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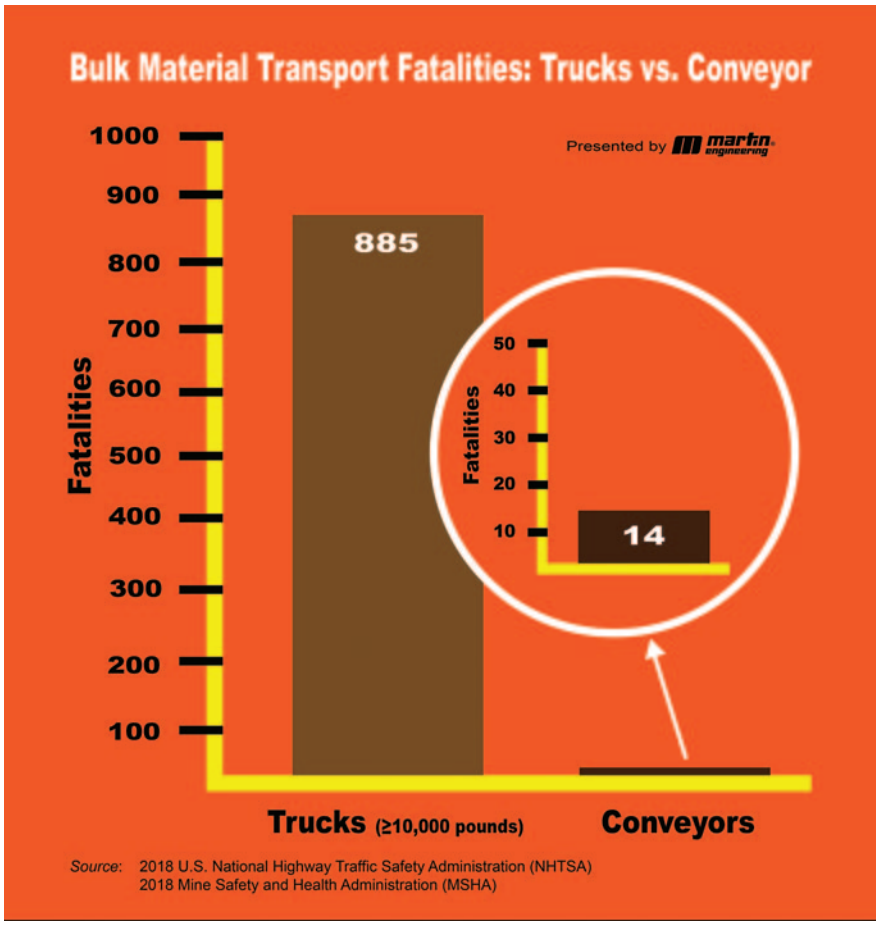
Challenges of maintaining long conveyors: monitoring & servicing remote transfer points

Searching online for images of the Bou Craa conveyor will reveal satellite photos of the longest belt-driven bulk handling system in the world, *writes John Barickman, Senior Product Development Engineer/Martin Engineering*. Stretching across the desert for 61 miles (98km), it transports phosphate from the Bou Craa mine in the Western Sahara region to Africa's northwest coast just south of Morocco. However, it's not the length of the conveyor that allows it to be seen from space. Instead, it's the distinctive white dust trail extending as far as 1.5 miles (2.4km) south of the belt caused by the northerly winds.

Beyond dust emissions, there are many logistical and maintenance considerations for long conveyors. Built to compensate for expensive, slow and potentially dangerous haulage by trucks, long conveyors often stretch down mountains, through woods and across plains, travelling at high speeds regardless of the weather. This appeals to operators for several reasons: reduced maintenance, less labor, increased production, improved safety and a lower cost of operation.

"We've observed that a fleet of trucks involves several logistical factors such as the need for experienced drivers, trained mechanics, safe roads and a lot of fuel," said Andrew Timmerman, Engineering Supervisor at Martin Engineering. "Long conveyor systems are designed to reduce some of the cost and safety issues. But like any solution, they have their challenges, too."

