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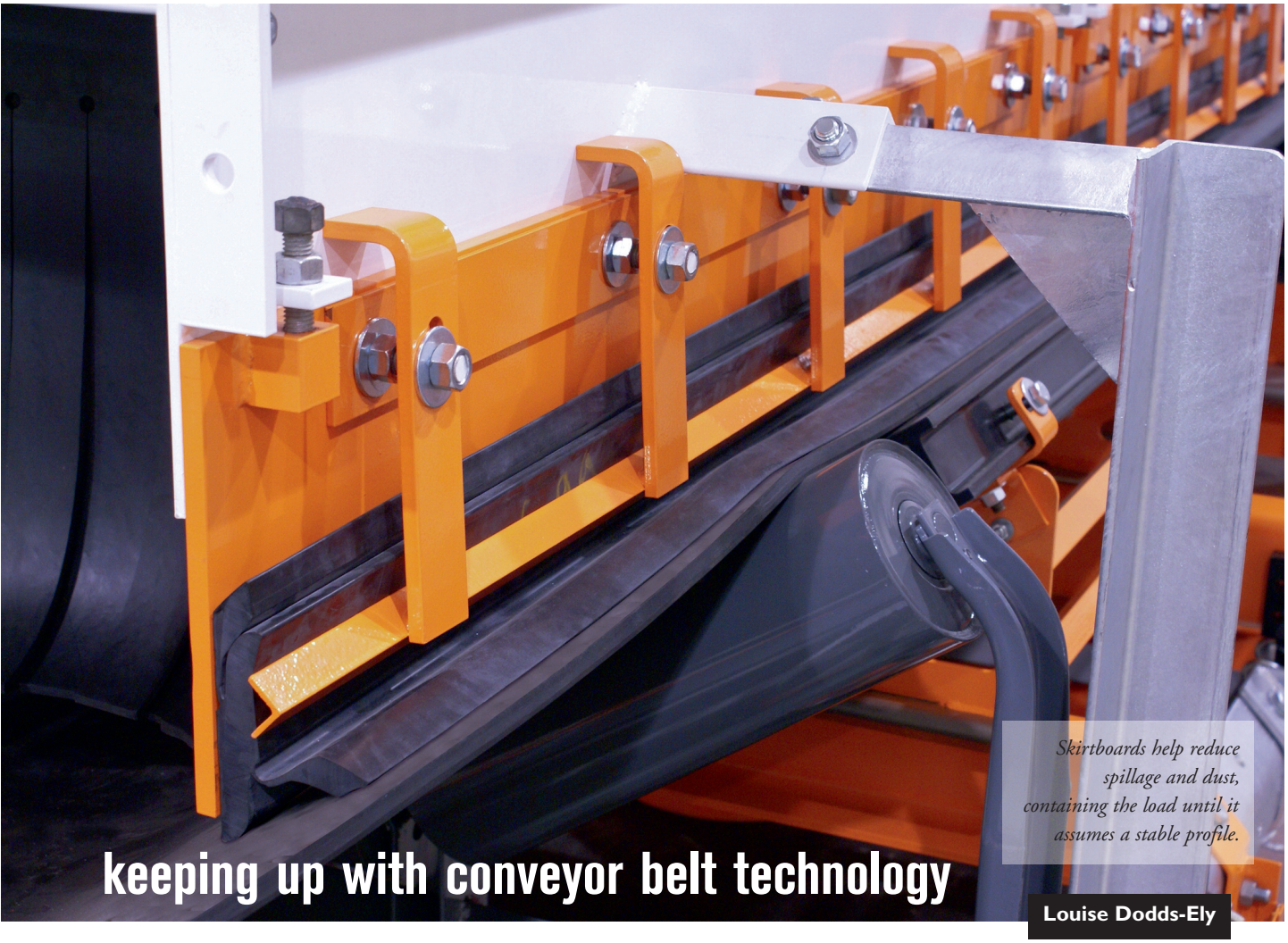
Carrying the bulk load



keeping up with conveyor belt technology

Skirtboards help reduce spillage and dust, containing the load until it assumes a stable profile.

Louise Dodds-Ely

Improved maintenance reduces risk, raises profitability in conveyor operations

When times are tight, it's more important than ever to minimize risk with ongoing maintenance and safety programmes that help protect workers, reduce waste and maximize efficiency, *writes Larry Goldbeck, Manager of Conveyor Technology at Martin Engineering.*

Few would argue with the assertion that a single serious conveyor accident can cost more money and anguish than virtually any safety programme. Most people would also agree that employees in conveyor-relayed industries deserve to have the safest workplace that is reasonably possible. Yet as downsizing trends advance and the economy continues to struggle, there is a temptation to postpone maintenance activities and safety upgrades in an effort to preserve profitability.

