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Tech Note
Technical Notes from the Technical Committee, NIBA – The Belting Association

#12 Conveyor Belt Repair Options

It is generally recognized in bulk materials conveying that optimum belt life has been achieved when belt cover and carcass wear out at about the same time. If a belt must be removed from service because of carcass breakdown or injury and much cover thickness is still in place, some of the cover life is wasted.

On the other hand, if a belt cover is worn through and the carcass is still intact, the remaining belt life will be foreshortened. Obtaining the obviously desirable maximum practical belt life depends on a number of factors, including among others:

- Belt design, specification and quality
- Conveyor design and engineering
- Conveyor accessories and their function
- Maintenance of the conveyor as a system.

In addition to the above factors, the scope and quality of **repairs** performed on a bulk materials handling belt will affect its life expectancy.

It is a relatively rare bulk materials handling belt that is installed and run to optimum wear-out without having some sort of repairs made to it. Thus a belt that is simply run without regard for necessary repairs most likely will have to be removed from service well before its maximum potential life is expended.

Belt Repair As An Operations & Maintenance Strategy

From a business management viewpoint, a vital question regarding conveyor belt repairs will usually be... is this economically feasible? Is it an effective expenditure of funds?

Closer to the conveying task itself, those responsible will ask... are these repairs the best way to keep us running? Cost is certainly a consideration but meeting a production schedule or other output pressures must enter into the judgment.

In the following pages, various aspects of the repair of conveyor belting will be reviewed including justification and techniques. At this point, however, it is evident that any rigid policy reflecting only the following three choices may lead to error:

- Always repair a damaged or worn belt
- Always discard a damaged or worn belt
- Always replace a belt when its turns x years old (or handles x million tons) regardless of its condition.

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Analyzing The Situation (As Time Allows)

The points below regarding a repair decision are interrelated in many situations. A general commentary follows:

How extensive is the damage?

Is replacement of the belt a better option?

How much time is available?

Is temporary repair feasible?

If a repair is preferable, what techniques should be used?

What supplies are available?

What personnel are available?

Are outside contractors available?

Are demurrage or other additional costs a consideration?

What insurance is applicable, if any?

Is there a materials handling bypass available?

How extensive is the damage? A small rip or tear along an edge or a small puncture, say up to 6" longitudinally, may pose little risk of spillage or snagging or enlargement; such minor damage can usually be left for repair at a scheduled down time. Comparatively widespread injuries, like edge fraying or cover scoring, may occupy hundreds or thousands of feet of belt yet not pose an operations hazard; again this type of injury could be left for repair at a scheduled down time.

Transverse and diagonal rips represent loss of essential strength and the tension forces normally carried by the damaged area are transferred to the adjacent section of the belt. If the width of the injury is great enough, the overstressed balance of the belt will yield producing total failure at that point. A common rule of thumb is that if no more than 25% of the belt width is involved, a repair is practical; when more than 25% of the width is damaged, a full resplice or saddle section insertion is preferable.

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In many cases, a rip or tear is ragged or partly hidden under the belt cover. Its extent must be carefully determined when making a repair decision. Relatively localized injuries can be drastically enlarged by snagging of a loose flap or dangling cable in a steel cord belt. Repairing or at least anchoring such damages are imperative before resuming belt operations.

Is replacement of the belt a better option? Belt size is often a determining factor in the repair or replace decision. Replacement obviously means the immediate or near term availability of a spare belt. Changeout time for a smaller (shorter) belt often can be less than needed for a major vulcanized repair. Therefore under such circumstances, the replacement choice is optimum. If a spare belt is not available, the time element in securing one versus the estimated repair time (assuming the present belt can be repaired) must be weighed.

Gross damages to a belt with major areas of ripping and tearing, or fire damage, for example, will obviously demand replacement of the belt or the affected sections.

Another factor when considering replacement of an injured belt is whether the belt is a good candidate for off-the-conveyor repairs. Will pushing the belt to provide a little more production right now reduce its potential repairability? The judgment in such a case is like deciding to drive another mile or two on a flat tire and thereby surely ruining it. Sometimes the age of the belt (or tire) makes the decision easier. If either is nearing the end of its normal useful life, trying to save it in the interest of further repairs just isn't necessary.

How much time is available? As implied in the foregoing questions, the time factor frequently affects belt repair decisions. Only a few fortunate conveyor operators don't have this as an acute decision--those with two conveyors. In the majority of cases, however, serious belt damage means taking corrective action as quickly as possible, not just diverting material flow to the adjacent conveyor.

