

Technical Article

Technical Article Content Pulled from the NIBA Belt Line Newsletter

Wear Resistance of Rubber Conveyor Belt

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One of the most important properties of a conveyor belt is cover wear resistance. As conveyor systems have improved qualitatively in recent years because of improved maintenance and alignment, premature or catastrophic failure has been reduced and gradual wear of the belt covers has become a more common reason for belt change out.

The key property of the cover compound is to protect the carcass from the material it conveys and the pulleys/idlers it comes in contact with. The first and more common type of wear is caused by the conveyed material rubbing against the rubber or thermoplastic cover. This is referred to as abrasion resistance where the belt covers tend to wear smoothly and evenly.

The type of material conveyed also affects wear. For example, coal is relatively non-abrasive whereas, in comparison, hard rock and taconite pellets wear covers extremely fast. The density of material, and speed of material being conveyed, also affects the wear rate, with heavier material and faster speeds increasing the wear rate.

A picture of pure abrasion wear failure mode is shown in Fig. 1, and a typical abrasive type of material is shown in Fig. 2. In Fig. 1, the belt has been worn down through the top cover and 3 plies.

The second and more aggressive type of abrasion is cutting and gouging where jagged or sharp surfaces from materials like limestone, granite, and ores, Fig. 3, will cut the belt cover and remove the cover in “chunks.” Typical appearance of the surface is shown below, Fig. 4.

THE FOLLOWING FACTORS AFFECT ABRASION RATE:

1. The faster the speed of the conveyor, the greater the wear. The material bounces and abrades in the loading zone until it gets up to the same speed as the belt. The higher the relative speed differential, the more wear will occur.
2. The shorter the center-to-center length of the system, the greater the wear. This is simply due to short cycle time. A 100-foot long conveyor traveling at 300 feet per minute will load material 54,000 times versus 5400 times for 1000-foot long conveyor running at the same speed. The 100-foot conveyor will wear out much quicker than 1000-foot conveyor.



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3. The higher the angle of incline at the loading point of the conveyor, the greater the wear. The higher angle makes it tougher for the material to get up to the speed of the belt (i.e., a 15-degree incline conveyor will wear faster than a flat conveyor).
4. The higher the angle of chute, the greater the wear. The more the material is being transferred to a conveyor belt in the horizontal direction instead of vertical, the less the wear. Therefore, a chute with a 30-degree angle to the horizontal will project the material at a greater horizontal velocity than a chute with a 90-degree angle, (i.e., a straight down drop), reducing the wear.
5. The higher the drop height, the greater the wear.
6. The higher the feed angle from one conveyor to the next, the greater the wear. This means that a conveyor belt that is fed inline from another conveyor will wear less than one that is being fed at a 90-degree angle. A conveyor feeding the next conveyor at 90 degrees will tend to put the material on the conveyor off center if nothing special is done with the loading.
7. Lowering the width of the chute opening will give higher wear in a localized area.
8. Scraper pressure on the belt is critical. Too loose and the material will not be removed from the cover. Too tight and the cover will get worn away significantly faster.
9. Frozen idlers, non-smooth pulleys, and trapped material in the pulleys will all cause belt wear.

THE FOLLOWING FACTORS PLAY A ROLE IN HIGHER CUT AND GOUGE RATE:

1. The higher the drop height, the greater the damage to the belt cover and carcass. When practical, installing bars in the crusher or chute to slow down the material will reduce the material speed and impact energy.
2. Loading fines onto the belt before the large diameter material will reduce impact damage dramatically. The fines absorb the high impact energy, protecting the belt cover.
3. Impact idlers reduce the amount of impact damage to a belt in comparison to impact beds (traditional beds with no give) because the belt has more room to deflect.

CURVED CHUTES

Curved chutes are engineered chutes that allow the material to come in contact with the belt at a matching speed, with minimal drop height and with less turbulence. Curved chutes minimize abrasion as well as cut/gouge and impact damage. Curved chutes may cost more than conventional chutes but help reduce wear and cut/gouge damage tremendously and will typically pay for themselves in a short time. Curved chutes are definitely recommended for new conveyors and for existing conveyors. Special material flow modeling



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techniques are used to design curved chutes, Figs. 5 and 6. Typically the chute is designed by consultant companies who have developed specialized software for studying the material flow inside the chute. With this software they can easily compare the effectiveness of one chute design against another. The customer should go through the exercise of cost versus the return to see if a specialized curved chute design can be justified.

HOW TO INCREASE THE BELT LIFE ON EXISTING CONVEYORS

- If chute modifications are possible, reduce the abrasion and cut/gouge rate. For example, reduce the impact by using a rock box thus lowering the drop height from 8 feet to 2 feet or direct the material flow towards the belt travel direction for a conveyor that is loaded by another conveyor at 90 degrees to the first.
- Increase the cover thickness by 1/16 inch when the cover is wearing out due to abrasion. Increase in wear life will outweigh the higher belt cost due to the extra rubber as wear rate increases as the cover gauge decreases.
- Different compound selection can also improve the cover wear. All compounds are not the same and each has unique properties. One of the most commonly used standards in rubber cover is RMA (Grade I and Grade II). RMA stands for Rubber Manufacturers Association.

RMA COVER GRADE TEST CRITERIA:

Compound	Minimum Tensile	Minimum Elongation
Grade I	2500 PSI	400%
Grade II	2000 PSI	400%

The RMA (Rubber Manufacturers Association) has established cover compound test criteria to help customers evaluate performance of various rubber compounds. RMA does not specify the abrasion characteristics.

The abrasion resistance is measured through the “DIN abrasion test method.” It is based on the German test method DIN53516 and also ISO4649 test methods A and B. The test involves preparing a “puck” of the cover and subjecting this sample to abrasion against a rotating drum covered with sandpaper. The sample is pushed against the drum with a specific force, the sandpaper is a specific type and the speed of the drum and number of revolutions are controlled. The sample is weighed before and after the test and the volume loss is calculated and expressed in cubic millimeters.

THE LOWER THE NUMBER OBTAINED THE BETTER THE ABRASION RESISTANCE.

If compound A has 100 DIN and compound B has 200 DIN, compound A will provide higher abrasion resistance than compound B.

- There are two ways to provide higher cut and gouge resistance. One of the ways is to select a different compound. All compounds don’t have the same ability to resist cuts/gouge. The general rule is that the higher the hardness of the cover compound, the better the cut and gouge resistance. The other way is to increase the



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top cover gauge. A higher top cover gauge gives better protection against the material digging into the top cover. To select the best compound for your application consult your belt manufacturer or their brochure.

THE BOTTOM LINE: Belt wear costs you money! Do whatever you can to minimize belt wear in your operations.