Unfortunately, there are a number of subtle expenses that typically result from this approach, ultimately costing far more than the savings from service and safety cutbacks. And many of the concerns are the same issues that conveyor operators first identified in the 1930s. The primary difference is that conveyors are larger, longer and faster in today's operations, with greater power and risk potential. When coupled with increasing

productivity demands, particularly on aging equipment, plant owners can put themselves and their earnings at unnecessary risk.

New advancements include an innovative design with a primary seal clamped to the skirtboard and an 'outrigger' strip to capture fines.

The path to injury

Conveyors apply large amounts of mechanical energy to what is essentially a giant elastic band, stretched tight and threaded through a maze of components. This stretched band is burdened with a heavy load of material and moved at high speed, sometimes with drive motors as large as 600HP (450kW). Given the inertia and kinetic energy, enormous forces are involved. The human body, able to generate less than 1HP, is simply no match.

A report from the Mine Safety and Health Administration found that over a recent four-year period, more than 40% of injuries were caused while a worker was performing maintenance or checking a conveyor. Nearly as many more were hurt while the subject was cleaning or shoveling near a moving belt.

In another study of more than 200 fatal mining accidents, data compiled by MSHA and the U.S. Department of Labor observed that 48 of those involved conveyors. Activities most often leading to conveyor-related fatalities were maintenance (such as replacing idlers or clearing blockages) and cleanup (including shoveling or hosing). Together they accounted for more than 50% of the total.

Some of the costs associated with these accidents can be easily identified, including medical treatment, lost wages, equipment downtime and potential legal liability. Less apparent are the costs of finding and training new employees, subsequent production delays and the supervisory time for investigating/reporting, not to mention damage to equipment or tools.

In 2007, the National Safety Council in the United States estimated the average cost of a work-related death to be around $1.2 million, a figure that's likely to be even higher now. The accounting included medical expenses, wage and productivity losses and administrative costs, but not property damage.

Training

The single most critical element in conveyor safety and efficiency is training, beginning with management. While managers are often too busy to take a course on conveyor systems, they'll frequently require attendance by an employee who has little or no influence in the decision-making processes that affect the safety and efficiency of the plant. The commitment to reduced risk must be initiated by managers and supervisors, if they expect the troops to buy in to the concept.

Many industries require specific amounts of training for new employees, and some demand continuing education, a good practice for reducing risk and maximizing productivity. These programmes typically provide an introduction to the work environment, and may also include topics such as hazard recognition, risk avoidance and health/safety. Unfortunately, there are few standards that focus on conveyor training, and in light of the number of conveyor-related accidents each year, it appears that existing programmes have not accomplished their mission.

As part of a good training programme, operators will learn the importance of observing the speed limit and capacity rating on any conveying system, ensuring that design specs are not exceeded. A safety 'walk-around' will become second nature any time inspection or repair is performed, so that all tools and work materials are removed before re-starting the conveyor. In a well-designed system, emergency shut-offs and controls will be located close to the belt, with ready access that is unobstructed

A settling zone controls the air current travelling with the material stream, allowing airborne particles to fall back into the bulk material.

by debris.

It's important that only competent, well-trained personnel — equipped with the proper tools — perform conveyor service and maintenance. These individuals should be trusted veteran employees empowered with the authority to shut down a conveyor for minor repair that is likely to prevent a major outage or equipment expense. One way to optimize maintenance is to document standard procedures for performing each task, ensuring that it's completed in the safest and most efficient manner possible.

A computerized maintenance management system (CMMS) is an excellent tool for archiving these service procedures. The specialized software will administer work orders and manage information, so the maintenance staff can perform tasks according to priority. Most systems will also track expenditures, an essential element in justifying equipment upgrades or purchases.

Belt selection

While it might sound basic, improper belt selection remains a common problem in conveyor systems, decreasing belt life and creating potential hazards. Belt conditions such as cupping and camber are often a result of improper specification, which leads to spillage, mis-tracking and improper loading. Belt selection must be based not only on the system length, width, material conveyed and angle of incline, but also on the parasitic drag of components such as idlers, bearings, belt cleaners and skirt board seals.

