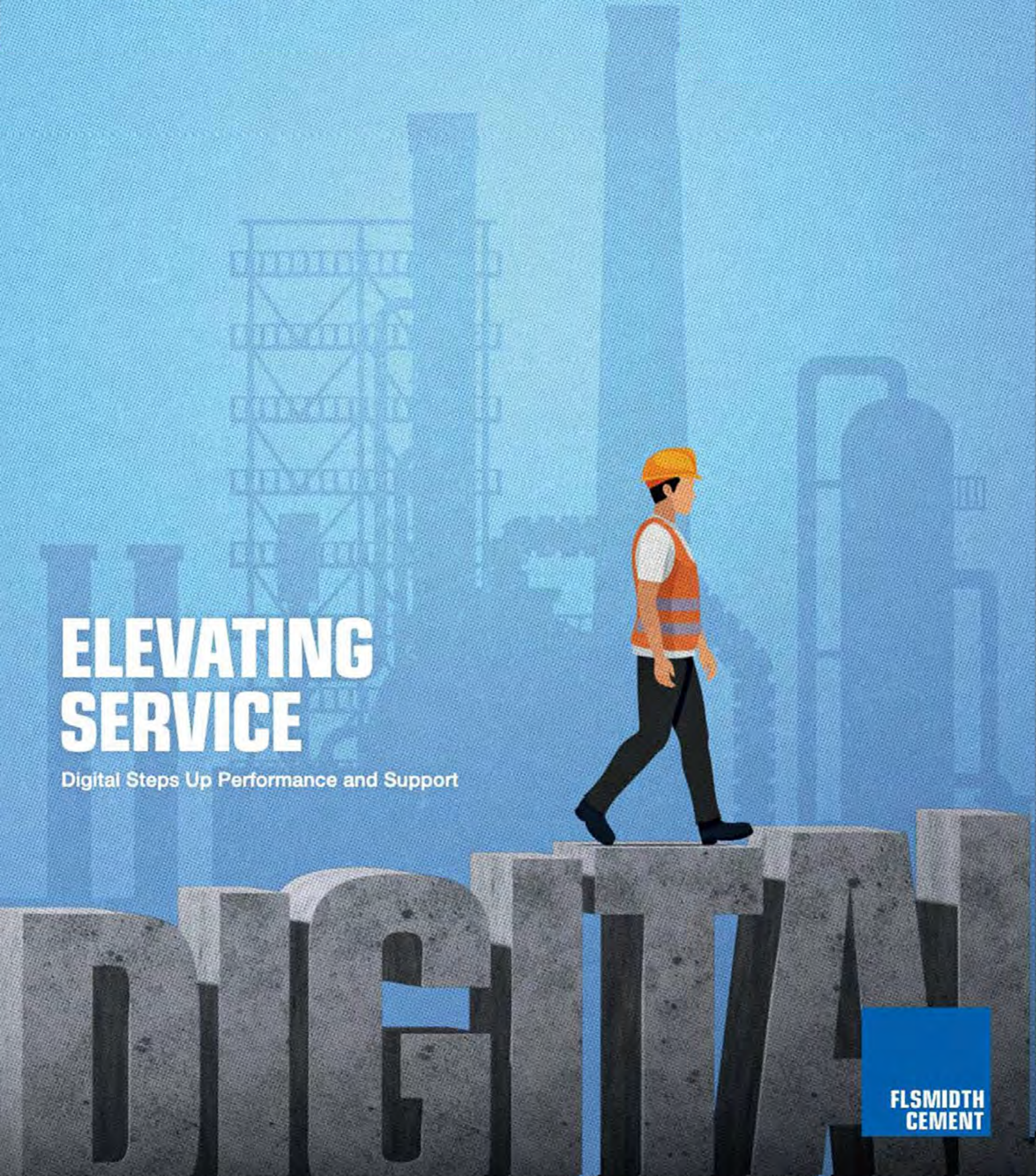
WORLD CEMENT

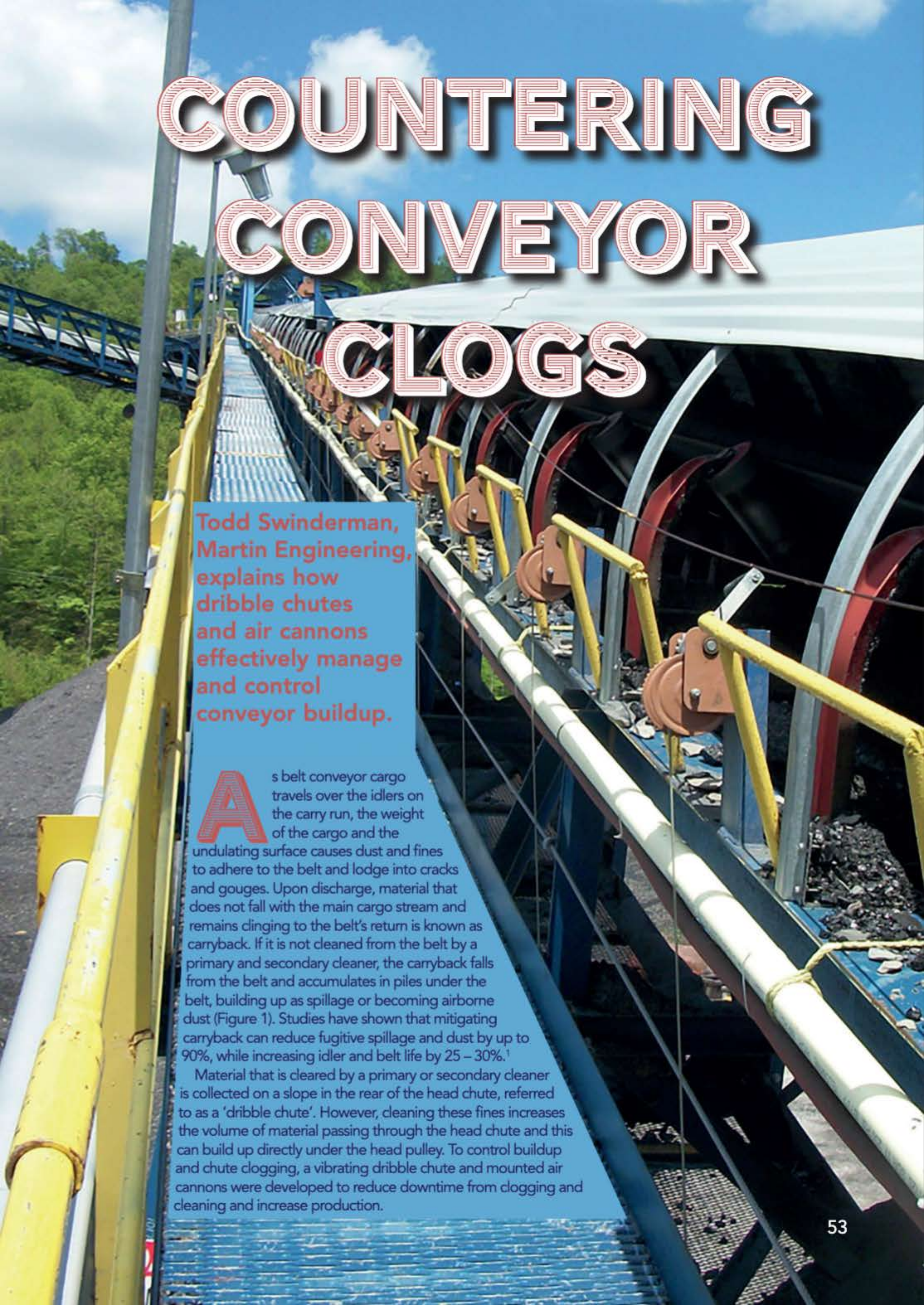
November 2024

ELEVATING SERVICE

Digital Steps Up Performance and Support



FLSMIDTH CEMENT



COUNTERING CONVEYOR CLOGS

Todd Swinderman, Martin Engineering, explains how dribble chutes and air cannons effectively manage and control conveyor buildup.

As belt conveyor cargo travels over the idlers on the carry run, the weight of the cargo and the undulating surface causes dust and fines to adhere to the belt and lodge into cracks and gouges. Upon discharge, material that does not fall with the main cargo stream and remains clinging to the belt's return is known as carryback. If it is not cleaned from the belt by a primary and secondary cleaner, the carryback falls from the belt and accumulates in piles under the belt, building up as spillage or becoming airborne dust (Figure 1). Studies have shown that mitigating carryback can reduce fugitive spillage and dust by up to 90%, while increasing idler and belt life by 25 – 30%.[1]

Material that is cleared by a primary or secondary cleaner is collected on a slope in the rear of the head chute, referred to as a 'dribble chute'. However, cleaning these fines increases the volume of material passing through the head chute and this can build up directly under the head pulley. To control buildup and chute clogging, a vibrating dribble chute and mounted air cannons were developed to reduce downtime from clogging and cleaning and increase production.