Time constraints can take many forms, a few of which are: the need to fill a bunker, complete a production run or a work shift, or the loading/unloading of a train or a ship. In each instance, the interruption of operations will bring up the same questions: repair or replace the belt? Depending on specific circumstances, a major rescheduling of operations may become the only choice.

Is temporary repair feasible? One of the most unhappy things imaginable is to make a rushed repair in a broken belt, then restart the conveyor only to see the belt pull apart again. There certainly is a place for improvised or temporary belt repairs--many have proved successful in maintaining at least partial material flow until other arrangements can be made. On the other hand, an ill-conceived repair is just a waste of valuable time.

The most vital question in considering temporary belt repairs is usually whether or not the tensile strength of the belt carcass can be restored or bridged sufficiently at the point of injury to withstand the drive and take-up forces.

If the nature of the damage will not permit this with some assurance of success, the belt should be completely respliced or have a repair section (saddle) spliced in at the point of injury.

Temporary repairs of the type referred to above would include some form of mending with metal fasteners or a scab overlay held in place with fasteners or elevator bolts. Such temporary repairs are usually employed in conjunction with a reduction of the belt feed rate to lessen effective belt tension.

Gross carcass damages over extensive areas of the belt would obviously limit the feasibility of temporary repairs and make replacement of all or major sections of the belt a preferable remedy.

Although not an all-inclusive list, two other aspects of temporary belt repairs are commonly encountered:

Longitudinal Rips: Both the carcass and steel cord belt rips are often repaired with metal fasteners. Set transverse to the belt width and placed on 6", 12" or greater spacings, the fasteners will reduce spillage and hold the belt together for days, weeks, or even months of additional service. (One absolute caution regarding metal fasteners is that they simply cannot be used to repair transverse breaks in steel cord belting.)

Cover Repairs: When a significant area of cover loss occurs and the underlying carcass is still intact, temporary coating or sealing of the exposed carcass fabric or cables is usually worthwhile. Even if no later vulcanized repairs are to be carried out, repeated coatings with various sealers will generally provide some additional useful belt life.

If a repair is preferable, what techniques should be used? In most cases belt repairs will be one of three types: vulcanized, metal fasteners or cold cure. Each of these are covered below with their application methods (see Types of Belt Repair, Page 5).

What supplies are available?
What personnel are available?
Are outside contractors available? These questions come under the general heading of maintenance planning. Any operator of even the most elemental belt conveyor system should give some advance consideration to the possibility of belt damage occurring, and usually under the most disadvantageous circumstances. Some suggestions under each topic are as follows:

Supplies: The most common and often the most effective supplies for basic belt repairs are metal fasteners and their application tools. Even a single belt conveyor operation should maintain enough fastener inventory to do one or two resplices. This will also be suitable for basic rip or tear repairs. Larger operations with multiple conveyors can scale up quantities proportionately.

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Less vital, but certainly worthwhile, is a supply of self-curing liquid sealer. These can provide a good temporary coating of exposed carcass fabric. Several easy to use one-part styles are available and they have good shelf life in unopened cans.

Personnel: The first line of defense for basic belt repairs is the conveyor operator or maintenance person. He or she should be familiar with the use of metal fasteners and coatings as applicable to their particular types of belting. Only an hour or two training is required for fundamental know-how of the fasteners and coatings.

Outside Contractors: In many areas, contractor specialists in belting repair are available on short notice. If not already established, some communication with such a firm is recommended. In addition to basic belt repair capability, the contractor specialist often can provide equipment for complete belt changeout operations, belt saddle sections, off-premises belt rebuilding facilities, and personnel experienced in coping with all types of belt conveyor breakdowns.

Are demurrage or other additional costs a consideration? This topic is related to the time availability discussed previously. Downtime devoted to belt repair or replacement will usually affect production rates, manpower deployment, and other internal matters. When demurrage or other overriding penalties enter the picture, the repair judgment may change.

One of the more likely changes may be the decision to use outside repair contractors who can reduce the net downtime. This might involve greater expense than doing the repair or replacement with in-house personnel only. There is no fixed formula for such matters and each situation must be evaluated on its particular circumstances.

What insurance is applicable, if any? Certain types of bulk materials handling projects or contracts may have specific insurance provisions that can influence repair or replace decisions. The most common of these incorporate protection for the conveyor operator against major tramp material damage to the belt.