In specifying the correct belt, thicker is not always better. It should be selected to deliver the proper pounds per inch of width that it's intended to carry, as well as the optimum trough angle, aspect ratio and cover material. While many suppliers are simply middle men who will sell whatever stock belt is best suited to the application, a better match will usually be obtained by using a quality software programme to design and select the belt according to specific criteria.

Fugitive material

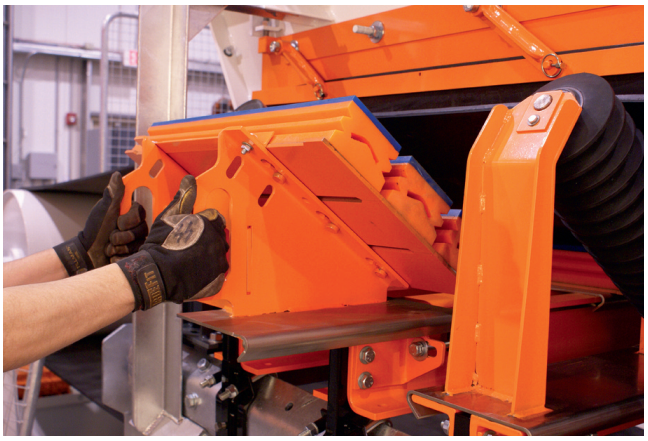
One of the primary approaches to reducing risk and improving profitability is to manage fugitive material. There are many ways that fugitive material from belt conveyors can create hazards, the most apparent being that it creates the need for personnel to perform maintenance around moving conveyors. Any time that employees are in close proximity to the moving belt, even minor or inadvertent contact can become a serious injury or fatality in just seconds.

By nature, spillage costs money. If people are cleaning up fugitive material, they're wasting labour. If material is escaping, it's wasting a valuable resource or product. While some operations can return the spilled material to the process, it often contains impurities that can raise product quality issues.

In other facilities, the material must be discarded or washed away, a particularly expensive approach if the conveyor's contents have already undergone some amount of refining by the time they reach the spill point.

In an example not uncommon in bulk materials handling, one facility conveying 800tph (tonnes per hour) was found to be literally washing an estimated $1.2 million worth of material down the drain every year. An effective system of fugitive material control that is properly installed can drastically reduce waste, often paying for itself in as little as 6–12 months.

Another problem caused by fugitive material is flow restrictions. Chute or bin blockages can bring even a large-scale process to a standstill, causing thousands of dollars in downtime, corrective measures and lost production. Blockages can also cause material boilover and sudden surges, as large amounts of material suddenly break free and drop through a receiving vessel and onto the belt. Both conditions are major contributors to



Modular components such as track-mounted pulleys and cradles can deliver slide-in / slide-out convenience.

spillage, which can also introduce belt tracking error that can damage equipment and increase the risk of injury.

A well-designed conveyor system will often employ skirtboards for reducing spillage and dust, used to contain the load as material is placed on the belt and until it assumes a stable profile. Skirtboards at each transfer point must be engineered to match the characteristics of the material, the receiving conveyor, drop height and transfer point design.

Another form of fugitive material is dust, whether settled or airborne. In addition to the potential fall hazard, risk occurs primarily when fine, lightweight particles are sufficiently disturbed to launch them into the air, where their low mass causes them to hang suspended and travel in the wind.

Dust inhaled by workers or members of the surrounding community can irritate airways and exacerbate conditions such as asthma. From a purely financial perspective, when equipment air intake includes significant amounts of dust, it can lead to more frequent maintenance and greater engine wear, causing operating costs to rise. Conveyor dust can also generate complaints from local residents and businesses, affecting community relations, creating obstacles to future operating permits or leading to increased scrutiny.

As material escapes, it accumulates on idlers and other components, contributing to premature failure. Once a bearing seizes, the constant belt movement can wear through an idler shell with surprising speed, leaving a razor-sharp edge that poses a threat to workers and the belt itself.

Spillage can also contribute to the risk of fire by interfering with pulleys and idlers and by providing potential fuel. Most conveyor fires are ignited by friction-generated heat from a pulley turning against a stalled belt or a belt moving over a seized idler. A conveyor belt fire of any size is a serious issue, not only because the belt or its contents may burn, but also because the length and movement of the belt can spread a fire a great distance in a very short time. One overheated bearing and a small amount of powdered material can quickly turn into a large-scale event. Even worse, in confined spaces, airborne particles can create the right ingredients for an explosion.

