AUSTRALIAN
BULK HANDLING REVIEW
www.bulkhandlingreview.com
VOLUME 29, ISSUE 2 | MARCH/APRIL 2024

In this issue:
Conveyor components fetaure
The need for a revised AS 3774
3D-printed engineering

TOOLS TO FEED THE WORLD

The team at HE Silos Forbes have travelled the world and seen first-hand the heartbreaking effects of famine. The company's ultimate goal is to create a world without hunger. *ABHR* learns about the vision and how the company's roadmap is helping achieve this mission.

For the full story, see page 18

Image: Martin Engineering

This quarry hopper directs material to a conveyor while the air cannons support flow and prevent clogging.

Total discharge: Clean belt, clear chute

Dan Marshall, a process engineer at Martin Engineering, explores how conveyor components can mitigate the spillage, dust, and flow issues associated with material discharge and belt cleaning.

SUGGESTING THE "total discharge" of cargo from a conveyor belt in any bulk handling application is enough to make operators and maintenance staff chuckl . In the dirty and punishing atmosphere of bulk handling, there are no absolutes.

Spillage, carryback, chute clogging and fugitive dust emissions obstruct walkways, foul rolling components, cause unscheduled downtime and degrade air quality, but they don't have to. Manufacturers of innovative equipment solutions are always striving to improve workplace safety and production effic ncy by eliminating the causes as much as possible.

Following the installation of modern belt cleaning technology, operators realise that the volume of material entering the transfer chute grows exponentially, rather than piling around the discharge zone. This greater volume can lead to blockages in the transfer chute followed by downtime to unclog it.

However, designers can take a holistic approach and engineer an effic nt discharge transfer point with components that work together. This approach strives to make equipment last between scheduled closures, improves safety by minimising maintenance, and addresses the causes of ineffic ncy.

Signs of inefficiency at a discharge zone

The discharge zone starts at the last troughed idler before the conveyor belt flatt ns and encounters the head pulley. Cargo falls from the conveyor into a transfer 'drop' chute that can lead to several places including another conveyor, a storage silo/pile, or a transport vehicle. The primary cleaner is located after the discharge stream to clear any adhered material caused by the weight or characteristics of the cargo (moisture, cohesion, or heat). A secondary cleaner clears dust and fin s from divots and cracks in the belt. Material cleared from the secondary

cleaner is generally directed to a sloped surface connected to the transfer chute.

Obvious signs of discharge ineffic ncy are spillage, carryback, chute clogging and dust. Alone, each can lead to a workplace safety violation, together they result in unscheduled downtime and an increased cost of operation. From an operational standpoint, three of the most expensive consequences are workplace injuries, belt damage from friction and fouled equipment replacement.

Spillage and safety

Primary cleaners or 'scrapers' can fail in several ways, causing adhered coarse aggregate and caked fin s to pass by the blade and spill around the discharge area. This fugitive material can build up quickly and encapsulate the belt, fouling rolling components and causing the belt to ride on top of the course pile, leading to serious belt damage and increased belt temperatures from friction.

Fugitive material spills into walkways, obstructs access for maintenance and creates a trip and fall hazard. When course grit fouls rollers it causes them to freeze, leading to friction and high-heat damage to the vulnerable return side of the belt, lowering the equipment's life. To avoid belt fir s and dust explosions, seized idlers/rollers should be maintained and changed right away, which makes clear access to the system imperative.

Cleaning spillage can be costly, divert staff from oth r essential duties, and become a workplace safety issue if workers are clearing material around a running belt. What may seem like a routine job in the beginning, clearing spillage by either shoveling it back into the cargo stream or into bins, requires more labour as time goes on and the problem worsens. Clearing material using machinery (front loaders, industrial vacuums, etc.) can result in accidental contact with the stringer or supports, potentially leading to belt mistracking.

Mistracking can be a major cause of spillage, not just along the belt path, but at the discharge point as well. The blade is centered on the head pulley, but if the belt is not, adhered material becomes spillage.

Recommendation: Install a belt tracker three to four times the width of the belt prior to the head pulley the head pulley as the trough angle flatt ns to ensure the belt hits the head pulley in the centre.