A long conveyor can transport bulk material faster and more consistently than vehicles (all pictures: Martin Engineering 2021).



Bulk handling logistics

A priority of any bulk handler should be workplace safety and mitigating or avoiding possible hazards. Vehicle transport relies on a fleet of trucks and trained drivers — in some cases sharing public roads — and is directly affected by weather conditions. This increases an operator's potential liability exposure and insurance costs.

Comparing worker deaths between large trucks (≥10,000 pounds) and conveyor bulk material transport using 2018 U.S. National Highway Traffic Safety Administration (NHTSA)[1] workplace safety data and 2018 Mine Safety and Health Administration (MSHA)[2] reveals 885 vehicular deaths versus only 14 conveyor deaths in the same year (see table, left). Even if only 25% of the vehicular deaths (221 incidents) were in trucks transporting raw bulk material, it would still be a 15x increase in fatalities over conveyors.

However, even with the massive discrepancy in fatalities between the two methods, conveyors can still be dangerous. Recorded injuries and deaths are most prevalent at the loading zones and discharge zones, i.e., transfer points.

[1] NHTSA, "Traffic Safety Facts – 2018 Data – Large Trucks", U.S. Department of Transportation. March, 2020. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812891

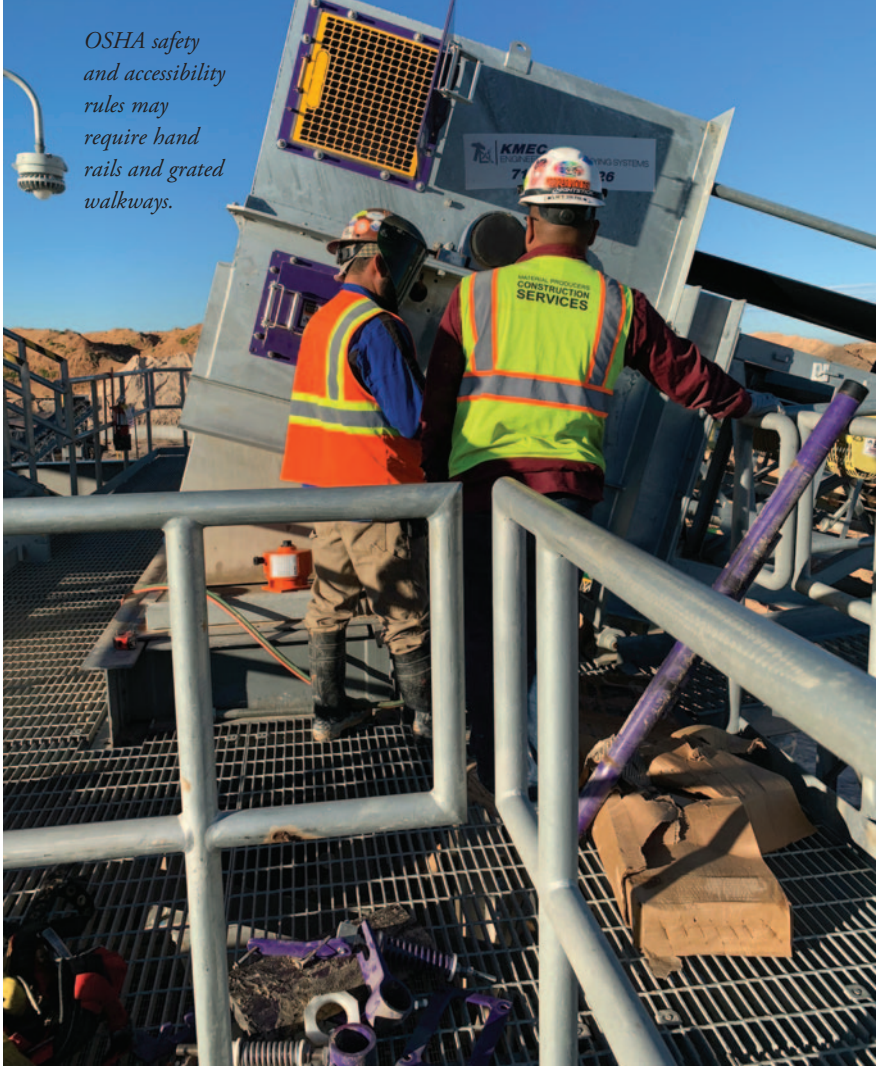
[2] MSHA, "Fatality Reports", U.S. Department of Labor. February, 2021. https://www.msha.gov/data-reports/fatality-reports/search