An elastomer edge seal is often used to prevent the escape of fines, typically constructed from steel plate. In addition to managing the bulk material to control spillage, the skirtboard and sealing system form a settling zone that contributes to effective dust management. In this zone, the air current travelling with the material stream is slowed and controlled, allowing airborne particles to fall back into the bulk material.

When a conveyor has multiple loading points relatively close together, it may be advisable to install a continuous skirtboard between the loading zones. An experienced supplier of conveyor technology should be well-versed in the design options and able to provide sound advice on optimum features to suit an individual application.

The symptoms of carryback are most often seen as return roller buildup that

causes belt tracking problems. Often, an employee will try to clean the return roll while the belt is running, a highly dangerous and potentially fatal decision.

Absent or inefficient belt cleaning is both a safety hazard (because an employee is typically required to somehow remove the carryback) and an efficiency drain (because this material isn't getting delivered to the desired destination). While it may seem like a small amount of inevitable waste, in reality it's a preventable loss. If it's material that has already been processed in some way, then an even greater investment has been made without any return. Belt cleaning systems can drastically reduce the amount of carryback. Unfortunately, many bulk material handling systems exhibit symptoms of all forms of fugitive material: spillage, carryback and dust, complicating the effort to correctly identify the sources and apply effective remedies.

Guarding

It's essential that pinch points be equipped with well-designed guards to prevent accidental or unwise encroachment by employees. This includes rotating components like pulleys and idlers, as well as equipment that may create sudden movement, such as gravity take-ups. Many plants are beginning to totally enclose hazardous spaces as a way of protecting employees and visitors using walkways and inspection points, with heavy guards fabricated from metal mesh or screen that permits observation of moving parts without posing an opportunity for injury.

Safety guidelines for the US are published in *ASME Standard B-2.1-2006: Safety Standard for Conveyors and Related Equipment* and in *B15.1: Safety Standard for Mechanical Power Transmission Apparatus*. While almost every nation has individual requirements that apply to the placement of guards, local and general industry standards should also be consulted and implemented.

