reduces both the troughability and impact resistance of the belt and also causes tracking issues. In addition, less weft in the belt can also reduce rip resistance, fastener strength and ability to handle small pulley sizes. The seriousness of the detrimental physical effects for the end-user are therefore huge. One test that I witnessed recently revealed that the tensile strength of the carcass was more than 20% lower than the specified minimum. To sum up, simply replacing a belt with one with a specified higher tensile strength and/or an increased number of plies is most often merely compensation for poor quality rather than a genuine and honest lack of (tensile) strength.

As with the solution to premature surface wear, the real solution lies with only buying belts where you are as sure as you possibly can be of the quality, the provenance and the integrity of the supplier. Bigger is certainly not always better.

ABOUT THE AUTHOR

Rob van Oijen is Manager Application Engineering for Dunlop Conveyor Belting in The Netherlands is one of the most highly respected application engineers in the industry. He has specialized in conveyors for over 14 years, supporting businesses throughout Europe, Africa, the Middle East and South America.