Intersecting conveyors and system accessibility

"Access is critical with virtually any conveyor," Timmerman pointed out. "No matter how well the system is running, transfer points will need to be inspected and serviced at least every six months."

On long conveyors, a transfer point is generally required when:

- *There's a change in system direction:* belt conveyors are generally straight lines. To circumvent obstacles, reach established road access points, or avoid unauthorized areas, cargo must be transferred onto another belt travelling in a straight line in the new direction.
- *There's a change in belt type or speed:* some systems require transfer to a cleated belt for steep angles or a faster belt to increase tonnage.
- *The pulley drive motor has reached the max load and torque limit:* to avoid running power over long distances to booster pulleys, a long conveyor may be split with one drive at the head pulley and another at the tail pulley to share the power load. Even if booster drives are used, they also create additional transfer points.
- *The cargo is split or redirected to several*



OSHA safety and accessibility rules may require hand rails and grated walkways.

CI Global Traders conveyor investigations and plans for 3D printer for spare parts

CI Global Traders is focused on getting the best solutions for its customers. The company specializes in rubber conveyor belts for ports, cement companies, mining operations and chemicals companies. It has customers in Colombia, Ecuador, Central America, and its belts are used in the development of many countries and many cities. It also helps to build homes, and to export and import food products. Among other uses, its belts are used for fertilizer for crops, and in sugar processing to provide the sweet moments.

However, CI Global Traders offers more than this. As well as rubber belts, it works with different kinds of belts — PU, PVC, POM, PP. The world is big, and CI Global Traders' light belts are present in many sectors and areas around the Americas. With its belts, the company helps at all levels — from the shampoo that we wash our hair with in the morning, to the drinks that we hydrate with, to the animal-shaped candies that delight children.

The company's conveyor belt portfolio is very large, and it has supported major companies around the globe. Its belts are high quality, as are its accessories including idlers and spare parts.

CI Global Traders designs and manufactures conveyor belts. Its installation team has considerable experience in the field, and its warehouses are ready to meet all demands.

Listening to customers helps the company understand the importance of technologies, and to develop maintenance systems with its customers. It can control, in real time, systems and conveyor belt parts; it can also predict maintenance requirements and control variables, so its customers have complete control of their conveyor systems.

Among a recent advanced project is the development of a 3D printer in conveyor belts, to make spare parts. CI Global Traders knows that replacing part of a machine can be costly, and take time. The company is therefore testing this new technology so that it can 3D print parts just from the design, to save time and cost. It will then be possible to install these 3D printers at customer sites, and solve maintenance issues in just minutes or hours.

CI Global Traders works continuously to develop its technologies, confirming its slogan 'move your world'.

One modern belt cleaner takes a unique approach to how the devices are designed.

areas: some operators separate cargo to other processes (different crushers, mills, etc.) or divert some material to a stacker conveyor for stockpiling.

- *At the final point of discharge:* since the final point of discharge is likely within a staffed facility or storage area, many of the equipment and monitoring concepts could apply, but this transfer point would not be considered 'remote'.

Access to a transfer point by vehicle is recommended, if not critical, because of the nature of the most common maintenance tasks which could involve heavy lifting and work with power tools such as cutters and grinders. Discharge and loading zones experience the largest amount of spillage, and fugitive material can quickly pile up and encapsulate the belt, causing dust emissions and idler fouling. Maintenance staff needs to access the area to make adjustments to remedy causes of carryback and spillage and clear away accumulation.