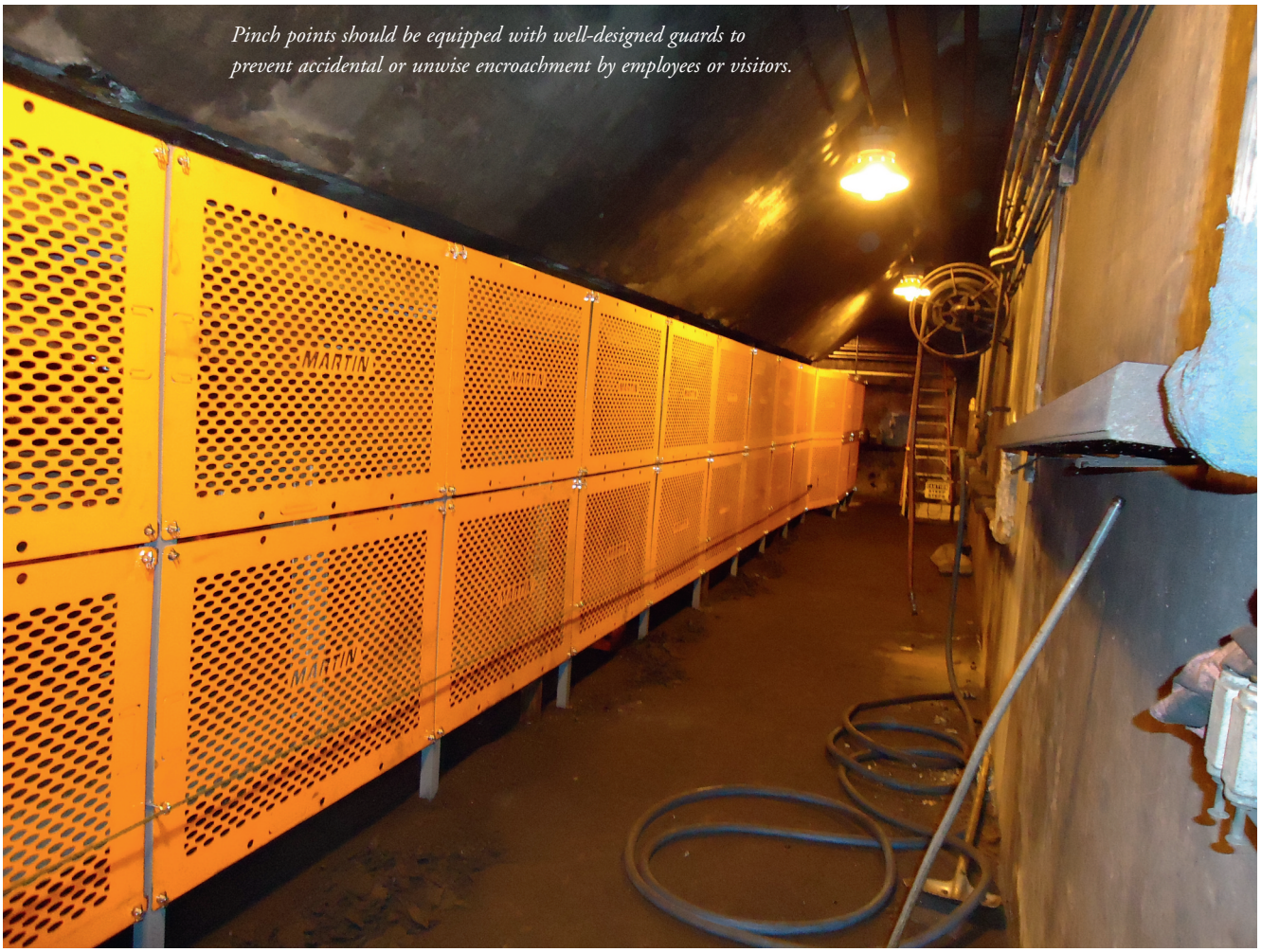
Scheduled inspection & maintenance

It's easy to focus on the fact that companies make money only when the conveying system is loaded and running, especially if employee compensation is tied to plant performance. As a result, there's a reluctance to shut down a running line until there's a compelling reason, which creates a 'We'll fix it when it breaks' attitude.

What some managers fail to recognize is that this approach will change their conveyor service from scheduled maintenance to crisis management. Such short-term thinking is an almost certain path to component failure — probably catastrophic — which will ultimately cause more system downtime, higher repair costs and more labour investment than if a sensible plan had been created and followed from the outset.

It's critical that the production schedule allows adequate system downtime to perform necessary inspections and maintenance. A formal inspection and service schedule must be developed for the material handling system and followed religiously. This programme should include review of emergency switches, lights, horns, wiring and warning labels, as well as the conveyor's parts and accessories, such as chutes, cleaners and other components.

There are certain conveyor safety practices that should always be observed, regardless of the size, design or operating environment. Lockout/tagout/blockout/testout procedures must be established for all of the belt's energy sources, as well as accessories and associated process equipment. Bulk material handling systems can still present a hazard from the energy that is stored in a stretched belt after its motion has stopped, which



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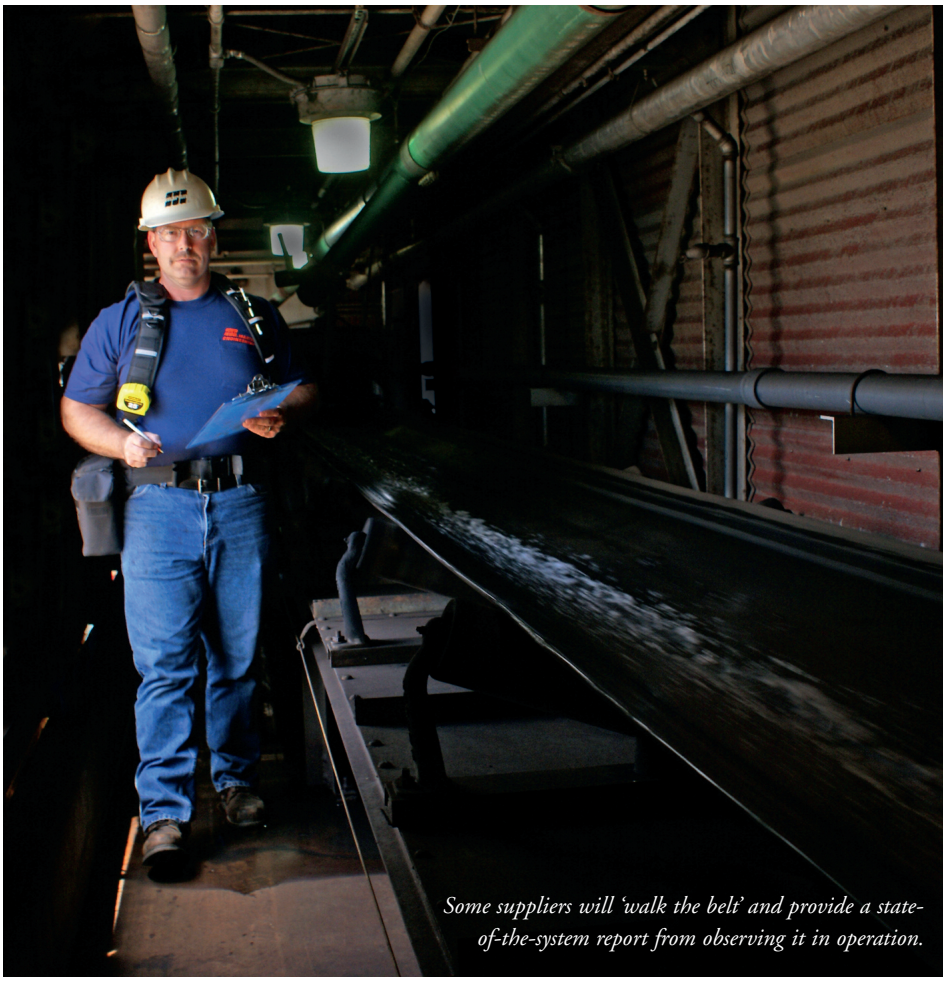

