STRENGTHENING THE BOND

A guide to improving splice joint reliability

Splice joints represent the weakest point of any rubber conveyor belt. It is estimated that splice joint problems account for some 80% of time-consuming conveyor stoppages and lost productivity. The more splice joints there are then the greater the risk. In this special feature, Rob van Oijen, one of the world's most experienced and highly regarded application engineers, provides invaluable advice on how to improve splice joint reliability.

COMPATIBILITY

There are a huge variety of different rubber compounds. Their creation involves a process where a range of very precisely measured chemical additives, 'cross-linking agents', polymers such as carbon black, reinforcements, plasticisers, antioxidants, anti-degradants and zinc oxide to name but a few, are mixed together according to very specific, unique recipes. No two manufacturer's rubber compound recipes are the same. Some may be more similar than others, but they are never the same.

To achieve strong, reliable splice joints, it is essential that the splicing material rubbers (unvulcanised adhesion rubber, unvulcanised cover rubber and the unvulcanised rubber used on the reinforcement fabric have very similar physical properties (such as adhesion) and behavioral characteristics compared to the rubber used to make the belt, including the outer cover rubber and the skim (inter-ply) rubber. Ideally, they should come from the same source.

Perhaps even more importantly, the various materials must allow them to be bonded together, including vulcanised materials in the belt against un-vulcanised splice materials used to build up the splice and any solvents used as a cleaner and rubber solution.

Up to 80% of unplanned stoppages are caused by splice problems.

Best advice: It is always best to use splicing materials supplied by (or recommended by) the manufacturer of the belt. For this and other reasons to be explained later, avoid buying 'generic' splice materials in bulk.

'TASK-SPECIFIC' SPLICE MATERIALS

The more specialised the belt grade, such as fire resistant for example, the more critical matching (compatibility) becomes. If the rubber materials used to create the splice joint do not have the equivalent resistance to fire, oil or heat, then a weak spot is automatically created both in terms of how the rubber reacts to exposure and its adhesive properties.

The negative effects of incompatibility are unlikely to be seen in the very short term but over time, reliability will suffer, leading to increasingly more stoppages to carry out splice repairs and, in the case of fire resistance, greater risk exposure.

Best advice: Once again, avoid using generic splice materials. Whenever possible, it is always best to use splicing materials (a full splicing kit) supplied or recommended by the belt manufacturer.

ONLY USE GOOD QUALITY SPLICE MATERIALS

In addition to ensuring that the splice materials match the belt rubber, there is also the question of quality. Rubber represents the biggest single influence on the performance and longevity of a conveyor belt. It also represents some 70% of the volume and up to 50% (or more) of the cost of making a belt. Consequently, in these times of ever-increasing price competition, led and dominated by manufacturers in South and East Asia, primarily China, rubber is the biggest target for savings. Cost-cutting practices include the use of unregulated*, low-grade ingredients, increased use of large proportions of rejected and used rubber and reduced quantities (or total omission) of essential ingredients such as antioxidants.

(* Not compliant with European safety and environmental REACH and POPs (Persistent Organic Pollutants) regulations designed to regulations protect human health and the environment by restricting or banning chemicals that pose hazards including those chemicals or substances that may have category 2 carcinogenic classifications. Manufacturers based outside of Europe and the UK are not subject to these regulations).

Best advice: Avoid using 'cheap' low-grade splicing materials because their price always reflects the quality of the product. Importers of these products should be aware that non-compliant products cannot be legally imported, sold, or used within the EU or UK market.

OZONE AND ULTRAVIOLET RESISTANCE.

Aside from the resistance that all forms of rubber needs to have against elements that cause damage and premature ageing, another form of resistance that every rubber compound must have, which is being able to resist the effects of exposure to ground-level ozone (O3) and ultraviolet light (UV) from sunlight and artificial (fluorescent) lighting.

Exposure (to light and air) is, of course, unavoidable and the damage they cause is considerable. The early signs of ozone attack are small cracks in the rubber surface, in some cases within weeks of first being fitted with much

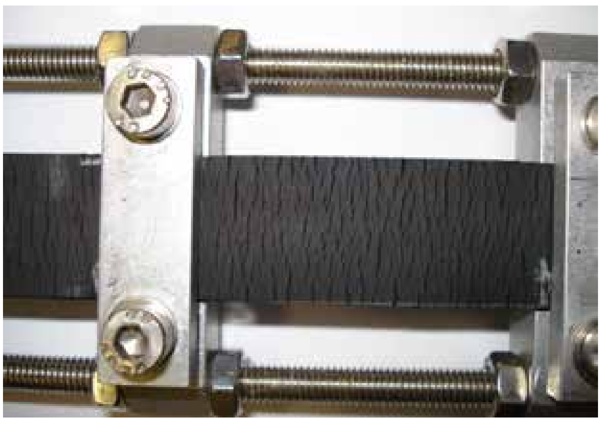
Rubber splice materials should have equivalent resistance properties.

