

# CONTROL THE PROCESS

THE BEST IN BULK MATERIAL HANDLING

**CONTROL**  
SYSTEMS TECHNOLOGY

PRINT POST APPROVED PP1000008185

OFFICIAL  
MEDIA  
PARTNERS



AUSTMINE



AusIMM

SERVING THE MINING INDUSTRY SINCE 1908



# ANALYSING CONVEYOR BELT WEAR

MARTIN ENGINEERING BREAKS DOWN THE EFFECT OF RAW CARGO AND CLEANERS ON BELT CONVEYOR HEALTH.

**M**ost conveyor belts in quarries and on mine sites are considered operating in “severe duty” and typically don’t just wear out.

The fact they’re exposed to raw material and punishing weather conditions means they more often experience a shortened life from catastrophic events, whether it’s significant impact, splice failure or piercing damage. Or they suffer from chronic issues such as mis-tracking or frozen idlers.

In addition to correcting such problems to extend belt life, a concern to many bulk material handling operations is the damage from loading, belt wear from cleaning devices, and the difficulty of cleaning damaged belts.

## Belt wear from loading

Since the belt is a major financial element in the process of conveying bulk materials, much attention is focused on reducing wear and damage.

In general, loading wear occurs over a long period from the discharge of material onto the belt and from contact with conveyor components such as idlers and belt cleaners. Belt wear from loading includes impact damage and frictional wear.



ENGINEERED CHUTES CONTROL CARGO FLOW ON THE RECEIVING BELT TO AVOID OVER SHIFTING AND MIS-TRACKING

Damage to the belt can be a single event, such as from tramp metals or oversized lumps in the material flow stream. This type of sudden damage can result in catastrophic failure that requires immediate attention in the form of a system shutdown.

The negative effects of long-term wear are less dramatic, and replacement can generally be scheduled for planned outages to avoid affecting conveyor availability.

One key to understanding belt wear from loading is the chute. The development of discrete element modelling (DEM) as applied to conveyor loading chutes has given the industry a valuable tool for verifying chute designs and predicting conveyor belt wear.

The primary objectives of chute design are to direct an uninterrupted flow of the bulk solid from the chute to the receiving belt, centred

in the direction of belt travel and as close as possible to the speed of the receiving belt.

While the interaction between the belt and the bulk material is complex, troubleshooting belt wear caused by chute design can generally take advantage of some simple relationships. The first is the relationship between material impact angles and the wear rate of rubber.

Figure 1 shows that as the impact angle increases, the wear generally decreases.

The second fundamental principal that can be applied to chute design to minimise belt wear is the speed of the bulk material stream, which is affected by friction and acceleration due to gravity as the load falls to the belt.

The coefficients of friction between the bulk material, chute and belt are important parameters that are utilised in DEM programs to optimise the shape of the chute, producing the desired exit velocity and direction of the discharged bulk material.

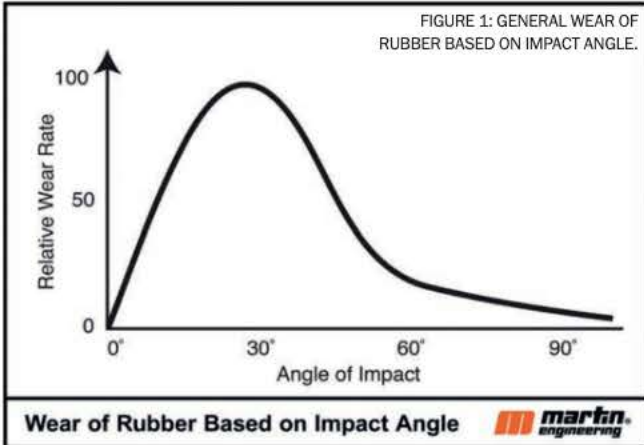
Common chute configurations include rock boxes, inclined flat chutes and curved chutes (as shown in Figure 2).

Other factors to consider when designing the optimum chute for a given application include drop height and preferred liner materials. However, belt wear from the choice of chute design is generally greatest with rock boxes, which do little to slow the material’s velocity and introduce a large amount of disruption as the load cascades from one shelf to the next,



PROPERLY POSITIONED AND TENSIONED CLEANERS MITIGATE BELT WEAR ISSUES COMMONLY ASSOCIATED WITH CLEANERS.





then lands on the moving belt at a near-perpendicular angle.

Flat inclined chutes help shift the load in the general direction of the receiving belt's travel but, depending on the drop height, can involve even greater impacts than a rock box. The violent landing takes a constant toll on the belt, often creating significant fugitive material in the form of dust and spillage.