Some suppliers will 'walk the belt' and provide a state-of-the-system report from observing it in operation.

can cause the conveyor to move suddenly, even when the system is de-energized.

Lockout and tagout alone may not be enough to ensure a worker's safety, so it's imperative that the conveyor be blocked and tested to confirm that it cannot move. These procedures should be followed before beginning any work in the area, whether it be construction, installation, maintenance or inspection.

Safety by design

The most efficient way to address conveyor safety and maintenance is by building the system from the outset with those features in mind. But even without that luxury, a thorough evaluation of the conveyor system will help identify potential problems and upgrades, whether performed by a qualified staff member or by an experienced independent supplier.

While any conveyor supplier can build a system to transfer material from one place to another, adding safety and fugitive material control as critical elements will complicate the equation for some manufacturers. For optimum safety and productivity, a conveyor system should be designed for easy installation, maintenance, repair and cleanup. Specifiers should look for standardized components that can be easily serviced; maintenance access points at strategic locations; comprehensive barrier guards at all pinch points; and upgradability options to meet future requirements.

The design should provide adequate walkways, platforms and utilities such as water, electricity and compressed air to facilitate maintenance and service. Modular components such as track-mounted pulleys can deliver slide-in/slide-out convenience. Even if a procedure is only required infrequently, the time and money savings can be significant.

Dust-resistant structures, engineered flow chutes and properly designed skirtboards all contribute to fugitive material control, helping to reduce maintenance and downtime. Common features such as wear liners, seals and belt cleaners help minimize waste and maintain consistent belt tracking, while customized designs may include specialized chutes and belt-washing systems. Modern 3-D drafting and fabrication techniques now allow conveyor suppliers to build and arrange components in non-traditional ways, without greatly increasing the costs.

Contract services

When the economy lags, plants often reduce their head count. In an effort to concentrate the efforts of remaining staff on core activities and stabilize maintenance costs, many bulk materials handlers are entrusting their conveyor installation and service to outside contractors. Most will find the best success with specialty contractors whose sole focus is conveyor systems and bulk material flow. These specialists, employed by a proven manufacturer, trained and certified to specific standards, will have conveyor expertise which exceeds that of a general contractor.

Having an outside expert opinion often helps to identify problem areas that plant personnel may have come to view as normal. Some suppliers will offer to 'walk the belt' and provide a state-of-the-system report from observing it in operation. While no repairs should ever be attempted with the belt in motion, watching and listening to the system will help an experienced conveyor mechanic to identify components in need of attention, often before a catastrophic failure or safety incident occurs.

Trustworthy parts/service providers will provide upfront quotes on the equipment and labor they supply, as well as performance guarantees to ensure customer satisfaction. They should be skilled in conveyor science and safety, able to identify opportunities for system improvements and quantify the potential benefits. Some will also offer operator training programmes and continuing education, helping to facilitate a company-wide commitment to safety and preventive maintenance, while fostering a culture of continuously reducing risk and enhancing plant performance.

All forms of bulk material movement carry their own risks and safety concerns, but properly designed, maintained and operated conveyor systems remain one of the most effective modes of material transport. Rather than view them purely as an operating expense, owners and crews would be better served to investigate the opportunities to improve both safety and productivity. Thorough planning by well-trained personnel will help maximize efficiency by eliminating fugitive material and minimizing hazards as much as humanly possible. The result will be healthier, happier employees and an improved bottom line.