In simplest terms, such a contract may specify size, density, heat level and other characteristics of the material to be delivered to the conveyor system. If an unintended destructive item such as a stump, rail, plate, crowbar, etc. comes through in a manner that damages the belt, the insurance policy may compensate for the belt repair or replacement.

If insurance coverage is a consideration, one of the principal functions during the repair operations is to record the nature and cause of the damage. This would include for example, photographs, witness accounts, tramp material samples, damaged belt section, etc.

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Is there a materials handling bypass available? An additional factor in judging a repair or replace situation for a damaged belt concerns alternate means of delivering the materials. If material flow can be at least partially maintained, this will provide extra time for belt changeout if that is necessary, or more extensive belt repairs, as appropriate.

Alternate materials handling methods might consist of truck haulage, train or barge haulage, a portable conveyor set-up, or a combination of these. Alternate haulage methods can also be valuable in handling other non-belt related conveyor problems.

TYPES OF BELT REPAIR

Vulcanized Repairs are the closest match to the original belt manufacturing procedures employed at the factory. Using the vulcanization process, damaged or missing sections of cover or carcass can be replaced with little sacrifice of belt strength. The key to vulcanized repairs is restoration of damaged cover or carcass areas in a carefully trimmed, cleaned, and rematched fashion. Figures 9-1 and 9-2 illustrate the removal of cover damage. After cleaning and cementing, new uncured cover rubber is inserted per Figure 9-3. The repair is then cured by means of heat and pressure producing a result (Figure 9-4) that is nearly imperceptible after the belt is returned to service.

Figures 9-5 through 9-10 show the essentials of carcass puncture or fracture repair. Figures 9-11 through 9-14 illustrate edge repairs. Figures 8-26 and 8-27 cover the repair of broken cables in a steel cord belt.

In all cases, the new uncured rubber, whether cover stock or inside gum, adheres to both the virgin belt and the repair elements with adhesion values nearly equal to the original factory specifications. Thus, the strength and durability of vulcanized repairs.

Where belt damage is extensive or occupies more than about 25% of the overall belt width, vulcanized splicing or insert of a repair section (saddle) by means of two vulcanized splices is often preferable. Figures 4-14, 4-15, 4-20, 4-29, and 5-A highlight some of the fundamental steps in vulcanized splicing.

As is evident in the illustrations, vulcanized splices and repairs require special craftsmanship and equipment for best results. Vulcanized work is therefore done mostly by contractor specialists although a limited number of plants have equipped and trained their own personnel.

Metal Fastener Repairs represent a completely different principle in handling the problem of restoring damaged belting.

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To begin with, metal fasteners are often the only splicing method used in a wide variety of belt applications. Therefore, their suitability for repairs is well established. Metal fasteners used strictly for splicing can have many attachment formats including hooks, bolts, staples, and rivets. For most bulk materials handling belt repairs, however, the bolted plate type fastener is selected.

The advantages of the bolt type fasteners are that they're fundamentally simple to apply, they have good gripping and durability, and they can be installed relatively quickly. (Metal fasteners are not applicable to cover-only repairs.)

To obtain best repair results with bolted plate fasteners, they must be selected in the appropriate size for the belt in question and must be seated so as to grip the remaining strength area of the belt carcass adequately.

Illustrations BFG and FSL show some of the possible applications of metal fastener repairs. The window repair would ordinarily be considered a temporary repair for use only until a vulcanized repair or full resplice can be made. As noted previously regarding steel cord belting, metal fasteners can only be used for longitudinal breaks or splits--they will not grip properly for transverse or diagonal repairs.

Cold Cure Repairs are similar to hot vulcanized repairs in that the damaged belt components, cover or carcass, or both, are restored by inserting new materials. Instead of heat and pressure to accomplish vulcanization, the cold cure material depends on a chemical cure to achieve adhesion to the virgin belt.

Cold cure (or self-cure or chemical-cure) materials can include cover repair patches and strips, fabric ply materials and cements, and various putties and urethane fillers.

Illustrations 1 through 9 show cover patch-type repairs. As with hot vulcanized work, successful cold cure repairs require good craftsmanship. Cleanliness and dryness of the belt work area, as well as ambient temperature control, will affect results.

After the actual making of cold cure repairs, a time element is necessary for the chemical action to reach minimum useful strength, often four hours or more.