Over-/under-tensioning and/or extending blade changes for too long can also cause spillage. Over-tensioning causes rapid wear on the belt/splice and lower blade life. Under-tensioning allows material to pass without being removed. Allowing primary cleaners to go too long can result in pull-through, where the force of the belt causes the blade to face the opposite direction and, in some cases, break off

Recommendation: Enter a service agreement with the blade manufacturer to regularly monitor, tension, and change the blades as needed. Consider installing a modern assembly that allows workers to slide units from the stringer for fast and easy one-person blade changes. There is also the option of innovative cleaner technology with four times the life of the normal primary blade and needs no tensioning.

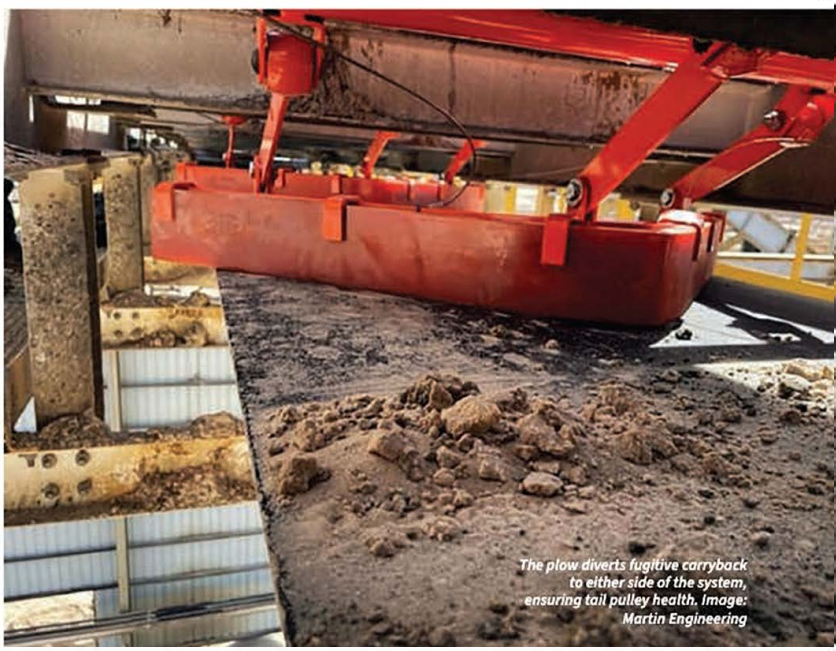
Reducing carryback

Anything that clings onto the return side of the belt and travels with it is considered carryback, which can seriously damage a system. Not only is it a major source of fugitive dust and fi es, but it migrates easily into return rollers and takeup pulleys, fouling the bearings, drives and the face of the roller. The grit grinds down roller bearings and leads to excessive friction heat, causing them to misshapen and seize.

Like spillage, carryback can migrate to the non-carrying underside of the belt. These chunks travel all the way to the tail pulley. The intense pressure between the pulley and the belt causes the hard sharp mass to damage the vulnerable side of the belt and the pulley face, cycling over and over, delivering more damage as it does. Along with lowering the life of the belt, dust and fin s can get into these blemishes and foul the pulley face.

When a roller or pulley face becomes fouled, it is caked with abrasive grit that can degrade and damage the belting over time. In some cases, fouling causes slippage which can disrupt the smooth operation of the belt and promote mistracking.

Recommendation: If there is adequate space, install secondary and tertiary cleaners to ensure the belt is absolutely clean on the return. To improve safety,



The plow diverts fugitive carryback to either side of the system, ensuring tail pulley health. Image: Martin Engineering

Innovative cleaner designs require less monitoring and no tensioning. Image: Martin Engineering

consider units that allow a single worker to pull them away from the stringer for faster external servicing. Consider a diagonal or V-shaped plow placed underneath the loading zone right before the tail pulley that rides on the underside of the belt removing any loose traveling material. For more eff ctive cleaning and reduced friction damage, consider a plow with torsion arms rather than one held in place by chains. Install belt trackers or crown rollers along the upper and low belt path to ensure alignment.