Properly engineered material transfer includes belt cleaning, sealing, chute clog prevention, impact management, tracking and monitoring to control the need for maintenance and unscheduled downtime. A goal should be to minimize the number of trips and address all issues in a single visit.

Transfer Point Maintenance

Transfer points can take some care to maintain. The most common ongoing transfer point maintenance tasks are:

- primary and secondary belt cleaner blade replacement;
- cleaner performance monitoring and tensioner adjustments;
- spillage cleanup; and
- transfer chute maintenance and clog mitigation.

Many of today's urethane blade designs are highly effective at removing adhered material from the belt and controlling carryback. Cleaning is essential, because cargo pressure and material moisture content on the carrying side can cause the material to cling to the belt after discharge. As a result, spillage drops off during the return run, releasing dust and fines over the entire length of the system. Interesting as it might be to see a conveyor system from space, no operator wants attention from inspectors because of dust.

Having to frequently maintain a basic belt cleaner to make sure it is adequately tensioned and cleaning properly is costlier in labor over the long run than installing quality belt cleaning equipment upfront. This is known as Return on Performance (ROP), which differs from Return on Investment (ROI) in that it calculates the savings in labor for maintenance and equipment life over the long term, instead of merely the period in which the initial capital investment is recovered regardless of increased costs and replacements afterward. At a transfer point located miles away, having a reliable belt cleaner tensioning system that is self-adjusting and/or low maintenance drastically reduces the cost of operation.

Shoveling spillage is something that can be done on an ongoing basis, but for remote transfer points where fugitive material has built up over time, the job requires transporting personnel and equipment to the site. Allowing volumes of spillage to build up may lead to permit violations for airborne emissions and wastewater runoff, so sealing the transfer point to mitigate spillage saves in both labor and possible fines.

Transfer chutes can experience buildup due to material properties, lump/particle size, moisture content, temperature, abrasiveness and corrosiveness.[3] When clogs happen, production stops and backflow fouls components in the discharge zone and spills over the edges of the system. Due to the distance and equipment needed on extended conveyor lengths, the unscheduled downtime and associated costs can be excessive.

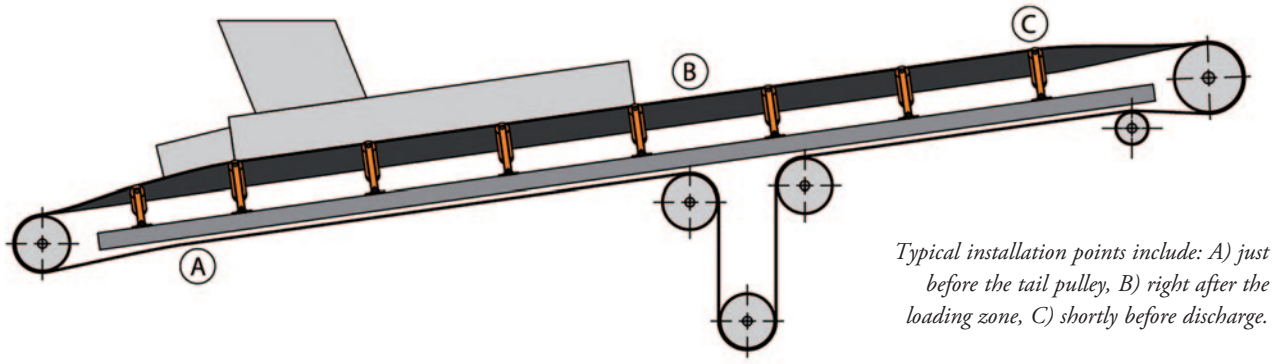
Equipment Reliability at Transfer Points

"Quality and durability are key elements for a sustainable remote transfer point," Timmerman pointed out. "Getting to the work site alone increases the cost of maintenance, so calculating the ROP on low maintenance equipment may be a better metric than ROI."

