DRY BULK®

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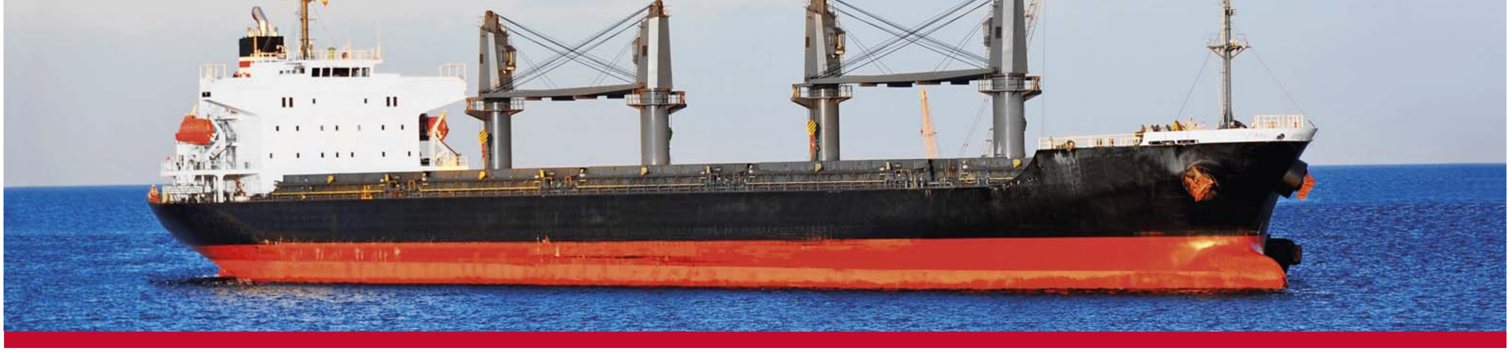

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ON THE COVER

Bedeschi SpA, founded in 1908, is a historical European company which specialises in the supply of turnkey solutions for bulk handling and port terminals. The company takes care of each step of the project execution, from the engineering phase to the assembly, installation and start-up.
On the cover picture are two SHL shipped fully erected to the Barcelona port terminal.

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CONVEYORS OF THE FUTURE

R. Todd Swinderman, Martin Engineering, USA, describes the key factors that must be considered when designing new conveying systems to transport bulk materials safely and cost-effectively.

Higher production demands across all bulk handling segments require increased efficiency at the lowest cost of operation, in the safest and most effective manner possible. As conveyor systems become wider, faster and longer, more energy output and more controlled throughput will be needed. Add an increasingly stringent regulatory environment, and cost-conscious plant managers must closely review which new equipment and design options align with their long-term goals for the best return on investment (ROI).

There are primarily two separate markets using conveyor belts. One is in process industries such as food, chemicals, paper and powders. Handled in relatively low volumes, the bulk materials that enter these processes are generally of a consistent size and quality. The other market comprises handling, mining and cement, where the bulk material's quality and size vary, and the volumes are typically much greater. While both segments face similar issues with safety and environmental control, the properties of the materials handled and the volumes transferred suggest different approaches, with one thing in common: increased belt speeds requiring modern equipment upgrades.

Safety at higher belt speeds

With companies recognising that safety does indeed pay, safety is likely to become a new source of cost reduction. The percentage of mines and processing facilities with a robust safety culture are likely to increase over the next 30 years to the point where it is the norm, not the exception. In most

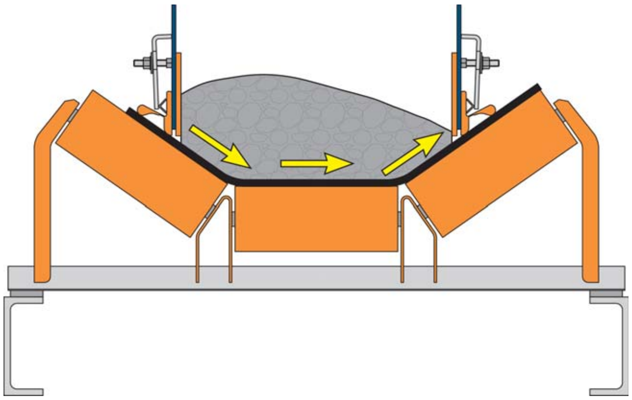

Figure 1. When the belt is not centre-loaded, the cargo weight pushes the belt toward the more lightly-loaded side.

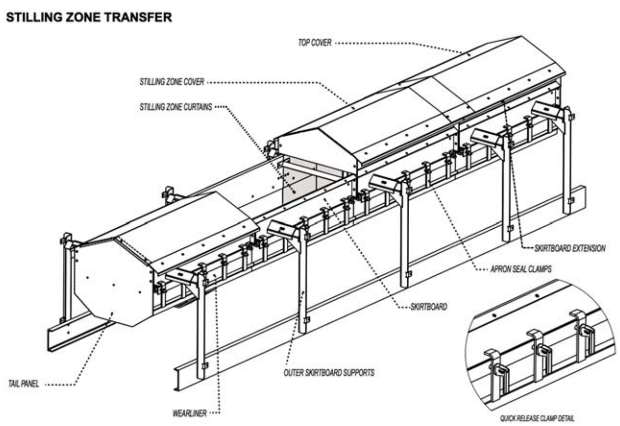

Figure 2. Safer stilling zones have many redesigned components intended to reduce labour for maintenance and clean-up.

cases, with only a marginal adjustment to the belt speed, operators quickly discover unanticipated problems in existing equipment and workplace safety. These problems are commonly indicated by the larger volume of spillage, increased dust emissions, belt misalignment and more frequent equipment wear/failures.