Safely addressing bulk handling clogs

A clogged transfer chute or hopper is one of the most dangerous situations in bulk handling. Untrained and uncertifi d (enclosed chute entry certification) p rsonnel should never enter a clogged chute or bin under any circumstances. A sudden discharge can be deadly as an unknown void engulfs and crushes a worker. Material adhered vertically to the sides can loosen and send a sheet of debris falling on anyone occupying the vessel.

Buildup points in chutes include:

- Rockboxes – shelves, even if they're sloped, can experience buildup.
- Exit gates or doors – as these help control flow, th y are also prone to clogging.
- Sloped points – under the secondary cleaner, chute grades, or located at choke points.
- Metal surface grain – the metal grain of chute plating should match the flo of cargo.
- Exposed surfaces – surfaces where moisture can collect and cause buildup.
- Damaged surfaces – surfaces that have scratching, denting, creasing, or divots.

Misguided practices for addressing buildup are banging on the sides of the hopper with a mallet or to loosen the obstruction by poking at it from below. In some operations, clogs are so frequent that spots for pounding are marked and mallets are left in the area for convenience. This is hazardous because it reduces the structural integrity of the vessel or chute, causing it to buckle. Ripple damage from pounding creates a situation where it is easier for material to build, shortening periods between clogs and leading to more unscheduled downtime. Poking from below is even more dangerous, since a sudden discharge sends tons of material in a surge that can injure anyone in the vicinity and break equipment below.

Recommendation: Air cannons strategically installed around the chute have nozzles pointed in the direction of the material flo . Powerful shots of air are distributed across the surface inside the vessel, dislodging material and preventing buildup. The air cannons are supported by vibration units that ensure gates and narrow spouts on hoppers and chutes retain proper flo before bridging starts. In many cases, vibration alone can handle most dry material flow but chan es in humidity raising the stickiness of cargo and chute surfaces, along with fluctuatio s in production volumes, are much better handled by air cannons.

Discharge dust

Emissions at the discharge zone can be found billowing out of the chute against the direction of the cargo stream or exiting the sides and bottom as it loosens from the belt's return side. Dust has become a highly regulated workplace and environmental concern which can lead to stiff es and potential forced downtime if high volumes of respirable crystalline silica (RCS) is detected.

RCS is found in nearly every substance pulled from the earth, but is prevalent in limestone, coal, clay, etc. Regulators measure fugitive particulate matter (PM) at the size of <10 microns mass (µm) in volumes of >50 micrograms (µg) per cubic meter (m3) over an eight-hour time weighted average (TWA). This is the volume and size determined to cause serious chronic lung issues in workers and it doesn't just apply to RCS, it is any PM.

Dust emissions returning from the chute can derive from uncontrolled airflo at the exit point. The emissions can also be caused by hitting rock boxes meant to slow the flo of material or an unobstructed impact causing turbulence.

Dust from carryback can permeate the area and spread emissions down the entire length of the belt return. If the belt reaches into a tower or is exposed to the outdoors, this causes dust to be carried long distances on air currents into nearby communities leading to possible violations. Studies have shown that dust can be controlled by adequate cleaning at the discharge using Levels 1-3. One is a primary cleaner, two a secondary cleaner, and level three a tertiary cleaner.

Recommendation: By reconfi uring the chute's exit into a sloping scoop, material can be slowed and loaded onto the next belt in a controlled and centered manner with less turbulence. Air cannons installed along the chute are pointed with the material stream and can help direct air flo .

Conclusion

Modern bulk handling industries are changing and growing every day. Demand for raw and processed materials for construction and manufacturing keep rising. Production increases can change throughput volumes and belt speeds, which have a direct effect on spilla e, carryback, clogging and dust.

Retroactively installing equipment that improves both safety and effic ncy should be a priority of any operator. Although the initial capital investment might be slightly higher, the benefit are not just in fewer injuries, but reduced labour costs for maintenance, less equipment replacements, greater compliance and an overall lower cost of operation.