A clean belt is an efficient belt

If a belt has no cleaners, operators should expect to add labour to their budgets to clean spillage and replace fouled components from excessive dust and carryback. When spillage is left to build up, the belt rides on the dried pile of abrasive material, which prematurely erodes the belt covers and damages the unprotected return, resulting in a lower belt life (Figure 2). Further down the return path, carryback can foul rollers and spill into walkways, requiring regular maintenance to retain efficiency and uphold adequate workplace safety standards.

Figure 1. Carryback dislodged from the belt by a return idler.

Figure 2. Inadequate cleaning leads to carryback build up and potential encapsulation.

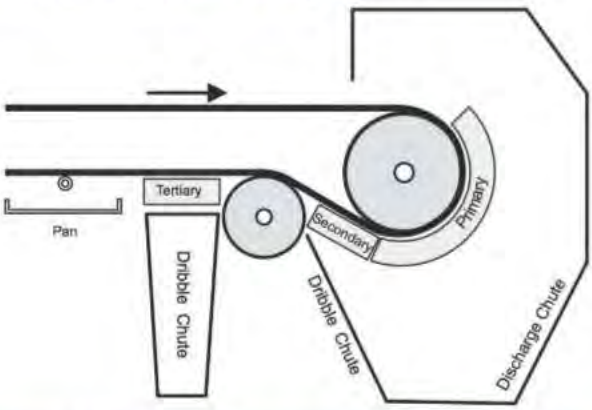


Figure 3. Discharge chute design depends on a series of factors including the application, space restrictions, head pulley size, and volume.

Without adequate cleaning, a belt in a heavy-duty dry bulk handling operation can carryback more than 0.5 t (0.45 t) of material per hour. The addition of just a primary cleaner will still experience carryback, leaving only an average of 0.02 lb/ft^2 (100 g/m^2) on the belt. Adding multiple cleaners can get the carryback level down to 0.01 – 0.004 lb/ft^2 (50 – 20 g/m^2) on the belt. Depending on the speed of the belt, length of the system and the space in which it is operating, this amount of average carryback would keep spillage levels sustainable and dust levels relatively compliant to workplace air quality regulations.

Using a high quality belt cleaning system drastically reduces carryback, dust and spillage, but also introduces a design dilemma resulting in faster build up on the dribble chute. Depending on the characteristics of the application, the design of the dribble chute is an important consideration. Material buildup on them requires addressing in order to maximise production efficiency.[2]

Some heavy-duty applications might require two primary cleaners and a secondary cleaner between the discharge and snub pulleys, which can create a lot of buildup. Due to space restrictions from a small head pulley, tertiary cleaners might be the only option, so designers recommend a vertical dribble chute. Vertical dribble chutes are also prone to buildup and clogging and are difficult to clean. If only a tertiary cleaner is allowed, catch pans are often used to gather carryback from idlers when the conveyor path crosses environmentally sensitive areas, roads or walkways (Figure 3).

Dribble chutes: catch or release?

Some methods of controlling carryback capture the material for cleanup, while others aid flow and release it back into the cargo stream. Capture systems, such as drip pans or catch pans, are often designed to be lowered or hinged, making cleanup faster. However, they still expose the workers to hazards, as large build ups can break loose during cleaning (Figure 4).

Instead of catch pans, some systems allow material to drop below the system and are cleared by drag chain or pusher conveyor. These can be effective in operations with larger aggregates, but may run into issues if loads are unbalanced or if moist fines are left to harden during downtime. Operators who use this method have reported that the extra power required to run these systems is costly, and that more labour is needed to keep systems functioning than they previously predicted.

The most basic flow aid is the use of water to saturate the discharge and keep it flowing onto the receiving belt. Although some applications can attribute silica content, magnetic properties and surface friction for buildup, moisture is a large factor in adhesion (buildup on surfaces) and cohesion (buildup of material upon itself). Most bulk solids begin to lose adhesion strength at 15% moisture, so not using enough water makes the carryback stickier. In contrast, oversaturation could cause problems since many processes cannot tolerate the addition of water.

One highly effective and field-proven method is installing a sloped chute with a low friction 'active' surface. A vibrating dribble chute is a vibrator attached to a floating low friction liner that makes the surface active, using vibration and gravity to move the material toward the discharge stream (Figure 5). In some cases, whole chutes can be isolated to make the applied vibration more effective.

Air cannons for transfer chutes

Air cannons have been demonstrated to be highly effective for aiding flow and eliminating the clogging of difficult materials in large chutes. The benefit of air cannons is that, when properly mounted, they dislodge material in typical buildup prone areas such as corners and low angle surfaces. Air cannons release pulses of compressed air to shear buildup from surfaces. They are simple devices with one moving part that only requires compressed air and a trigger method. The cannons can be discharged manually as needed or set to operate on a timed sequence (Figure 6).