Higher volumes of cargo on the belt can produce more spillage and fugitive material around the system. This can pose a tripping hazard. According to the US Occupational Safety and Health Administration (OSHA), slips, trips and falls account for 15% of all workplace deaths and 25% of all workplace injury claims.[1] Moreover, higher belt speeds make pinch and sheer points on the conveyor more deadly, as reaction times are drastically reduced when a worker gets clothing, a tool or a limb caught from incidental contact.[2]

The faster the belt, the quicker the belt wanders and the harder it is for a belt tracker to compensate, leading to spillage along the entire belt path. Caused by uncentred cargo, seized idlers or other reasons, the belt can rapidly come into contact with the mainframe, shredding the edge and potentially causing a friction fire (Figure 1). Beyond the deadly workplace safety consequences, the belt can convey a fire throughout the facility at extremely high speeds.

Another workplace hazard, which is becoming progressively more regulated, is dust emissions. An increase in the volume of cargo means greater weight at higher belt speeds, causing more vibration on the system and leading to reduced air quality from dust. In addition, cleaning blade efficiency declines as volumes rise, causing more fugitive emissions during the belt's return. Abrasive particulates can foul rolling components and cause them to seize, raising the possibility of a friction fire and increasing maintenance costs and downtime. Furthermore, lower air quality can result in fines and forced stoppages by inspectors.

To sustain a low cost of operation, managers generally outfit systems with equipment graded for average speeds and volumes at the time of purchase. It is hard to predict exactly how existing equipment such as cleaners, trackers, idlers etc. will react to higher speeds and volumes. Maintenance, clean-up and equipment replacement is an unavoidable reality of production, and the increased cost of operation associated with the new output goals are typically the main factors used to justify the ROI for new, safer equipment.

Modern chute design

To drive down the cost per tonne of conveyed material, the mining sector is moving towards wider and faster troughed conveyor belts. Although flat belts are well-suited to high tonnage conveying, the traditional troughed design will likely remain a standard. With the push toward wider and higher speed belts, the industry will need substantial development in more reliable components, such as idlers, impact beds and chutes.

A major issue with most standard chute designs is that they are not engineered to manage modern production demands. Bulk material unloading from the transfer chute onto a fast-moving belt can shift and load off-centre, emitting dust well after leaving the settling zone. The result is spillage around the system and walkways, lower air quality and uneven cargo loads, leading to mistracking.

Modern transfer chute designs aid in centring material onto the belt in a well-sealed environment that maximises throughput, limits spillage, reduces fugitive dust and minimises common workplace injury hazards. Rather than material falling with high impact directly onto the belt, the cargo's descent is controlled to promote belt health and extend the life of the impact bed and idlers by limiting the force of the cargo at the loading zone. Reduced turbulence is easier on the wear liner and skirting and lowers the chance of fugitive material being caught between the skirt and belt, which can cause friction damage and belt fraying.

Longer and taller than previous designs, modular stilling zones allow cargo time to settle and easily accommodate future modifications. An external wear liner raises the walls of the chute, accommodating more space for air to slow, so dust settles more completely. The design also permits the liner to be changed from outside of the chute, rather than requiring dangerous chute entry as in previous designs. Chute covers with internal dust curtains control airflow down the length of the chute, allowing top-mounted dust bags to collect dust and deposit it back onto the belt. Dual skirting has a primary and secondary sealing strip in a two-sided single elastomer that helps prevent spillage and dust from escaping from the sides of the chute (Figure 2).

Figure 3. A single roller generator has enough power output to run an efficient autonomous system.

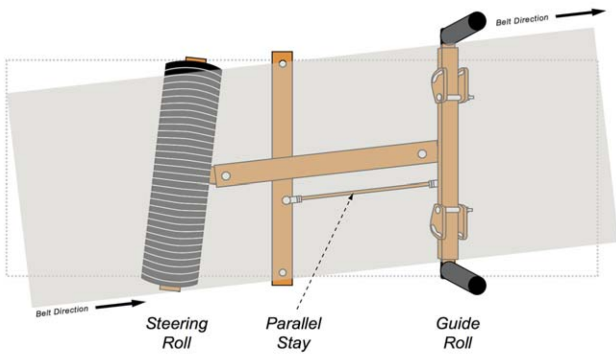

Figure 4. The pivoting ribbed roller design grabs the belt and uses the opposing force to train it back into alignment.

Figure 5. Mini generator attached to a roller producing power using the belt's movement.