Equipment geared toward mitigating common transfer chute issues can include service-friendly primary and secondary cleaners, autonomous tensioners, belt alignment devices, self-adjusting skirting, vibration and localized power generation.

Service-friendly primary and secondary cleaners are track-mounted components that pull away from the stringer for safe service outside of the system. After performing the proper lock-out/tag-out/block-out/test-out procedures, a single worker has easy access to safely service the blades using basic tools. At least one modern cleaner design is tensioned upon installation and needs no further adjustment. Positioned at an angle across the discharge pulley, it has a rubber strip

[3] Swinderman, R. Todd; Stahura Sr., Richard P.; Marshall, Daniel; et al: Foundations for Conveyor Safety; First Edition; pg. 208; Martin Engineering; Worzalla Publishing Company; Stevens Point, Wisconsin 2009. https://www.martin-eng.com/content/page/552/foundations-conveyor-systems-book



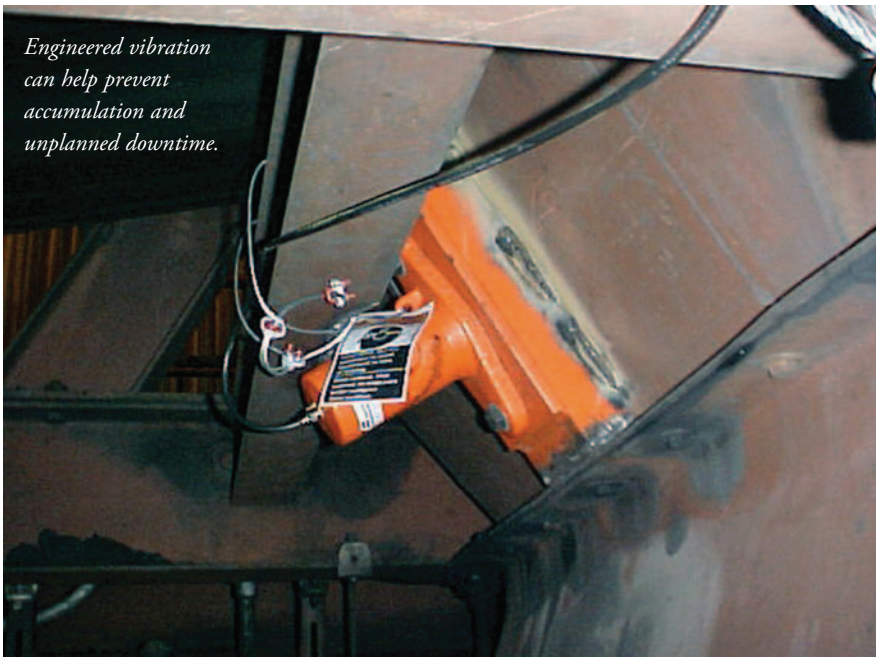
Typical installation points include: A) just before the tail pulley, B) right after the loading zone, C) shortly before discharge.

constructed with tungsten carbide tips, requiring far less maintenance and delivering as much as 4x the blade life of conventional designs.

Autonomous tensioning is a relatively new concept that monitors the blade's contact with the belt and automatically adjusts the tension. This ensures consistent pressure and optimum performance, reducing the amount of spillage and carryback. It eliminates the need for ongoing tensioner maintenance, reduces the amount of spillage from carryback and lowers dust emissions along the belt path.

Belt alignment devices ensure that the belt and the cargo remain centred, which is especially critical in loading and discharge zones. Standard belt training devices either impede the belt from drifting into the stringer or react to the belt drift (top). On long conveyors, belt trainers are required along the belt path both on the carrying side and the return to mitigate mistracking.

Self-adjusting skirting rides the belt to create an effective seal automatically. Historically, skirting had to be adjusted when excessive dust and spillage escaped from the loading zone. Self-adjusting designs prevent spillage and equipment breakdown caused by fugitive material, creating a constant tight seal to the belt. The unit self-adjusts to rubber skirt wear, regardless of material volume and size diversity, delivering an adaptable and low-maintenance solution.



