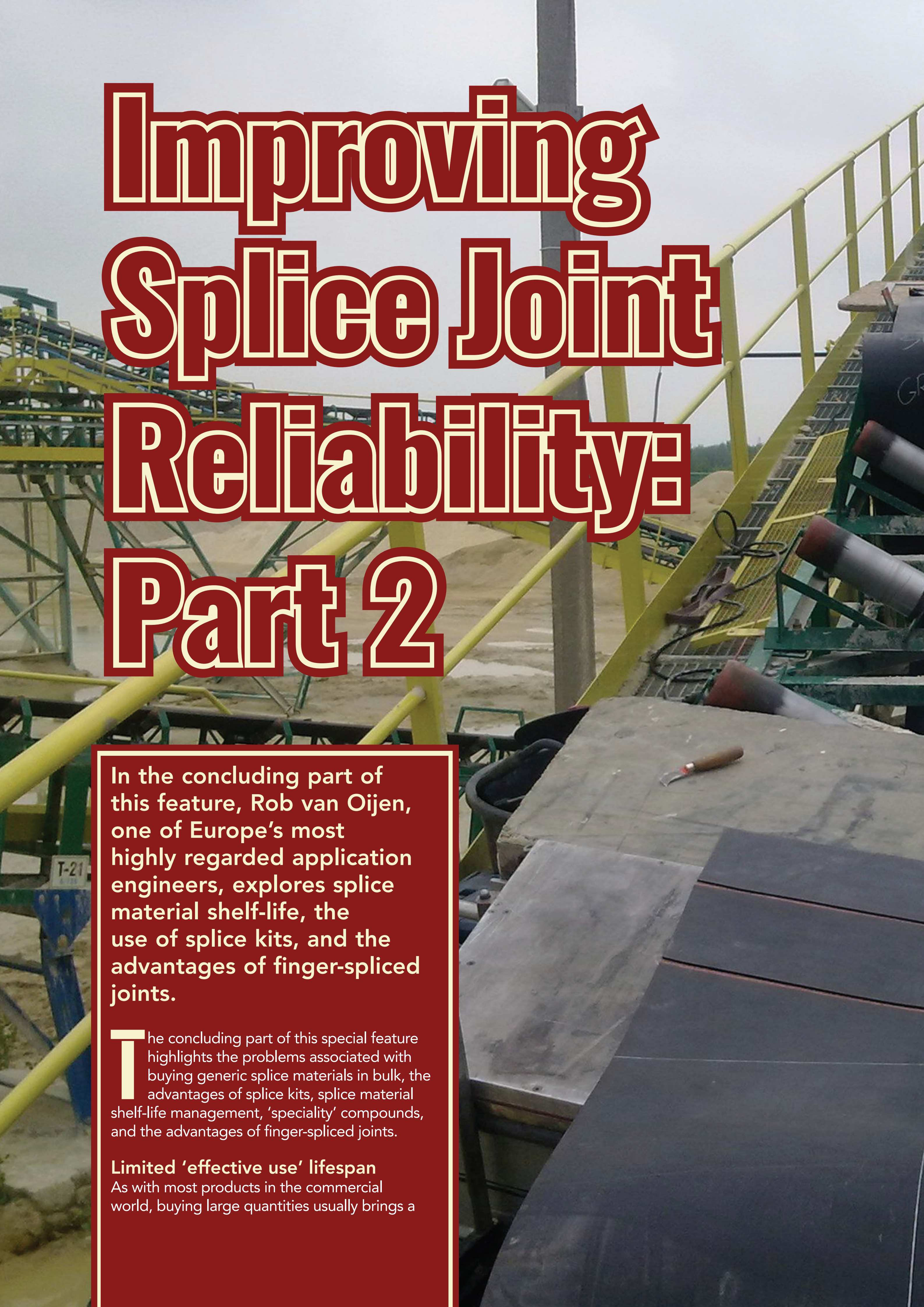

Improving Splice Joint Reliability: Part 2

In the concluding part of this feature, Rob van Oijen, one of Europe's most highly regarded application engineers, explores splice material shelf-life, the use of splice kits, and the advantages of finger-spliced joints.

The concluding part of this special feature highlights the problems associated with buying generic splice materials in bulk, the advantages of splice kits, splice material shelf-life management, 'speciality' compounds, and the advantages of finger-spliced joints.

Limited 'effective use' lifespan

As with most products in the commercial world, buying large quantities usually brings a

price benefit. The other advantages are avoiding the need for frequent repeat orders and, even more importantly, ensuring adequate stock levels. The downside of buying large quantities is that there are several different 'task-specific' materials and each has an individual restriction regarding its functional lifetime (shelf-life), after which the effectiveness of the material begins to decline, in some cases very rapidly indeed.

Unfortunately, there are no standard guidelines, it is just a matter 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.

Figure 1. Shelf-life largely depends on what is in the mix.

Figure 2. Rubber splice materials should have equivalent resistance to fire, oil, or heat.

Figure 3. Splice kits are invaluable for special cover grades.

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 do 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.

As with the food products, splicing materials need to be stored according to the recommended conditions shown on the packaging (especially temperature) and should not be used once the use-by date has passed. To do so is a false economy and the first thing that suffers is the all-important adhesion properties.

'Task-specific' splice materials

As explained in Part 1,* all splicing materials must be a compatible match to bond effectively with each other and have very similar mechanical properties and characteristics compared to the rubber compounds used to make the belt. The more specialised the belt grade, such as fire resistant for example, the more critical matching 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 more and more stoppages to carry out splice repairs. To avoid such problems, it is best to use splicing materials supplied by, or at least recommended by, the manufacturer of the belt.