Belt wear from loading impact is generally minimised when using curved chute designs, as the bulk material stream's velocity can be most closely matched to that of the belt with curved chutes.

Figure 2 is a generalisation, but it shows that the exit velocity of a curved chute is the lowest of the three design choices. This is due in part to the force resulting from the curved chute, which tends to reduce the impact velocity relative to a flat chute, even if the basic discharge angles are similar.

Rock boxes may reduce chute liner wear but can create significant belt wear due to high vertical velocity and the resulting shearing action between the bulk material and the belt as the load gets up to belt speed.

While belt wear is the main concern, attention should be paid to the selection

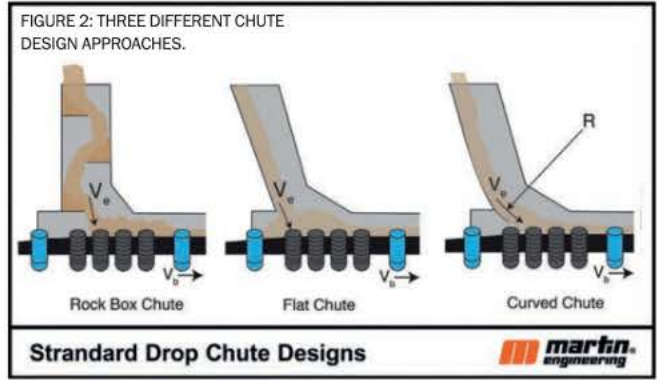
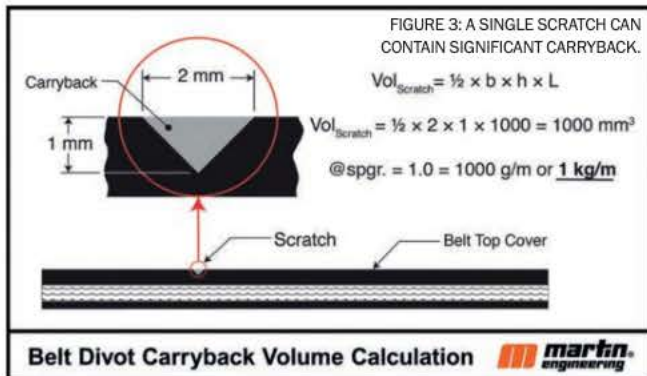
of liners to prolong chute life. Given the relative cost of the belt compared to the chute in most applications, wear liners should be considered sacrificial components and attention is better spent on improving chute design, selecting lower friction liners and making the liners easier and quicker to change.

For example, some manufacturers have engineered new designs for liners that can be serviced from outside the chute, eliminating the need for confined space entry and drastically reducing replacement time.

**Cleaning damaged belts**

Cleaning efficiency is related to the material properties extracted from the mine, the number of belt cleaners, the mechanics of a particular belt cleaner design, and the belt surface, among other variables.

It's a common expectation that a conveyor belt can be cleaned with an efficiency approaching 100 per cent, but even a new belt has macro and micro defects that make cleaning at this level practically impossible. These imperfections can result in as much as 60 grams per square metre (g/m<sup>2</sup>) of carryback passing a belt cleaner station with a new belt.



When the belt surface is damaged, the amount of carryback that can be shielded from belt cleaning in scratches and gouges can be even more significant, in the order of 100–200g/m<sup>2</sup>.

Figure 3 shows how much carryback can be contained in a single scratch measuring 2mm wide and 1mm deep in the belt top cover.

The US Mine Safety and Health Administration estimates that 85 per cent of all conveyor problems – including wear – come from fugitive materials, which escape the conveyor other than at the discharge, including spillage, dust and carryback.

Since carryback is a significant source of fugitive materials, it makes sense to focus on adequate belt cleaning. Cleaning damaged belts is best accomplished using water in combination with mechanical scrapers.

In severe cases, brush cleaners are effective in removing material from damages such as skirtboard grooves, but these cleaners require more frequent adjustment and replacement than mechanical scrapers.

With a belt in good condition and professional maintenance, a belt cleaning station can usually control carryback to within 10–100g/m<sup>2</sup>.

The seventh edition of the Conveyor Equipment Manufacturers Association's 'Belt conveyors for bulk materials' has established a system for rating the difficulty of the belt cleaning application and for desired levels of carryback exiting a cleaning station to aid users in specifying belt cleaning performance, rather than making decisions based on brand preference or price alone.

