

Conveyor talk — holding it all together

CONVEYING ADVICE

THE CRITICAL IMPORTANCE OF GOOD ADHESION IN RUBBER PLY CONVEYOR BELTS

Although the technical term 'adhesion' is well known within conveyor belt engineering circles, it is rarely mentioned and very unlikely to be taken into consideration by buyers and operators of multi-ply conveyor belts, even though the adhesion properties are a critical influence on both performance and longevity, writes Rob van Oijen. Here is how and why:

What is adhesion? Rubber belts with 'multi-ply' textile reinforcement are the most commonly used type of

conveyor belt for dry bulk handling. The inner carcass is effectively the backbone of the belt because it provides the inherent characteristics such as its tensile strength and elongation (elasticity or 'stretch' under tension). The construction consists of a single or multiple layers of extremely strong but flexible synthetic fabric ply such as polyester and nylon. Each layer is covered by a thin 'skim' of rubber that bonds them together. Different rubber compounds are used for the outer protective covers and skim, although in some cases the polymers may be the same. Usually, different fillers are used to create the skim rubber. To increase the adhesion, the fabrics are pre-treated with a specialized coating. Without this treatment, the fabrics would be too smooth and too resistant to effectively absorb the polymer, elastomer or rubber in a manner that achieves acceptable ply adhesion.

Adhesion testing — good ply adhesion is vital to avoid delamination.



Delamination — layers separate and the belt literally falls apart.

The term 'adhesion' when used in relation to conveyor belts is the adhesive bond between the inner ply layers to adjoining layers and between the surfaces of the outer plies and the rubber covers. Basically, it is what holds the conveyor belt together. Adhesion is defined as the force required to separate (pull apart) the adhesion between adjoining plies and/or between the plies and the outer covers. This is usually measured in Newtons per millimetre (N/mm).

Why are adhesion levels important? Adhesion between the plies and the covers is fundamental to the durability, functionality and structural integrity of a conveyor belt. Conveyor belts continually flex over pulleys and drums and this repeated flexing action stresses the ply adhesion. It is therefore essential for long-term durability that the belt has adequate ply adhesion to withstand this stress without delaminating, which is

where the various layers separate and the belt literally begins to fall apart.

Good adhesion also helps the belt resist adverse environmental conditions, such as extreme temperatures and humidity, as well as enhancing the belt's ability to trough and carry heavy loads without the risk of ply separation, making it suitable for more demanding applications.

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 problems in the making of both hot and cold vulcanized joints. At the opposite end of the scale, and far more commonplace, is an inadequate level of adhesion because this compromises the strength of the joint, even when the workmanship has been of the highest standard. Unreliable splice joints are a very common cause of unplanned stoppages to carry out repairs.

Causes of poor adhesion. There are numerous reasons why a belt can have inadequate adhesion properties. As with nearly all other inadequacies in conveyor belts, the root cause is the use of low-grade (low cost) raw materials, the quality of the rubber and production methods that are centred on economy rather than being end-performance and longevity driven. Low-grade ingredients such as polymers, fillers such as carbon black, vulcanizing agents, plasticisers, resins and curatives all have a negative impact on adhesion levels. Other causes include moisture ingress, overheating or overcooking during the vulcanization process, poor or non-compliant rubber formulation in combination with the fabric coating and the use of bulking fillers such as chalk or clay. Another factor is the type and quality of the fabric treatment itself, which plays an essential role in both short and long-term adhesion.

Yet another cause is the omission of antioxidants in the rubber compound that

Ozone & UV exposure degrades rubber and can seriously impair adhesion.



Longevity determines the true cost of any conveyor belt.



prevent damage caused by exposure to ground level ozone and ultraviolet light. The absence of such important additives is purely cost driven. Tests reveal that up to 90% of the rubber belts used in Europe and Africa are not resistant, despite the fact that ozone and UV significantly accelerates the oxidation of rubber, resulting in its premature degradation and loss of mechanical strength. Over time, as the adhesion properties of the rubber diminish, splice joints become more and more unreliable and makes repairing them increasingly difficult.

LIFE SHORTENING

There is no doubt that longevity determines the true cost of any conveyor belt. Premature wear and catastrophic damage caused by rips and tears are well acknowledged causes of early belt replacement, especially with 'cheap' imported belting.

For the same reason, delamination caused by inadequate adhesion properties is increasingly becoming a major 'life shortener'. With so much to get right, and so much that can go wrong, it is hardly surprising that adhesion plays such a key role in the operating life of a conveyor belt. Compromises in the pursuit of a price advantage serve only to benefit the manufacturer, never the end-user.

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 17 years, supporting businesses throughout Europe, Africa, the Middle East and South America and is one of the most highly respected application engineers in the conveyor belt industry.