Customised 'ready to use' splice kits

When splicing special cover-grade belts, such as oil-, fire-, or heat-resistant types, the most reliable method of ensuring that the splice materials closely match the belt rubber is to use a complete splicing kit produced or supplied by the belt manufacturer.

Such kits contain all the necessary materials including cover rubber, interply rubber, and rubber solutions (also called 'cement' by some suppliers). Kits are also available for different belt types including steel-reinforced and also pre-formed splicing kits for steel cord belting.

Ozone and ultraviolet resistance

Aside from the resistance that rubber compounds need to have against the different elements that damage and prematurely age the rubber, there is another form of resistance required that all rubber compounds must have, which is the ability to resist the effects of ground-level ozone (O_3) 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 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. The best advice is therefore to always insist on written confirmation that the splice materials purchased are fully resistant to the effects of ozone (O_3) and ultraviolet light (UV).

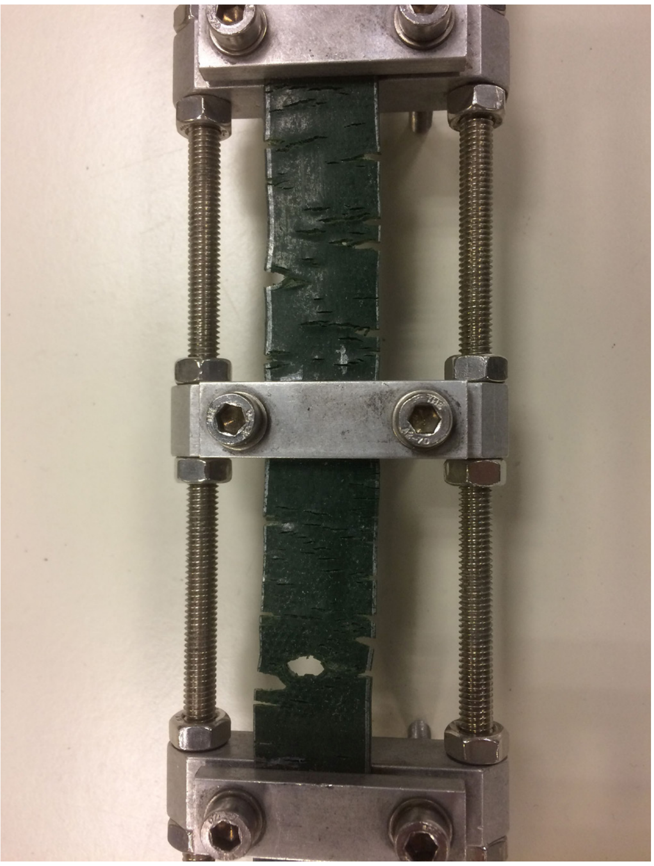

Figure 4. The damage caused by ozone and ultraviolet exposure is considerable.

Figure 5. A finger splice may take longer but is stronger and more reliable.

Bonding methods

There are a number of ways that multi-ply conveyor belts can be joined/spliced. The primary methods are cold-glue splicing, hot vulcanisation using a heated press, and mechanical joints, although these are principally used for emergency repairs or for extremely lightweight or inaccessible belt applications. Cold glue splicing is generally seen as the easiest, fastest (lowest cost?) method, although this is a false economy if cold splicing is carried out correctly; 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 a much quicker restart of the system, which can lead to early failure and need to repeat the process. Also, cold glue splicing is not an option when heat resistant belts are involved, as the glue would soften and separate with the temperature increase.

Hot vulcanisation using a mobile press requires handling and setting up the press, which takes some extra time and is therefore considered more costly. But in comparison to cold gluing, it produces a stronger, longer lasting, and more durable joint that is especially desirable on heavier duty applications. And when including the required cure time of cold glue, the whole process would not take any additional time.

Splicing methods – 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. Although easier and faster to make, the main disadvantage of a step splice is that it will always create a proportional loss of tensile strength equivalent to the strength of one ply.

By comparison, finger splicing is where a zigzag pattern is cut into both sides of the belt ends, creating several 'fingers' that are carefully aligned, interlocked together, and finally bonded using a hot vulcanising press to make a splice that is typically stronger and flatter than a conventional step splice while retaining a much higher level of longitudinal tensile strength.

As can be seen in Table 1, a 2-ply step splice only retains a maximum of 50% of the belt's longitudinal tensile strength, a 3-ply step joint can only achieve a maximum tensile strength of 67%. In contrast, the finger splice method retains up to 90% of the belt's 'static' tensile strength. Another reason for the increased reliability of the finger splice is that in dynamically stressed conditions (when the belt is working and under load) is that it is vastly superior in terms of resistance to dynamic failure.

How to improve splice joint reliability – the key points

- Use splicing materials supplied by (or recommended by) the manufacturer of the belt.
- Do not use incompatible and/or poor quality (cheap) splice materials.
- For cover grades such as oil-, fire-, and heat resistant, use splicing materials (preferably splicing kits) with matching properties - do NOT use generic, non-task specific materials.
- Make sure that each splice material component/kit has been stored correctly.
- Check the 'use-by' date on the packaging. Discarding and replacing costs much less than a failed splice joint.
- Insist on written confirmation that the splice materials purchased are fully resistant to the effects of ozone (O_3) and ultraviolet light (UV).
- Whenever possible, use finger-splice joints. ■

Notes

*For Part 1 of this two-part feature, see the May 2026 issue of *World Cement*.

Table 1. Maximum tensile strength by belt splice type.

No. of plies	Maximum % tensile strength
1	90%
2	50%
3	67%
4	75%
5	80%