Manufacturer's splice kits are invaluable for special cover grades.

REACH
COMPLIANT
European Chemicals Agency

COMPLIANT
PERSISTENT
ORGANIC
POLLUTANTS
EU Regulation 2019/1021

Manufacturers based outside of Europe and the UK are not subject to REACH and POPs regulations.



The damage caused by ozone and ultraviolet exposure is considerable.

worse to come as the rubber becomes increasingly brittle and inflexible. Cracks form in rubber that is under tension at the points where the strain is the greatest, so splice joints are particularly vulnerable.

Best advice: Always insist on written confirmation that the splice materials you are buying are fully resistant to the effects of ozone (O3) according to EN ISO 1431 testing methods and ultraviolet light (UV). If they are not resistant then they will begin to deteriorate and lose strength and elasticity prematurely.

'SHELF-LIFE' AND STORAGE

As with most products in the commercial world, buying large quantities usually brings a price benefit. However, the downside is that different 'task-specific' materials have different individual restrictions regarding their functional lifetime, after which their effectiveness begins to decline quite rapidly. There are no standard guidelines. It is just a question of what is in the mix, how their molecular structure and behaviour (effectiveness) changes over time, their curing speed at ambient temperature and so on. This means that shelf-life can range from one month following manufacture up to 12 months, with various permutations in between.

Generally speaking, splice materials for speciality belting have the shortest shelf-life (as short as only one month), with certain fire, oil or heat-resistant types ranging from 3 to 6 months and the longest (up to 12 months) is more typical for 'regular' abrasion resistant belts. The shelf life is dependent on being stored according to the manufacturer's recommended conditions shown on the packaging, especially ambient temperature.

To add further complexity, recommended shelf-life varies between manufacturers. Just as the rubber compound recipes used for the outer covers and inter-ply skims vary from manufacturer to manufacturer, so does the recommended shelf-life for the various rubber-based splice materials. These include uncured inter-ply rubber (used to rebuild the belt carcass), the uncured cover rubber used to rebuild the belt's cover area and uncured rubberised fabrics used as reinforcements in heavy duty / high tensile splices.

Best advice: Be aware of storage recommendations and do not use once the use-by date has passed, especially once opened. To do so is a false economy and the first thing that suffers is the all-important adhesion properties.

SPLICING METHODS

The primary splicing methods are cold-glue splicing and hot vulcanisation using a heated press. Cold glue splicing is generally seen as the easiest, fastest (lowest cost?) method, although the preparation work is quite similar to hot vulcanisation and the glue needs at least 6-8 hours cure time, although many take a massive risk of restarting the conveyor too quickly, which can lead to early failure.
Although hot vulcanisation using a mobile press requires handling and setting up the press, in comparison to cold gluing, it produces a stronger, longer lasting and more durable joint that is especially needed on the heavier duty applications commonly found in mining and quarrying.

Shelf-life largely depends on what is in the mix

A finger splice is stronger and more reliable.

THE ADVANTAGES OF FINGER SPLICING

For many years, the step splice has been the most commonly used splicing method but when looking to reduce the frequency of stoppages caused by splice joint failure by improving reliability, the increasingly popular choice is finger splicing. A step splice requires the removal of the length of the step of subsequent layers of fabric plies so that the two belt ends can be overlapped and either glued or hot vulcanised together. However, the main disadvantage is that it will always create a proportional loss of tensile strength equivalent to the strength of one ply.

By comparison, finger splicing, where several 'fingers' are interlocked and bonded together using a hot vulcanising press creates a splice that is typically stronger, flatter and more reliable than a conventional step splice while retaining a much higher level of longitudinal tensile strength. Another reason for the increased reliability is that in dynamically stressed conditions (when the belt is working under load) it is vastly superior in terms of resistance to dynamic failure.

Best advice: Hot vulcanisation, especially when used to create a finger-splice joint, produces a stronger, longer lasting and more durable joint that is often needed for the heavier duty applications commonly found in mines and quarries.

AUTHOR

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