The cannons are pointed in the direction of the cargo flow enabling consistent and

Figure 4. Hinged drip pans designed to be lowered with winches.

efficient production. Firing sequences are accomplished with a simple timer set at an interval based on the cycles of material flow. Intervals can be fine-tuned for fluctuations in humidity or freezing where clogging is more prevalent, or during changes in volume, material type or belt speed, when added flow aids are required. Adjustments to firing sequences are accomplished manually by a nearby solenoid box. They can also be routed to a centralised logistical system.

Another use of air cannons on dribble chutes is to angle the nozzle downward behind a heavy flexible curtain that ripples when the air cannon is fired, dislodging the adhered material from the surface. Ideally, the curtain would be made from a rubber material with a slick low-friction face that is easily replaceable once it is worn.

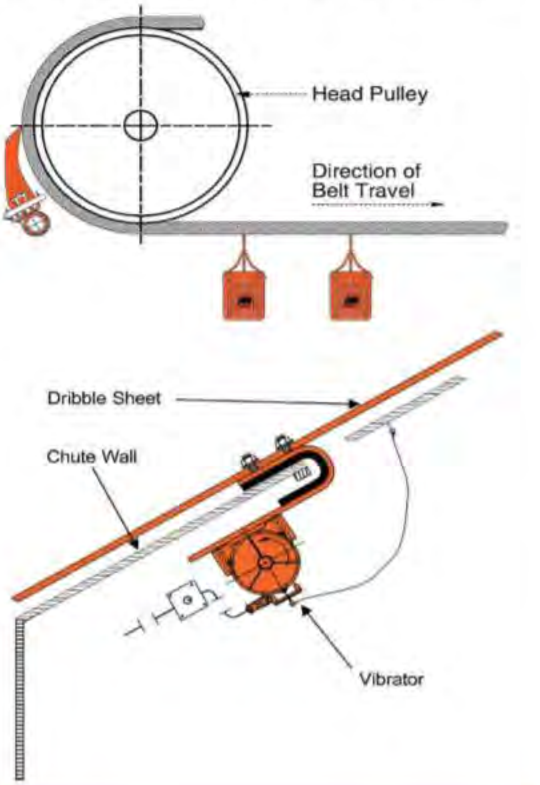


Figure 5. A vibrating dribble chute uses a low friction UHMW liner activated by rotary vibrator.

Figure 6. Air cannons prevent clogging and help direct the flow of material.

Conclusion

Problems associated with carryback, such as cleaning spillage, clearing buildups and unclogging chutes used to be considered a cost of doing business. For operators experiencing excessive buildup from carryback, labour costs and workplace safety concerns might require a review of the discharge zone design of their belt conveyors.

Over time, when calculating for labour and lost production, unplanned outages to manually clean spillage can justify the cost of a total discharge zone redesign. This includes a larger head pulley, the adequate number of cleaners for the application, and a complete transfer chute configuration with flow aids. Using proven flow technology – like a vibrating dribble chute and air cannons working in combination – will promote more uptime and greater production. ■

References

1. SWINDERMAN, R. T., STAHURA SR., R, P., MARSHALL, D., et al., 'FOUNDATIONS – The Practical Resource for Cleaner, Safer, More Productive Dust & Material Control; Fourth Edition', (2009). p. 197.

2. SWINDERMAN, R. T., STAHURA SR., RICHARD P., MARSHALL, D., et al., 'FOUNDATIONS – The Practical Resource for Cleaner, Safer, More Productive Dust & Material Control; Fourth Edition', (2009). p. 227.

3. SWINDERMAN, R. T., 'Dribble Chutes, Video Tutorial', – https://foundations.martin-eng.com/en-us/webinars-on-demand#carryback&beltcleaning

About the author

R. Todd Swinderman earned his B.S. from the University of Illinois, joining Martin Engineering's Conveyor Products division in 1979 and subsequently serving as V.P. and General Manager, President, CEO and Chief Technology Officer. Todd has authored dozens of articles and papers, presenting at conferences and customer facilities around the world and holding more than 140 active patents. He served as President of the Conveyor Equipment Manufacturers' Association (CEMA) and was the editor of CEMA's 6th and 7th editions of Belt Conveyors for Bulk Materials, The Design Guide for Belt Conveyors. Todd is active on several CEMA committees including Chair of the Bulk Safety Committee and is a member of the ASME B20 committee on conveyor safety which set US conveyor safety standards. Swinderman retired from Martin Engineering to establish his own engineering firm, currently serving the company as an independent consultant.