Engineered vibration can help prevent accumulation and unplanned downtime.

Applied vibration helps prevent the buildup of dust and fines on the inner walls of the transfer chute. Clogging can bring the entire operation to a stop, causing excessive downtime, but disrupting and loosening the material helps prevent accumulation, which can lead to backflow and spillage.

The Martin® Roll Gen™ System is a self-contained mini power station.

Localized power is essential for lighting, automated accessories and monitoring equipment. Battery power is a possible solution, but it comes with a fairly substantial environmental footprint and the need for periodic replacement. Options such as solar power are not well suited to the general conditions of a conveyor system, as monitoring devices are often required in an enclosed structure without access to sunlight, or for continuous operation during both day and night. Recently, a self-contained generator housed in an idler roller has been invented that uses the kinetic energy from a moving conveyor belt to generate enough power to run a wide variety of electronic systems, including sensors and monitoring devices, safety mechanisms and even belt cleaner tensioners.

Monitoring and Sensors

In addition to cameras that provide an overall view of conditions, sensors monitor operations and flow, delivering important data. One thing to keep in mind is the need to relay the information to a central control center via Global System for Mobile Communications (GSM), which requires the proper equipment and power.

A *position indicator* is an intuitive sensor that allows remote monitoring of the belt cleaner blade position and remaining service life, notifying operators when re-tensioning or blade replacement is required. A position indicator can be mounted anywhere from 3–800 metres (10–2,625 feet) from the cellular gateway, and the robust, sealed construction means it is virtually immune from damage. Up to 50 units can be monitored by a single gateway connecting to the Internet, usually located at the highest point in the plant, where the cell signal is strongest. The system does not require a cellular line for each PI, instead communicating via radio frequency from each sensor to the gateway. *Load sensors* are specifically geared to communicate with automated tensioning systems so the unit can pull the blade away from the belt when there is no cargo. Running a cleaner on an empty belt can reduce blade life, degrade the belt face and create potentially dangerous friction heat and static.

The Position Indicator notifies service personnel when a cleaner requires re-tensioning or replacement.


Remote material flow sensor powered by an idler roll generator.

Flow indicators or "plugged chute detectors" can either alert operators to the need for maintenance or automatically activate flow devices like vibrators or air cannons to disrupt stuck material and commence flow without worker intervention.

Service and Safety

Each piece of equipment requires a knowledgeable and trained technician for safe service. As a result, performing maintenance on a remote transfer point might involve the most experienced technicians in the facility for long periods to inspect and maintain it. Additionally, it could require a fully equipped service truck with lifts and onboard power.

Many operators have turned to specialty service contractors who are trained and equipped to safely conduct regular inspections, provide maintenance and offer recommendations. These highly trained and certified technicians can reduce replacement equipment lead times and perform maintenance tasks faster, minimizing downtime.

To improve response time, many systems can be set up so technicians can be alerted through the GSM to issues at the same time as operators. Some service contractors can even maintain data logs on customers' conveyors, recording system specifications, status details and service procedures performed. The collected information is helpful in scheduling preventive maintenance activities and in determining when outside resources should be utilized. This data can be used to better manage an operation's equipment and budget.

Improving Efficiency and Operating Costs

Although there are several considerations and obstacles associated with installing and operating a long conveyor system, the improved safety and long-term cost savings over vehicle transport should be convincing. Once the conveyor system is built, material transport is more predictable and easier to control and maintain, which reduces the cost of operation and improves the bottom line.

Well-monitored autonomous equipment can make a remote transfer point much more cost-effective to operate. ROP-minded design and maintenance performed by trained service technicians can mitigate many of the disruptive issues and downtime associated with transfer points in general.

"Long conveyors with multiple transfer points have been around for several decades, and equipment designs for this unique environment have evolved in recent years," Timmerman concluded. "By focusing on safety, ease of service and reduced risk exposure, operators are realizing that many of the most troubling issues can be effectively resolved."

Specialty contractors can provide faster, longer-lasting service solutions.