Rethinking belt cleaning

Faster belt speeds can cause higher operating temperatures and increased degradation of cleaner blades. Larger volumes of cargo approaching at a high velocity hit primary blades with greater force, causing some designs to wear quickly, leading to more carryback and increased spillage and dust. Although manufacturers may reduce the cost of belt cleaners in an attempt to compensate for a lower equipment life, this is an unsustainable solution that does not eliminate the downtime associated with cleaner servicing and regular blade changes.

As some blade manufacturers struggle to keep up with changing production demands, industry leaders in conveyor solutions have reinvented the cleaner industry by offering heavy-duty engineered polyurethane blades made to order and cut onsite to ensure the freshest and longest lasting product. Using a twist, spring or pneumatic tensioner, the primary cleaners are forgiving to the belt and splice but are still highly effective for dislodging cargo. For the heaviest applications, one primary cleaner design features a matrix of tungsten carbide scrapers installed diagonally to form a 3D curve around the head pulley. Field service has determined that it typically delivers up to four times the service life of urethane cleaners, without ever needing re-tensioning.

High belt speeds can also cause adhered fines to pass the primary blade, so secondary scrapers using a spring tensioner offer enough tension to clear tacky fines that tend to cling to the belt and drop along the return. Even after passing a secondary cleaner, some finer materials can still remain lodged deep into cracks and divots in the belt, creating dust and spillage along the return. For operations with conveyor systems that pass over walkways or need extra cleaning due to combustible dust, a washbox cleaning system offers extra coverage by combining pressurised water spray and secondary cleaning blades in an enclosed and self-contained unit.

Taking cleaner technology into the future, the automated pneumatic tensioner increases blade life and belt health by removing blade contact with the belt at any time the conveyor is running empty. Additionally, it reduces labour for the constant monitoring and tensioning of blades to ensure peak performance. Connected to a compressed air system, pneumatic tensioners are equipped with sensors that detect when the belt no longer has cargo and automatically backs the blade away, minimising unnecessary wear to both the belt and cleaner. The result is consistently correct blade tension with reduced power demand on start-up, all managed without operator intervention.

Correcting misalignment before it happens

Older trackers react to drift and may not adequately correct the belt path before expensive edge damage or a friction fire occurs. Although there are several types of trackers, many systems merely have vertical edge guides that prevent the belt from hitting the mainframe, often causing the belt to curl in the process. Other systems only utilise shutdown switches that can lead to excessive and costly downtime.

As belts get longer and faster, modern tracking technology becomes mandatory. It detects slight variations in the belt's trajectory and quickly compensates before the weight, speed and force of the drift can overcome the tracker. Typically mounted on the mainframe every 70 - 150 ft (21 - 50 m) and directly prior to the tail pulley, these upper and lower trackers utilise innovative multiple-pivot, torque-multiplying technology with a sensing arm assembly that detects slight variations in the belt path and immediately adjusts a single flat rubber idler to bring the belt back into alignment (Figure 4).

Power generation

Systems designed to operate at high speeds over considerable distances are generally only powered at vital locations, such as the head pulley, disregarding secondary access for autonomous 'smart systems', sensors, lights, accessories or other devices. Running auxiliary power can be complicated and costly, requiring transformers, conduits, junction boxes and oversized cables to accommodate the inevitable voltage drop over long runs. Solar and wind can be unreliable in some environments, particularly in mines, so operators require alternative means of reliable power generation.

By attaching a patented mini generator to idlers and using the energy created by the moving belt, the accessibility obstacles found in powering ancillary systems can now be overcome. Designed to be self-contained, power plants that are retrofitted onto existing idler support structures, these generators can be employed on virtually any steel roller (Figure 3).

The unit employs a magnetic coupling that attaches a 'drive dog' to the end of an existing roller, matching the outside diameter. Rotated by the movement of the belt, the drive dog engages the generator through the outer housing's machined drive tabs. The magnetic attachment ensures that electrical or mechanical overload does not force the roll to stop; instead, the magnets disengage from the roll face. By placing the generator outside the material path, the innovative new design avoids the damaging effects of heavy loads and fugitive material (Figure 5).

Bulk handling, safety and automation in the future

Automation is the way of the future, but, as experienced maintenance personnel retire, younger workers entering the market will face unique challenges, with safety and maintenance skills becoming more sophisticated and essential. While still requiring basic mechanical knowledge, new maintenance personnel will also need a more advanced, technical understanding. This division of work requirements will make it difficult to find people with multiple skillsets, driving operators to outsource some specialised service and making maintenance contracts more common.

Conveyor monitoring, which is tied to safety and predictive maintenance, will become increasingly reliable, allowing conveyors to autonomously operate and predict maintenance needs. Eventually, specialised autonomous agents (robots, drones etc.) will take over many of the dangerous production jobs, particularly in underground mining as the ROI for safety provides additional justification.

Ultimately, moving large quantities of bulk materials inexpensively and safely will result in the development of many new and higher capacity, semi-automated bulk transfer sites. Previously fed by truck, train or barge, long overland conveyors transporting materials from the mine or quarry site to storage or processing facilities may even impact the transportation sector. Stretching vast distances, these long bulk handling networks have already been built in some places with low accessibility but may soon be commonplace in many areas around the world. DB

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